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MEDICAL COMMUNITY OF INQUIRY: A DIAGNOSTIC TOOL FOR LEARNING, ASSESSMENT, AND RESEARCH

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ABSTRACT

Aim/Purpose	These days educators are expected to integrate technological tools into classes. Although they acquire relevant skills, they are often reluctant to use these tools.
Background	We incorporated online forums for generating a Community of Inquiry (CoI) in a faculty development program. Extending the Technology, Pedagogy, and Content Knowledge (TPACK) model with Assessment Knowledge and content analysis of forum discourse and reflection after each CoI, we offer the Diagnostic Tool for Learning, Assessment, and Research (DTLAR).
Methodology	This study spanned over two cycles of a development program for medical faculty.
Contribution	This study demonstrates how the DTLAR supports in-depth examination of the benefits and challenges of using CoIs for learning and teaching.
Findings	Before the program, participants had little experience with, and were reluctant to use, CoIs in classes. At the program completion, many were willing to adopt CoIs and appreciated this method's contribution. Both CoIs discourse and reflections included positive attitudes regarding cognitive and teacher awareness categories. However, negative attitudes regarding affective aspects and time-consuming aspects of CoIs were exposed. Participants who experienced facilitating a CoI gained additional insights into its usefulness.
Recommendations for Practitioners	The DTLAR allows analyzing adaption of online forums for learning and teaching.
Recommendation for Researchers	The DTLAR allows analyzing factors that affect the acceptance of online forums for learning and teaching.

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Impact on Society	While the tool was implemented in the context of medical education, it can be readily applied in other adult learning programs.
Future Research	The study includes several design aspects that probably affected the improvement and challenges we found. Future research is called for providing guidelines for identifying boundary conditions and potential for further improvement.
Keywords	community of inquiry, online forums, hands-on experience, TPACK, instructional technology, teacher professional development

INTRODUCTION

Teaching involves multi-faceted skills, beyond content expertise (Mishra & Koehler, 2007; Polly, Mims, Shepherd, & Inan, 2010; Shulman, 1987). A challenge today's educators face is the adaptation of novel technologies involved in e-learning (Barak, Hussein-Farraj, & Dori, 2016; Breslow, Pritchard, DeBoer, Stump, Ho, & Seaton, 2013; Koehler, Mishra, & Yahya, 2007). Although e-learning environments have clear potential for learning enhancement, well-established guidelines for maximizing and assessing their benefits are still lacking (Dori, 2007; Kozma & Vota, 2014; Schneckenberg, 2010).

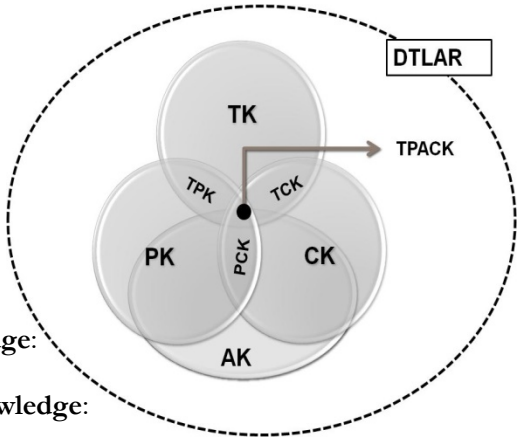
There is a consensus among researchers and education designers that merely providing instructors with technological training is insufficient for preparing them to implement novel technologies into their classrooms (Hung, Chou, Chen, & Own, 2010). In particular, previous studies reported limited success in embedding technology into medical education (Bligh, 2005; Steinert, 2012). A central challenge in distance learning is encouraging involvement of students in learning activities. A relevant tool is the Community of Inquiry (CoI) implemented via online forums. In the present study, CoI methodology was implemented in annual programs for medical faculty development and its benefits and challenges were analyzed by using a methodology detailed below.

BACKGROUND

An important characteristic of using CoIs as a learning and teaching methodology is the support of ongoing dialogue between students and instructors at any time (Arbaugh, Bangert, & Cleveland-Innes, 2010; Rubin, Fernandes, & Avgerinou, 2013). Important advantages of CoI in cases of scarce face-to-face meetings are the opportunities for ongoing in-depth processing of course content and for social support despite the physical distance (Cook, Garside, Levinson, Dupras, & Montori, 2010; Makoul, Zick, Aakhus, Neely, & Roemer, 2010; Sargeant, Curran, Allen, Jarvis-Selinger, & Ho, 2006). Of particular relevance for the present study is the finding that CoIs applied for training teachers were perceived by the trainees themselves as important professional development activities (Goldstein, Shonfeld et al., 2011; Goldstein, Waldman et al., 2011). However, several studies have identified that lack of 'e-competence'—previous technological experience, confidence, training, assimilation, and attitudes toward technology—was the central barrier for the successful implementation of teaching technologies (Avidov-Ungar & Iluz, 2014; Raby & Meunier, 2011; Ruiz, Mintzer, & Leipzig, 2006).

In the present study, we aimed to offer insights for increasing CoI utilization in medical courses, by extending the Technological Pedagogical Content Knowledge model (TPACK, see Figure 1) offered by Mishra and Koehler (2007) with additional, novel components. TPACK is a framework for effective integration of technology into pedagogy, building upon Schulman's (1987) Pedagogical Content Knowledge (PCK) framework. According to TPACK, learning is most effective when teachers are aware of the complex interplay among the various teaching facets (Dall'Alba, 2009; Oster-Levinz & Klieger, 2010). Acquisition of well-established skills for integrating novel technologies into teaching is suggested to be particularly successful if educators adopt a positive attitude and willingness to use these tools (Barak, Nissim, & Ben-Zvi, 2011; Huang & Liaw, 2005; Wong, Greenhalgh, & Pawson, 2010). Hence, professional development programs for teachers provide an opportunity for acquisition of such skills (Henderson, 2007; Prestridge, 2010). Albion, Tondeur, Forkosh-Baruch, and

Peeraer (2015) have recently suggested a model for evaluating teacher professional development practices in technological teaching environments for fostering educational change. In particular, experience with CoI is expected to attenuate the reluctance of teachers to use this pedagogical tool for interactions with students and to increase awareness of its potential contribution to education (Cook et al., 2010; Norris & Soloway, 2006; Steinert, 2012).



CK – Content Knowledge:
Medical Education
TK – Technological Knowledge:
Using Forums
PK – Pedagogical Knowledge:
Teaching in Small Groups
TCK – Technological Content Knowledge:
Technology in Medicine
TPK – Technological Pedagogical Knowledge:
Teaching Medicine via Forums
PCK – Pedagogical Content Knowledge:
Hands-on Experiences in Teaching Medicine in Small Groups
AK – Assessment Knowledge:
Composing Test Items, Conducting Self-assessment & Analyzing Forum Content
TPACK – Technological Pedagogical and Content Knowledge:
Learning & Mentoring Medical Education via Forums
DTLAR – Diagnostic Tool for Learning, Assessment, and Research:
A Methodology for Analyzing the Quality of Medical CoI

Figure 1: DTLAR incorporating the TPACK and Assessment Knowledge Model

Assessment Knowledge reflects yet another important aspect of applying CoI, focusing on knowledge and understanding teachers have about assessment, its value, types, and evaluating students' learning outcomes (Abell, 2007; Dori & Avargil, 2015; Magnusson, Krajcik, & Borko, 1999). It also refers to teachers' ability to design and apply assignments suitable for assessing students' knowledge and skills (Avargil, Herscovitz, & Dori, 2012).

In our methodology (described below), we combined the TPACK components with Assessment Knowledge and added an in-depth analysis of forum use. By this integrative approach, we hereby offer a novel tool, the Diagnostic Tool for Learning, Assessment, and Research (DTLAR; See Figure 1), as a method for guiding CoI design and analyzing educators' willingness to use it in their teaching.

DTLAR - A Diagnostic Tool for Learning, Assessment, and Research

The DTLAR is a methodology for in-depth analysis of the multi-facet acceptance of CoI as a learning and teaching methodology (see Figure 1). In the examined faculty development program, CoI served three purposes: (1) knowledge acquisition, (2) hands-on experience of educators with CoIs as a learning and teaching tool, and (3) a basis for assessing their readiness to incorporate CoI into their teaching. DTLAR's core is an in-depth analysis of discourse content and participants' reflections on their experience within a CoI. The tool was designed to serve learners for monitoring their own performance; instructors for gauging their students' progress; and, researchers for calibrating and comparing learning outcomes of various student groups and programs. The DTLAR was designed as a generalizable methodology for adult education programs aimed at promoting online

forums for learning and teaching. In this study, we demonstrate DTLAR by applying it the for the analysis of CoI acceptance among medical educators.

Employing the DTLAR comprises the following stages: (1) Data collection from CoIs discourse and reflection after each CoI; (2) Item extraction; (3) Categorization and sub-categorization of statements based on grounded theory and relevant literature; (4) Expert validation of the categorization; (5) Item categorization by attitude; and (6) Comparison between pairs of information sources: pairs of CoIs (e.g., first vs. last in the program) and CoI discourse versus reflection.

In view of the importance of instructors' positive attitude towards using novel educational technologies (Huang & Liaw, 2005), we utilized the opportunities CoIs provide for online tracking of participants' acceptance of this learning and teaching tool. Thus, we sought to expose participants' attitudes regarding CoI, incorporating both constructivist and interpretative methodologies defined in the literature as means of gauging acceptance of instructional methods (Denzin & Lincoln, 2005). Prior appraisals of training have focused on global satisfaction through reflection upon several experiences (e.g., Alvarez, Guasch, & Espasa, 2009; Rienties, Brouwer, & Lygo-Baker, 2013). In this study, we introduce two variations to traditional CoIs. First, in order to obtain an authentic picture of participants' experience online, we examined their attitudes as they emerged, directly from CoIs' discourse while discussing subject matter topics. Second, we collected reflections on action after completing each CoI, regarding the experience while participating in the CoI. The reflections were used to increase the participants' awareness towards the qualities of the learning tool by re-evaluating their experiences (Schön, 1988). One of our objectives in this faculty development program was to allow participants to translate and transfer theoretical concepts into practice and encourage critical thinking, above and beyond experience alone (Angeli & Valanides, 2009; Aronson, 2011; Kramarski & Michalsky, 2010; Sandars, 2009). The picture of participants' attitudes that was revealed from both online (CoI discourse) and in retrospect (reflections) is offered as a diagnostic tool for assessing the acceptance of technological tools for teaching.

The faculty development program also presented an opportunity for providing participants with hands-on experience in facilitating CoIs. We expected that experiencing the facilitation of a CoI would increase awareness to the strengths and challenges involved in using this teaching method (Curran & Fleet, 2005). Previous studies found that the quality and quantity of interactions between participants and forum facilitators affected perceptions of effectiveness regarding online learning (Cook et al., 2010; Sargeant et al., 2006). Thus, we analyzed the effect of CoI facilitator type, instructor versus peer, on attitudes of other participants.

By contrasting CoI discourse and reflection, we examined the added diagnostic value of exposing the attitudes of the medical educators that came from discourse and reflection. We examined the participants' attitudes by dividing the statements provided during and after the forums into three types: positive, negative, and ambivalent. In order to delve deeper into the diversity of the attitudes, we further divided the statements by categories that emerged from the literature as well as from the discourse. We hypothesized that the attitudes of each participant are diverse. Combining the two information sources (CoI discourse and reflection on the action of CoI participation) while maintaining a detailed picture within each category allowed complex mirroring of participants' attitudes. In particular, we hypothesized that attitudes expressed online would differ from those expressed in retrospect. Furthermore, we examined the change in attitudes as participants gained experience with using CoI, during the faculty development program. Beyond the global picture, at the group level, this within-participant analysis allowed drawing conclusions at the individual level, as a basis for personalized support.

METHOD

STUDY FIELD

The faculty development program at the Technion's Faculty of Medicine aims at enhancing teaching and learning skills, assessment and evaluation skills, motivation and willingness for teaching, as well as at exposing participants to up-to-date teaching methodologies. The program includes eight face-to-face meetings over the course of an academic year. CoI interactions took place between the face-to-face meetings and focused on TPACK-related topics. The reported data was collected along two program cycles.

PARTICIPANTS

Two cohorts of twenty clinical professionals (43% women, 57% men, Mean age = 42.1, *SD* = 3.9) participated in the research during two consecutive academic years (one year for each cohort). All participants had at least two-year experience in teaching clinical courses. Table 1 provides more detailed information regarding participants' seniority and experience.

Table 1: Participant's demographic data

Seniority (years)	**1-5**	**6-10**	**11-15**	**> 16 years**
%	8%	35%	41%	16%
Teaching Experience (years)	**1-5**	**6-10**	**11-15**	**>16 years**
%	41%	38%	11%	10%

PRE- AND POST-PROGRAM QUESTIONNAIRES

Two questionnaire versions were used for eliciting pre- and post-program knowledge and perceptions. Shortly before the program's onset, the participants filled in a questionnaire asking for personal details, as well as eight questions about prior experience working with up-to-date teaching methodologies (e.g., How much experience do you have in adjusting assessment to learning objectives?) and six questions about prior experience with e-learning and forums (e.g., How much experience do you have in participating in forums?).

At the conclusion of the program, the participants filled in a feedback questionnaire with eight questions regarding general aspects of the program (e.g., To what extent did the program contribute to your ability to adjust appraisal to learning objectives?), as well as four questions about the effectiveness of forums and use of e-learning (e.g., To what extent did the program contribute to your ability to use e-learning in your teaching?). All the responses were provided on a 0 (none) to 5 (extensive/highly) Likert scale.

COMMUNITY OF INQUIRY (COI) PROCEDURE

We used the Moodle platform (the online Management System of Technion courses) for the forums. Three asynchronous online forums for CoIs were incorporated into each of the two faculty development programs. CoI facilitators introduced a topic for discussion during seven days. Posting was voluntary with no associated assessment. Each year, two participants volunteered to jointly facilitate one CoI.

CoI topics were selected on the basis of TPACK principles. In the first research year, CoIs focused on TCK, while TPK was discussed in the face-to-face meetings. This structure was reversed in the second year. Both participant-facilitated CoIs focused on the same topic. Figure 2 illustrates the CoI topics, their sequence, and the forum facilitators by year.

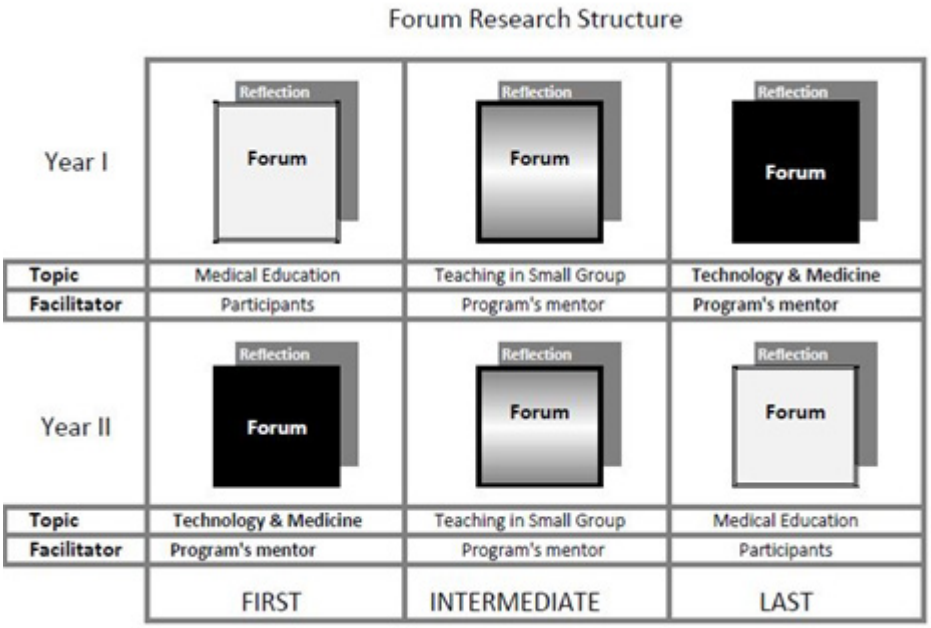


Figure 2: Community of Inquiry (CoI) topics, their sequence, and the type of facilitators in each program year

The data reported regarding *CoI discourse* was collected throughout two academic years in two cycles of the faculty development program (2011, 2012). In the face-to-face meeting that followed each CoI, participants provided *reflection* on their experience; for example: (1) What were the main objectives of the last CoI? (2) What were the determinants of your level of participation in the last CoI? (3) What did you learn from the last CoI? and (4) What was the most significant challenge of the CoI for your learning?

Participants who were CoI facilitators reflected on their experience using the following dedicated questionnaire: (1) What prompted you to post your question to the CoI? (2) Please describe your thoughts while facilitating the discourse. (3) What challenges do you identify in facilitating CoIs? (4) What are the main differences between facilitating face-to-face meetings and CoI?

Data Analysis

We employed a mixed data analysis approach involving qualitative analysis of CoI discourse and reflection content, and quantitative statistical analyses of the frequency of statements per type (positivity) and category. In order to ascertain trustworthiness, the statements were categorized and validated independently by three science education experts. One of the experts was the first author of this paper. The questionnaire's internal consistency (Cronbach's Alpha) across the three judges was 0.88.

In addition to global attitude picture emerging from content analysis of CoI discourse and reflection, incorporating several CoIs throughout the course of the faculty development program allows examining changes in attitudes at the individual level as participants gain experience with using CoIs. For demonstrating this close look into the attitude trends, we chose six representative participants (see Appendix A for additional information regarding these participants). The scores were calculated by adding two points for positive statements, subtracting two points for negative statements, and giving no points for ambivalent statements.

Results

Uniformity of age, gender, seniority in medicine, and teaching experience across the two cohorts allowed combining the data of the two research years for data analyses.

Prior Experience and Feedback Questionnaires

At the program onset, the mean rating of participants' experience with up-to-date teaching methodologies was 3.7, while for e-learning and CoIs the mean score was 2.5. In addition, 40% of the participants expressed willingness to incorporate e-learning in their teaching. At the end of the program, the mean scores increased to 5.2 and 4.2, respectively. Moreover, 72% of the participants appreciated the CoI contribution to learning and 78% felt confidence enough to apply CoIs in their teaching.

Attitudes within CoI Discourse and Reflection

The categories, which emerged from both data sources, were: cognitive aspects, peer interaction, affect, teacher awareness, and time. (See examples in Table 2.) CoI discourse data included 932 statements ($N_{participants}$ = 34/37) and 303 statements from the reflections ($N_{participants}$ = 31/37), indicating a high level of participants' cooperation despite lack of enforcement. As Figure 3 shows, positive statements dominated both data sources (the CoI discourse and the reflections), while ambivalent and negative statements distributed differently, $\chi^2(2) = 106.41$, $p < .0001$.

Table 2: Examples of statements from CoI discourse and reflective answers, with the attitude assigned for each statement

Category	Attitude	Statement
Cognitive	*Positive*	*"You are right. The purpose of medical education today is to transfer knowledge and competency to prepare for better physicians" (F_ZAFF11)**
		"If surgery can nowadays take place with the patient while the surgeon is located in a different country or even continent, there is no reason not to use the wonders of online communication for learning purposes." (F_BPFL11)
	Negative	*"It feels like ventilation of frustrations and also allows the raising of unfocused ideas" (R_YGFF11)*
		"I am against interactive forums, I do not believe it is possible to teach values or learning skills through forums and do not think in this way uniformity and high level of learned material can be maintained."(F_YSF12)
	Ambivalent	*"The level of expressed knowledge in the forum on the discussed topic [was different] compared with other topics [that were not discussed online]"(R_IMSFI11)*
Peer Interaction	*Positive*	*"First I would like to thank you all, I feel I can learn from everyone…" (F_ESFI12)*
		"…[The forum helps in] enhancing the interaction and connection between our group" (R_ADFI11)
	Negative	*"This is the first time for me to participate in such a forum amd it was a failure for me" (R_RAFF11)*
		"Personally I don't like the social networks like FACEBOOK …(F_MSFF12)
	Ambivalent	*"My obligation is to my peers [while talking about posting to forums]" (R_MFL12)*
		" I felt obligated to participate" (R_NLFF11)
Affective	*Positive*	*"Thinking about myself, I remember the role models who are always in my thoughts and design my professional approach" (F_BFL11)*
		"Sharing our feelings and supporting each other" (R_KLFL11)
	Negative	*"Personally I prefer a face-to-face vs. discussion" (R_NFL12)*
		"I am lost with this type of learning [Forums], something is missing. It feels lonely, with no 'Intercommunications'" (F_BMFI11)

Category	Attitude	Statement
	Ambivalent	*"I think there is no substitute to learning in active setting via a direct contact [F2F] with the instructor, provided that the lecturers are talented and charismatics"(F_AKFL11)*
Teacher Awareness	*Positive*	*"Y. used a PBL teaching methods in his lesson" (F_IZFI11)* *"Although we are no longer students we must continue to learn more about technology and also to be good doctors and good teachers" (F_MSFF11.*
	Negative	*"As O. said there were many defects in the teaching methods…" (F_YGFI11)* *"During the clinical learning years there is no place for technology teaching methods unless we would like to develop a technologist rather than a physician" (F_OSFL11)*
	Ambivalent	*" I realized in the last forum that the facilitator was not dominant as in face-to-face's learning class" (R_IZFI11)* *"I think that in our age, students are learning (or we teach?) more technology and less clinical thinking"(F_IZFI11)*
Time	*Positive*	*"Flexibility in time and location" (R_ASFL111)* *"Perhaps if we'll have the roadmap for this technology at an early stage - we can save them time and bring them to the destination faster" (F_DGFL12)*
	Negative	*"He (the doctor) has no time for his students…(F_D_GFL12)* *"Lack of free time and lack of understanding that the forum is time limited" (R_DAFI11)*
	Ambivalent	*"The best lessons need a lot of time…" (F_Z_AFF11)* *"[It is difficult] to divide my time resources between different activities" (R_IZFF11)*

* Statement identifiers starting with F relate to forum discourse while those starting with R relate to reflection.

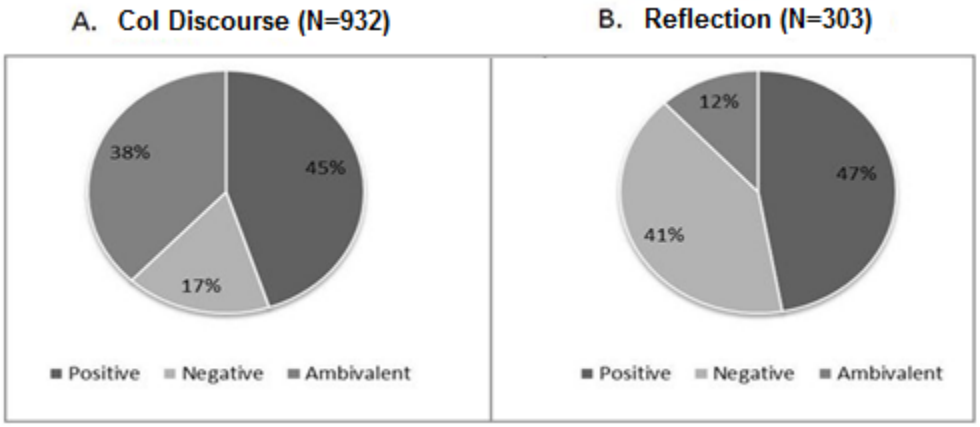


Figure 3: The distribution (%) of attitudes in Community of Inquiry discourse (CoI discourse, panel A) and in reflections (panel B).

Analyzing participants' attitudes by category, the distribution of statement types differed within each category and within each data source (both *p*s < .0001; see Figure 4).

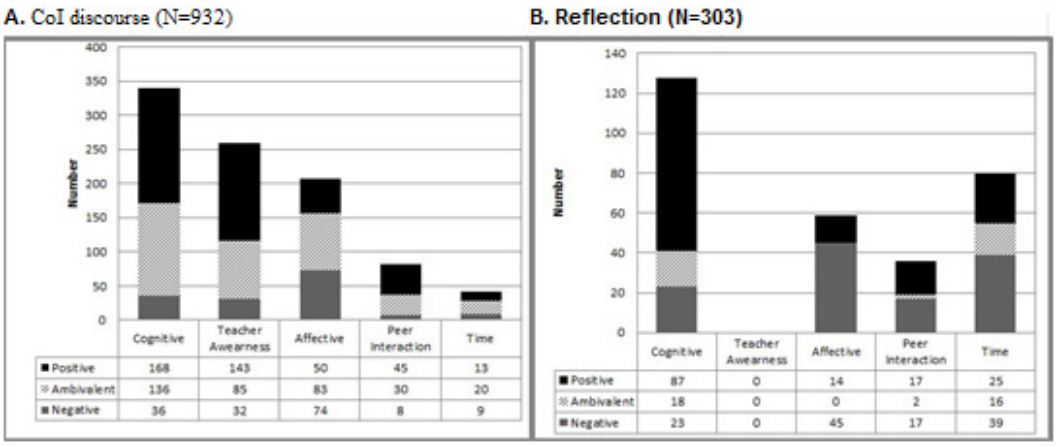


Figure 4: Division of statement types into categories for Community of Inquiry Discourse (CoI discourse, panel A) and reflections (panel B)

'Teaching awareness' appeared only in CoI discourse. 'Affect' had more negative statements than other categories in both CoI discourse and reflections, while 'Cognitive aspects' and 'Teacher awareness' had more positive statements relative to other categories. Negative type items within the 'Time' and 'Affect' categories were dominant only in the reflections.

In light of the centrality of technological aspects in TPACK, we compared the two technological CoIs (which focused on TCK and TPK) to CoIs that focused on Pedagogical Content Knowledge. The technological CoIs included more positive statements than the Pedagogical Content Knowledge CoIs, $\chi^2(2) = 7.46$, $p < .05$, with no difference between their corresponding reflections. Thus, there was no sign for particularly negative attitude towards technological topics.

The Effect of CoI Facilitators

Comparing the CoIs facilitated by instructors with those facilitated by participants yielded significantly more postings ($M = 16.0$, $SD = 23.3$) in instructor-facilitated CoIs than in participant-facilitated ones ($M = 9.1$, $SD = 8.6$), $t(108) = 1.99$, $p < .05$. However, when breaking the analyses into information sources, CoI discourse and reflection separately, both differences became insignificant. However, CoI discourse of instructor-facilitated CoIs included more positive statements than participant-facilitated ones, $\chi^2(2) = 19.29$, $p < .0001$, with no difference in the corresponding reflections. Examples of reflections provided by participant facilitators are presented in Appendix B. These examples demonstrate that these participants gained insights from their experience and became more aware of the strengths and challenges associated with facilitating CoIs.

Attitude Change During the Program

Figure 5 presents the attitude change of the six participants chosen for demonstrating analysis at the individual level allowed by the data collected in the CoIs. The tendency upwards in Figure 5 reflects an increase from the first CoI to the final CoI in positive attitudes towards CoI. For example, at the first CoI Participant 1 and Participant 2 expressed low willingness to learn or teach using educational technologies. However, Figure 5 highlights that, based on both the CoI discourse and reflection, participants' attitudes became more positive by the time they participated in the last CoI. Unlike these participants, Participant 3's attitude towards CoI did not change much as reflected in the discourse, and his/her reflections even became somewhat more negative after participating in CoIs. This phenomena represent the challenges and frustration some of the participants felt. According to our diagnostic model, Participant 3 would benefit from individual mentoring. For Participant 6, there was no change in attitudes as reflected by his or her discourse statements in the CoIs. However, the re-

flections exposed positive tendency toward incorporating technology in teaching, possibly signaling readiness to implement CoIs in his/her classes.

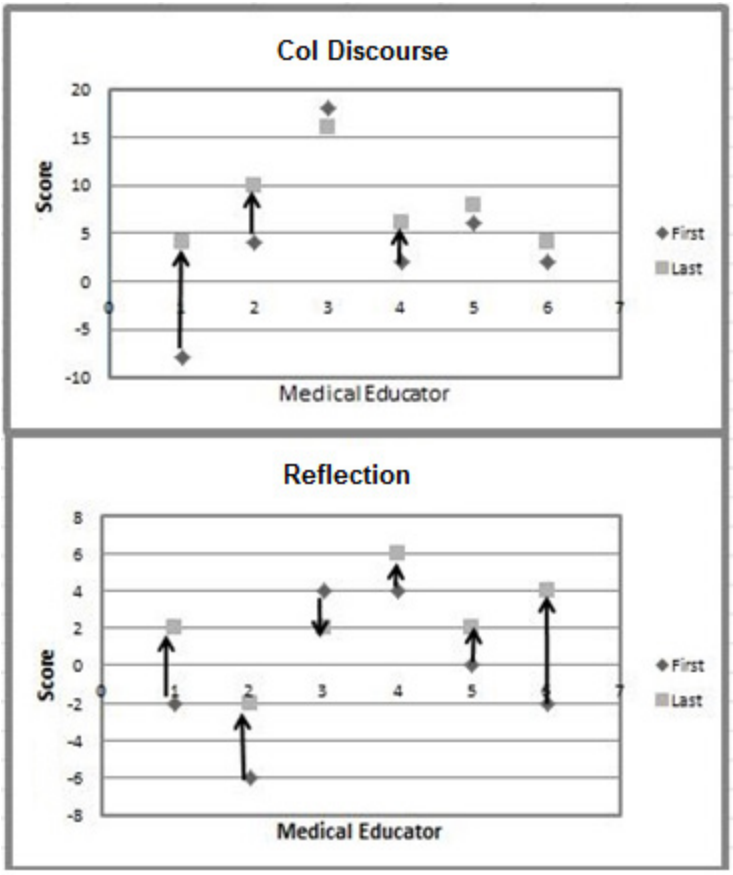


Figure 5: Change in attitude scores of six representative participants

DISCUSSION

The starting point for the present study was that overall educators lack experience in using technology for pedagogy—a well-acknowledged barrier that hinders integration of educational technologies into teaching. The a-priori reluctance of our participants to incorporate e-learning in teaching, like that found in many other studies (e.g., Kim, 2006; Raby & Meunier, 2011; Tondeur et al., 2012), confirms the need for professional support to overcome these barriers. In light of the great potential of CoI as learning enhancers, our aim was to increase its utilization in medical courses, despite this widespread a-priori reluctance of medical educators to adopt it. So far, most scientific examinations of CoI discourse have focused on promoting discussion and acquisition of content knowledge (e.g., Hasan & Crawford, 2003; Prestridge, 2010). In contrast, in this study we investigated the attitudes of educators while they learn to integrate CoI into their teaching. Hence, this study extends TPACK and Assessment Knowledge by putting forward a methodology for incorporating a particular educational technology—CoI—into teaching practice, by using the DTLAR.

Our findings demonstrate the effectiveness of the DTLAR methodology we offer for encouraging educators to incorporate up-to-date teaching methodologies, specifically CoIs, into their teaching. In particular, we found that the willingness of our participants to apply up-to-date teaching methodologies and CoIs in their teaching increased after participating in the program relative to their willingness before it. Our integrated analysis of the CoI discourse and reflection together provided a detailed picture of participants' attitudes, their attitude changes as the program progressed, and their diverse responses across multiple categories, which could not have been obtained by collecting only global

self-reports or by examining each data source alone. For instance, the increase in positive attitudes in the cognitive domain, as measured in the transition from the CoI discourse to the reflections, suggest that the CoI experience was better perceived in retrospect than during participation. We interpret the dominance of negative statements within the affect category in the reflections as expressing low confidence in using CoI. Interestingly, while participating in the CoI participants did not indicate that the process was time consuming. However, in the reflections this aspect was viewed negatively. We see this finding to suggest that while engaging in interesting discussions time becomes secondary to the engagement in the discussion. Indeed, the high rate of participation despite lack of external incentive (such as grade or monetary compensation) suggests that the participants found CoI activities to be beneficial. However, in retrospect, spending a lot of time on an activity, regardless of its contribution and level of engagement, is viewed negatively. These findings demonstrate the well-established benefits of reflection for improving awareness of participants to the processes they go through while learning (Barak, Watted, & Haick, 2016; Zohar & David, 2008; Zohar & Dori, 2012). One of the Innovative Learning Environment principles is to "…have learning professionals who are highly attuned to the learners' motivations and the key role of emotions in achievement" (OECD, 2013, p. 16). Learning environments can facilitate or hinder motivation. It is important to note that people hold intrinsic motivation towards activities of personal interest (Ainley, Hidi, & Berndorff, 2002; Ryan & Deci, 2000). The present study demonstrates motivating instruction by our application of CoI as a facilitator for learning. However, clearly, designers should be also aware to the potential obstacles, some of which were exposed in the present study.

A comparison across CoI topics revealed that there was no particular reluctance to engage in CoIs on technological topics. Had such reluctance emerged in another population or context, it may guide researchers to focus on these topics in future discussions within program development or with follow up activities. An important issue to be investigated is the sustainability of a positive attitude towards CoI in the long term and the conditions for achieving successful CoI incorporation into teaching.

We included in the DTLAR CoI discourse and reflection as information sources. Clearly, it can be extended furthermore to include additional data sources, such as observations, thinking aloud protocols, and reflections about other activities for promoting assimilation of instructional methodologies (e.g., Azevedo, Reategui, & Behar, 2014; Jang, 2008; O'reilly, 2003; Tearle & Golder, 2008).

One of the contributions of the present study is our diagnostic tool, DTLAR, as part of teachers' Assessment Knowledge that we added to TPACK. Few studies have investigated teachers' Assessment Knowledge (see Abell, 2007) and our study is the first one in medical education. Avargil et al. (2012) and Dori and Avargil (2015) shed some light on the connection of Assessment Knowledge in relation to other types of knowledge teachers possess; they found that Assessment Knowledge position is above Pedagogical Content Knowledge and requires on-going professional development.

As we demonstrated, the DTLAR can serve as a diagnostic tool for learning, assessment, and research that provides unique benefits for students, teachers, and researchers. Students can use DTLAR to monitor and reflect upon their learning progress. Teachers are able to evaluate their students' learning outcomes by analyzing discourse and reflection characteristics. Finally, researchers and program designers can use this tool as a means to (a) gauge educators' readiness to incorporate specific educational technologies, (b) detect related concerns and challenges, and (c) compare findings among different studies obtained through DTLAR.

DTLAR is not specific to the medical context—it can be readily applied to other educational settings. This tool can be implemented at three levels: the participant level, the designer and instructor level, and the organization level. Each level can adapt it to its needs. The participants are expected to become more aware of their learning process and pedagogical challenges. The designers and instructors may discover points for improvement and use the collected data for amendment of educational programs and for individualized support (e.g., leveraging confidence or enhancing participant skills). In particular, the individualized analysis demonstrated here (Figure 5) can shed light on obstacles at the

individual level. The organization can generalize the exposed attitudes, readiness, challenges, and solutions, and apply them to other team development programs. Clearly, further research is necessary for establishing the effect of various factors involved, such as experiencing CoI, reflection on its adaption, topic choice, and the hybrid mode we used which combined face-to-face and remote CoIs.

Two characteristics of our CoI implementation should be noted. First, the lack of enforcing participation in the CoIs. While designing the program, we decided in favor of non-mandatory participation. In retrospect, this was most appropriate for the population of medical educators, and the participation level was more than satisfactory. Future studies should examine the effect of mandatory participation and conditions which are necessary, desirable, or should be avoided.

The second central characteristic of our faculty development program is the hands-on experience of CoI facilitation. We explored the challenges and consequences of letting participants facilitate CoIs. Clearly, the facilitators gained rich and important experience, as reflected in their discourse and reflection. There are questions concerning the desirable implementation, including the reason for the lower quantity of positive statements in the CoIs facilitated by participants and the kind of support educators need before becoming effective CoI facilitators. For example, one participant suggested that more specific guidance is desirable before engaging in CoI facilitating, which is in line with TPACK principles (Angeli & Valanides, 2008; Kramarski & Michalsky, 2013). Another interesting research question is how the facilitation style affects participants' experience.

CONCLUSION

This study suggests that virtual CoIs can be effective and applicable for extending well-established benefits of face-to-face CoIs. In view of this, potential positive effects of incorporating virtual CoIs into adult training programs in various domains should be examined. In particular, faculty development programs have great potential for enhancing technological and up-to-date teaching methodologies. We hope that DTLAR can be instrumental in this endeavor.

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Appendix A – Demographic data for participants represented in Figure 5

No.	Initial	Specialist	Gender	Professionl experience (Years)	Teaching experience (Years)	e-learing experience	Willing to Teach	Willing to learn
1	YG	Family	M	10	4	NO	NO	NO
2	KL	Pediatric	F	12	6	NO	NO	NO
3	IZ	IM*	F	13	8	NO	NO	NO
4	AR	IM	F	15	10	NO	NO	NO
5	AK	E. N. T.**	M	13	8	NO	YES	YES
6	GW	IM	M	24	>15	NO	YES	YES

*IM – Internal Medicine ; ** E.N.T. = Ear, nose, and throat

Appendix B – Examples of reflection statements provided by CoI facilitators

"It was my first experience as a forum facilitator; Facilitating an online academic discussion group is a challenge" *"I did not like the asynchronous nature of the discourse, as the replies were not in real time" (AR_FF2011)*
"It was very important for me to create an interesting discourse…" *"By asking the right questions you can lead the discourse according to your purposes."* *"In order to elevate the level of the thinking in the discourse, participation should obliged to participate" (EZ_LF2012)*
"It seems to me that the motivation to participate is low…." *"It was a challenge for me to facilitate the forum. Even more than I have imagine" (GS_LF2012)*
"It was a challenge to elevate the level of thinking and learning in the experience... I need "guidance" *"Suddenly I felt I lost control" (OS_FF2011)*

BIOGRAPHIES

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MAKING SENSE OF THE INFORMATION SEEKING PROCESS OF UNDERGRADUATES IN A SPECIALISED UNIVERSITY: REVELATIONS FROM DIALOGUE JOURNALING ON WHATSAPP MESSENGER

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ABSTRACT

Aim/Purpose	The research work investigated the information seeking process of undergraduates in a specialised university in Nigeria, in the course of a group assignment.
Background	Kuhlthau's Information Search Process (ISP) model is used as lens to reveal how students interact with information in the affective, cognitive and physical realms.
Methodology	Qualitative research methods were employed. The entire seventy-seven third year students in the Department of Petroleum and Natural Gas and their course lecturer were the participants. Group assignment question was analysed using Bloom's Taxonomy while the information seeking process of the students was garnered through dialogue journaling on WhatsApp Messenger.
Contribution	The research explicates how students' information seeking behaviour can be captured beyond the four walls of a classroom by using a Web 2.0 tool such as WhatsApp Messenger.

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Findings	The apparent level of uncertainty, optimism, and confusion/doubt common in the initiation, selection, and exploration phases of the ISP model and low confidence levels were not markedly evident in the students. Consequently, Kuhlthau's ISP model could not be applied in its entirety to the study's particular context of teaching and learning due to the nature of the assignment.
Recommendations for Practitioners	The study recommends that the Academic Planning Unit (APU) should set a benchmark for all faculties and, by extension, the departments in terms of the type/scope and number of assignments per semester, including learning outcomes.
Recommendation for Researchers	Where elements of a guided approach to learning are missing, Kuhlthau's ISP may not be employed. Therefore, alternative theory, such as Theory of Change could explain the poor quality of education and the type of intervention that could enhance students' learning.
Impact on Society	The ability to use emerging technologies is a form of literacy that is required by the 21st century work place. Hence, the study demonstrates students' adaptation to emerging technology.
Future Research	The study is limited to only one case site. It would be more helpful to the Nigerian society to have this study extended to other universities for the purpose of generalisation and appropriate intervention.
Keywords	information seeking process, information seeking, dialogue journaling, group assignment, analysis of assignment, specialised university

INTRODUCTION

Information seeking is "a conscious effort to acquire information in response to a need or gap in one's knowledge" (Case, 2006, p. 5). Put differently, it is a conscious and constructive effort to derive the benefit of undistorted meaning from information for the purpose of knowledge acquisition and extension (Kuhlthau, 1991, p. 61). This process requires information handling skills, also referred to as information literacy skills. Wilson (2000, p. 9) views information seeking as "the purposive seeking for information as a consequence of a need to satisfy some goal."

Fourie (2004, p. 70) opines that information seeking is a complex process, consisting of social, communicative and interactive behaviour. Kuhlthau (1991, p. 61) perceives information seeking as a user's constructive effort to derive appropriate meaning from information for the purpose of clarity and extension of knowledge on a particular issue or topic. To carry out purposeful information seeking, the information user requires some cognitive abilities and skills to engage with information systems. This is referred to as information literacy skills. Bates (2010, p. 2382) assets that the term *information seeking* does not take into consideration the other dimensions in which people relate to and interact with information; consequently, with time, the term information behaviour has become the preferred term, employed to encompass all types of research on people's interaction with information.

The Centre for Information Behaviour and the Evaluation of Research (CIBER) (2008, p. 10) reports that users' behaviour online is very diverse in terms of geographical location, type of university, and gender and status. Users engage in horizontal information seeking and access authority and sources within a few seconds by relying on popular and favoured brands such as Google. The search engines fit students' lifestyle almost perfectly more than the physical or online libraries, their online behaviour is more public, and there are myriads of pre-publishing, for example, wikis, blogs and so on CIBER (2008, p.7). Green and Hannon (2007) expressed the concern of students about the unmanageable scale of the Web and their difficulty to prioritize and evaluate searches. The value of the various Web 2.0 sites lie in the way users are able to classify, evaluate, and add to the content; however, there is a skills gap between using media and how to create meaningful content (EDUCAUSE, 2007, pp. 5-9). Hence, Poore (2009, p. 68), in the study of the Net Generation information behav-

iour, implied that users need to be ICT literate too. Even though ICT literacy is crucial, the foundation is information literacy.

The primary aim of this paper is to explore the information seeking processes of Nigerian undergraduates in the course of assignment writing, using Kuhlthau's Information Search Process (ISP) model.

LITERATURE REVIEW

This section reviews literature on the information behaviour of undergraduates. It covers research in Nigeria, South Africa, and other African countries, as well as across the globe. The purpose is to explore the research on the information seeking process of students in the course of their academic work.

This section also focuses on Kuhlthau's ISP Model -theoretical framework used for the research.

INFORMATION BEHAVIOUR OF STUDENTS

It is expected that the information behaviour of undergraduates will differ from faculty to faculty. Applied sciences are pragmatic in nature and aim to invent new techniques and products which control the environment. Specifically, engineering is an application focused discipline, the aim of which is to develop products which can be used for practical purposes. According to Heinström (2002, p. 80), the knowledge base is cumulative in science and technology; consequently, discoveries are grounded on former ones. The aim of applied sciences is basically not in understanding "why" but to produce solutions that are both efficient and effective. As an example, professional engineers conduct various tasks, such as design, development, documentation, and implementation. These tasks, whether technical or non-technical, require specific information. Of the various tasks performed by professional engineers, especially designing, testing, manufacturing, and constructing, a final product is required or expected. Therefore in the training of student engineers, they are expected to perform one or more in their final year project.

As in all disciplines where quick and reliable results are expected, the use of Internet in the field of applied sciences is crucial.

Kerins, Madden, and Fulton, (2004) in their study of the information seeking behaviour of Irish engineering and law students found out that easy accessibility is a primary factor in the selection of an information channel by student engineers. Also, the student engineers appear to have a preference for information channels that require the least effort such as the Internet because of its speed and availability of current information sources which feed their initial information need. For most of the engineering students, the Internet is identified as the first information source they explore. However, some of the students who identified the Internet as best source of information for their project also considered it the worst because of information overload. Besides, they are not sure how reliable the information from the Internet is. This is an indication of the fact that they have poor information handling skills. However, some of the students did mention that they use print resources such as books, technical handbooks, and journals as resources to validate the information retrieved from the Internet.

Barker, Cook, and Whang (2006) determined which sources engineering students of the University of Washington College explored for their academic work and the possible reasons for their choice. The investigation was carried out with the hope to use the findings to better inform their library instruction efforts and the services provided at the University of Washington Engineering Library. Findings revealed that engineering students seek to "minimize loss rather than maximize gain" when searching for information, and they value quick, ease of use and convenience over reliability when selecting information sources for their assignment or project. They also use fellow students as information sources; however, librarians and library collections are not frequently consulted. They use the Internet, not because they think it is reliable, but because it is quick and convenient.

In the PhD research of MohdSaad (2008), the information literacy and information seeking behaviour of students conducting final year projects at the Faculty of Computer Science and Information Technology, University of Malaysia, Malaysia was investigated. Findings showed that the majority of the students use resources on the Internet. Other sources students consulted include past year project reports (81.9%), guidelines from lecturers (70.6%), books (69.4%), friends (62.5%) and other reports (50.3%). About 57.5% of the respondents conduct surveys and interviews to gather information from their respective sources, the students. Also, 98.1% use keyword search and 90.8% use subject search when browsing for information via search engines or databases.

Similarly, Kahlal (2011, pp. 15-16) also discovered that engineering students of Royal Melbourne Institute of Technology, Australia, are more comfortable using information available on the Web as their primary tool of information gathering than other tools. The secondary tools are also available online (i.e., databases and library electronic resources), which indicate that students would rather collect information off a computer screen, than make the extra physical effort of seeking academic help by using library hard copy resources.

In 2011, Ejiwoye and Ayandare investigated the level of test anxiety and its impact on the information seeking habit of undergraduate students of the Federal University of Technology, Ondo State, Nigeria. Also determined was the information sources used by the undergraduates. Findings revealed that applied sciences students need everyday life information on sports and healthcare in addition to information for their academic work. However, erratic power supply impacted negatively on their use of the Internet and electronic resources, hence, the mostly consulted information resources by the students were textbooks, reference materials, lecture notes, newspapers, and magazines. Also of concern is the fact that respondents complained of not having access to current and up-to-date information resources in the library.

In summary, applied science students consult the Internet as their first port of call in information seeking, however, with some reservations. They find it easy, convenient, and versatile as a source to meet their immediate information needs, however the reservation comes from the fact that they do not really trust the sources or see it as reliable enough, hence they tend to confirm the online information by consulting print sources. Some of the print sources they consult are textbooks, technical handbooks, and manuals with reliable specific protocols on how to go about their coursework, assignments, and project.

Kuhlthau's Information Seeking Process (ISP) Model

Kuhlthau's ISP model, which has its roots in both information science and constructivist cognitive learning, presents two unique features of "uncertainty" and "Zone of Intervention". Uncertainty is natural and important for constructing personal meaning in the process of information seeking. Increased uncertainty in the ISP is an indication for the need for intervention (Kuhlthau, 1996, 1999). The ISP model is a process of construction and seeking meaning, influenced by George Kelly's personal construct theory, Kelly (1963 as cited in Kuhlthau, 1996) explains the emotional experience arising from constructing meaning from new information; the information is taken-in in phases and it usually begins with confusion. The process of construction is not just reproducing information but also exploration and formulation, the process of which instils the value of lifelong learning.

In addressing the challenges of "seeking meaning" and "sense-making" in the 21st century, Kuhlthau (2008, p. 68) re-emphasizes the fact that the ISP model reveals a process in which a person is seeking meaning in the course of seeking information. The model clearly reveals the link between information seeking behaviour and the impact of information. In fact, from the user's perspective, the two are inseparably connected.

The ISP model in Figure 1 details a holistic stand point of information seeking from the user's perspective in seven stages (Kuhlthau, 2008, p. 67):

- Initiation: this is when a person first becomes conscious of a gap in knowledge or understanding during which the feeling of uncertainty is quite evident.
- Selection: at this stage, a general problem is identified, and the initial uncertainty often reclines due to some sense of confidence and a readiness to begin information search.
- Exploration: in the exploration stage, a volume of inconsistent information is encountered. Such information may be overwhelming and incompatible with the topic, hence, the person's level of confusion and uncertainty increases and low confidence level sets in.
- Formulation: formulation of focus is when confidence begins to increase and uncertainty gives way consequent upon a focused perspective.
- Collection: this stage portrays some level of certainty based on focused perspective and hence deep involvement.
- Presentation: at the completion of the search, there is a new understanding which informs learning, sharing and communicating with others.
- Assessment: A positive and conclusive information search gives a sense of accomplishment and increases self-awareness while it is contrary for an information search that is not conclusive.

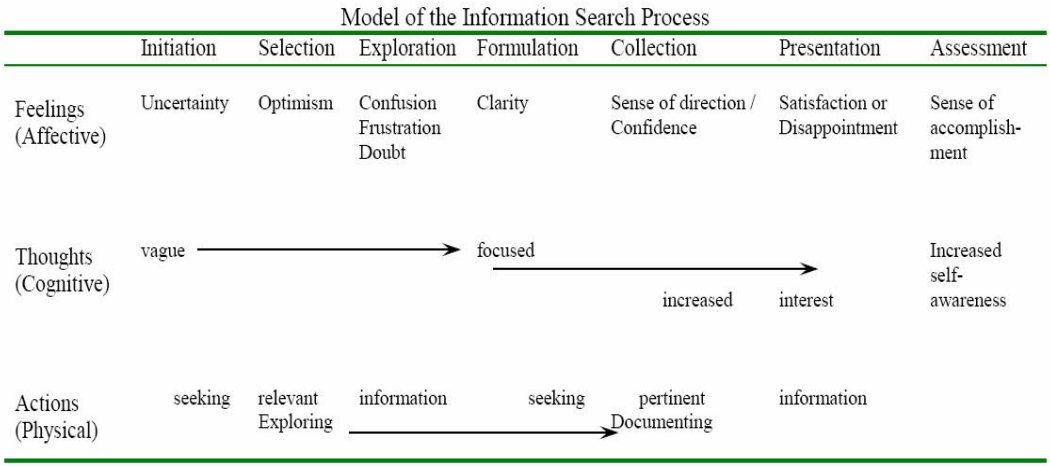

Figure 1. Information Search Process (Kuhlthau, 2004, p.82)

The ISP model as a process of knowledge articulation with varied cognitive and affective stages is relevant in the study of information behaviour irrespective of the information environment, whether print or online media.

Ongoing research reveals that the ISP model is a valid theoretical framework for the study of information behaviour irrespective of the information environment, whether print or online media. Branch (2003) confirms that students experience the phases of the ISP even on the Web (for example, they experience confusion and frustration when they come across barriers in their search), while Broch (2000) emphasizes that the search challenges elucidated by the model may be more serious when searching the Web.

Research within Kuhlthau's Information Search Process (ISP) model

The Information Search Process (ISP) model, which presents information behaviour as a process of gradual understanding and refinement of a problem area (Kuhlthau, 1993, is a result of more than two decades of empirical research by Professor Carol Kuhlthau, of Rutgers University as mentioned in the previous section.

In Kuhlthau's first study, she investigated whether users do have common experiences in the process of information seeking that can be articulated and described and whether users' experiences resem-

ble the phases in the process of construction. A questionnaire was administered to determine perceptions on a 5- Likert scale. She attempted to develop stages along with six categories for each stage: - task, thoughts, feelings, actions, strategies, and mood (Kuhlthau, 2004, p. 36).

- Task Initiation: students expressed feelings of uncertainty
- Topic Selection: uncertainty eased to a degree
- Pre-focus Exploration: could be most difficult stage if there is no focus
- Focus Formulation: for many, this is the turning point in their research effort
- Information Collection: renewed confidence
- Search Closure: begin writing

Major findings of her first study are that patterns experienced by students match those described in the process of construction and the information seeking process model developed. However, the problem with the study is that the initial group is small and not diverse; there is conflict between students understanding of the task versus actual experiences; and students do not perceive librarians as more than locators of resources.

In her second study, there was a large-scale and a more diverse group (low, middle, and high-achieving students). The study was a mix method of qualitative and quantitative research and a longitudinal piece that used process surveys conceptual maps, and perception surveys questionnaire.

The model of information search process is verified in her second study. Findings reveal that learning begins with vague thoughts and low confidence and progresses to clarification and increased confidence. She discovered that there is a correlation between an increase in confidence and teacher assessments of learning occurring and that information search process has more impact on learning than the quantity of resources.

The study conducted by the research team of the Rutgers Centre for International Scholarship in School Libraries in 2003-2005 led by Ross Todd, Carol Kuhlthau and Jannica Heinström provided an ample opportunity to revisit the model and investigate the validity of the model in the current information environment. The investigation involved 574 students in Grades 6 to 12 in ten New Jersey public schools where school librarians and classroom teachers implemented collaborative instructional units of work to engage students in meaningful research on selected curriculum topics (Kuhlthau, Heinström, & Todd, 2008). The pedagogical framework for the instruction was informed by guided enquiry based on the stages of ISP model (Kuhlthau, 2004).

Recently, Kahlal (2011) in his study of the information seeking behaviour of undergraduates in their academic environments, with focus on the impacts of technological advancements on students' capacities, employed the ISP framework. Findings reveal that students felt a lot of stress in addition to lack of confidence when it dawned on them that they lacked the requisite knowledge to attend to a task. However, when the initial search began, relief and confidence started to return but they got overwhelmed when they seemed to experience information overload. This study confirms the cognitive and affective stages of the model.

Kuhlthau's ISP model has been used to structure education programmes. For example, Kuhlthau's model is one of the models in use at the University of the Western Cape, South Africa, to develop an active learning information literacy spiral emphasizing cognitive thinking skills in Library Science 121 (Information Literacy Course) (King, 2007). In their appraisal of the model in 2008, Kuhlthau, Heinström, and Todd confirmed that the model has been very useful in structuring and enhancing education programmes, services, and systems, and this accords the model its credibility in the education world and its uniqueness amongst the information behaviour models. The researchers also reported that the model has been in use as a conceptual framework for developing a programme of inquiry-based learning at the Centre for International Scholarship in School Libraries (CISSL), Rutgers University, USA (Kuhlthau et al., 2008). The model is employed as an instrument for teachers and school librarians to recognize critical moments when instructional interventions are necessary in students'

information-to-knowledge experiences. The model assists students in no little way to get deeply involved in extensive exploration of thoughts and ideas before coming up with their own understanding of their topics and making presentations rather than just gathering information to please their teachers.

Ongoing research reveals that the ISP model is a valid theoretical framework for the study of information behaviour irrespective of the information environment, whether print or online media. Broch (2000) emphasizes that the search challenges elucidated by the model may be more serious when searching the Web while Branch (2003) confirms that students experience the phases of the ISP even on the Web; for example, they experience confusion and frustration when they come across barriers in their search while. In the Web 2.0 world, the affective stages of the model may be more eminent because of the read and write feature of the Web 2.0 platforms.

In her recent research work, Kuhlthau (2012, pp. 17-18) stressed the importance of technological tools as part of everyday life across the globe and that of Web 2.0 which helps to interact, connect, and collaborate. These tools make information instantaneous due to real time access to information. However she alerts one to the danger of everyone having a voice and access. Her concern is about the accuracy and reliability of information being communicated, which is a product of information literacy. Therefore, Kuhlthau's ISP model is relevant even on Web 2.0.

The research work by Orlu (2016) in a university in the United Kingdom investigated the various concerns associated with decisions, actions, choices, and emotions of students through the stages of their search, including search during proposal development, research design, and thesis. Interviews were recorded, transcribed, and analysed using thematic analysis. Findings reveal that the information seeking behaviour of students is organized, and in some cases, random. However, the randomness was glaring during the planning stage of their task. Many student follows Kuhlthau's model in which at the planning stage the search lacks a clear focus. Further indicated was that emotional response to search causes anxiety, apprehension, and confusion. The students studied were Masters students.

RESEARCH METHODOLOGY

According to Bryman (1998 in Struwig and Stead, 2001, p. 56), qualitative research methods incline towards understanding issues from the participant's perspective, describe the settings of the participants in context, and understand the thoughts, feelings and behaviours of the participant. The research explored students information seeking and search process in the course of writing an assignment using Kuhlthau's ISP as the lens to reveal how they interact with information in the affective, cognitive and physical realms. The students' assignment question was also analysed using Bloom's Taxonomy revised by Churches (2009).

The entire 77 third year undergraduates, in the Department of Petroleum and Natural Gas a specialised university in Nigeria, and their course lecturer formed the sample the research.

DIALOGUE JOURNALING

The 77 students were on a group assignment in the course of which dialogue journaling took place on WhatsApp Messenger, a cross-platform mobile messaging application that allows instant exchange of texts, audios, and videos (www.whatsapp.com). WhatsApp Messenger is compatible with iPhone, BlackBerry, Android, Windows Phone, and Nokia. According to Bouhnik and Deshen (2014, p. 217) WhatsApp groups can be employed as follows: communicating with students, nurturing the social atmosphere, creating dialogue and encouraging sharing among students, and as a learning platform. The students used WhatsApp messenger on their personal electronic device, such as android phones, iPhone, iPad, and BlackBerry.

Journaling in the current study is in the sense of *dialogue journaling*, it was a methodological tool adopted for interacting with participants by way of "peering" into their minds during their assignment. Dialogue journaling is a written discourse or dialogue between two or more persons in ex-

change of experiences, ideas, or reflections (Alsaleem, 2013; Haynes-Mays, Peltier-Glaze, & Broussard, 2011). The dialogue journaling exercise with the students was to understand how they go through their assignments, their thoughts, feelings and actions as explained in Kuhlthau's ISP model, during the various stages of assignment writing.

At the end of the journaling exercise, the data was sent from the chat groups on WhatsApp messenger to the researchers email from where it was downloaded, printed and colour coded for analysis.

Analysis of Basic Petroleum Geology Assignment (PNG 315) Question

Bloom's Taxonomy (Figure 2) revised by Churches (2009) examines the cognitive domain and categorizes thinking order and skills. This could assist instructors to design class activities and learning outcomes. Bloom's taxonomy is a continuum from Lower Order Thinking Skills (LOTS) to Higher Order Thinking Skills (HOTS) (Churches, 2009, p. 5). For example, a user must first of all remember a concept to understand it, and also a concept can only be applied if understood and remembered. The LOTS is about knowledge acquisition, interpretation, summarising, inferring, describing, and so on while HOTS involve analysing, judging, and producing. However, Bloom's Taxonomy is not an exclusive layer of the thinking process. At the university level, assignments should be tailored in such a way that it encourages critical thinking, evaluation and creativity, among others.

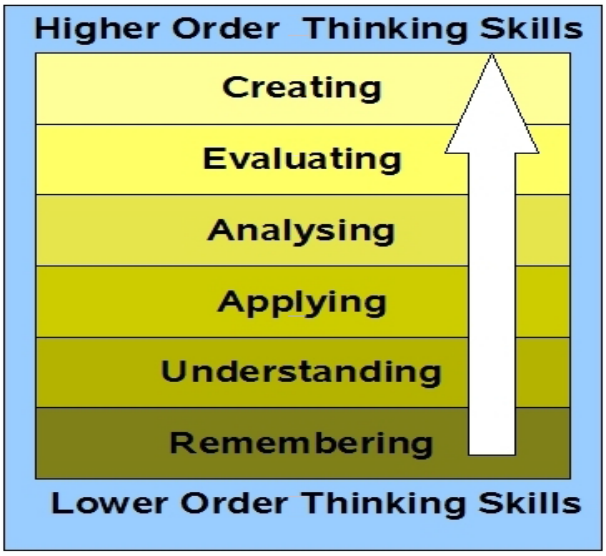

Figure 2: Blooms revised taxonomy by Churches (2009, p.5)

Following are some comments on the assignment question and conduct:

1. The Basic Petroleum Geology Assignment (PNG 315) was a group assignment. Seventy seven students were divided into seven groups; Group A, Group B, Group C, Group D, Group E, Group F, and Group G. That is, 11 students per group, a size that is somewhat too large for effective learning.
2. The instructions from the lecturer were clear as to the mode of presentation in terms of number of pages, font size and font type.
3. Initially, students had only eight days to attend to the assignment. However, the Lecturer later postposed the submission date by four days, making it twelve days. The researcher is of the view that the short time span and the later submission date given during the course of the assignment must have affected the pacing and the quality of the assignment.
4. Students were in seven groups and each group was assigned a specific session from the indicated source (book entitled *Basic Petroleum Geology* by Peter Link), but what to do with the

sections was not clear. However, a group leader explained to the researcher during a private chat that they were asked to read and summarise the content of the various sections assigned. They were also required to consult other sources.

Each of the seven groups was assigned a specific section in the book as follows:

- *GROUP "A" = Earth Structure; Depositional Basins; Post Depositional Processes*
- *GROUP "B" = Petroleum Traps*
- *GROUP "C" = Earth Structure; Depositional Basins; Post Depositional Processes*
- *GROUP "D" = Rocks, Geological Considerations and Engineering Practices*
- *GROUP "E" = Petroleum Traps*
- *GROUP "F" = Earth Structure; Depositional Basins; Post Depositional Processes*
- *GROUP "G" = Rocks, Geological Considerations and Engineering Practices*

Based on Bloom's Taxonomy, this is a lower order thinking assignment because it only encourages students to read, understand, paraphrase and possibly remember.

RESULTS

The results of the research are presented in this section. These will be discussed in the light of the Kuhlthau ISP model which is in seven stages: Initiation, Selection, Exploration, Formulation, Collection, Presentation, and Assessment.

The affective aspects of Kuhlthau's ISP are the feelings and emotions information seekers experience in the process of the information search (Kuhlthau, 2004, p. 82). Such feelings include uncertainty, doubt, confusion, frustration, optimism, satisfaction, and confidence, among others.

INFORMATION SEEKING PROCESS OF UNDERGRADUATES

Kuhlthau's ISP model reveals a process of seeking meaning while seeking information (Kuhlthau, 2008, p. 68). It reveals information seeking from the users' perspective in eight stages (Kuhlthau, 2008, p. 67): initiation, selection, exploration, formulation, collection, presentation and assessment.

Initiation

Initiation is when a person first becomes conscious of a gap in knowledge or understanding during which the feeling of uncertainty is quite evident, thoughts are vague, and seeking is evident.

The researcher had the opportunity to chat with some of the students face to face at the very early stage; that is, the first two days of the assignment. Their main complaint and concern was that they had too many assignments and hardly had time to work on them diligently. Rather than worry about the specific assignment in question, the issue was about being saddled with too many assignments. Hence, the dominating emotion was that of work or study under stress and pressure, as expressed below:

> *S42(Group D): At the beginning actually, I think I was not sure of the assignment since we have a short period for compiling and other course work and assignments were at their peak.*
>
> *S51 (Group E): The major constraint actually has to do with stress and timing. It has not really been easy to create spare time in working on the project. And again, going online to surf for materials in addition to what we were given has not been easy. You know after gathering materials, the next thing to do is to look for a way to correlate all the materials together so there is uniformity. So it is has really been stressful doing that!*
>
> *S71 (Group G): Our daily schedule of lectures is always tight so most of the time we are very busy. Also the Internet connection in the e-library is slow so it is very undependable.*

Even when interactions started on WhatsApp, students did not seem to express any or much uncertainty or vagueness in thoughts. This may have been due to the fact that the assignment question did

not require much critical thinking. They only needed to read a particular portion of a prescribed textbook, and summarise. Even though they were asked to source for more information, there was already a defined scope for which some were glad as expressed by the course representative *S14 (Group B)*, and a few others:

> *S14 (Group B): The material given to us actually covers the aspect of our research to a reasonable extent. I am thankful that our lecturer was able to give us a concise material for the research.*
>
> *S44 (Group D): I extracted only a few vital images from Wikipedia, since the lecturer has given us enough information to work on.*
>
> *S49 (Group D): Actually, the main challenge I faced while doing the project (Rocks) was combining the various ideas I got from the different materials I used.*
>
> *Researcher: Do you mean you are having problems drawing your own summary from the materials you have? You feel overloaded with information or what? Please kindly clarify*
>
> *S49 (Group D): Yes, I felt quite loaded with information. For instance, from the basic petroleum geology textbook by Peter Links that we were given, I saw that the main classes of metamorphic rocks were based on origin while some other materials classified it based on texture only which are foliated and non-foliated.*
>
> *Researcher: So how have you been able to resolve that? S49: I actually gave more preference to the material we were given by partially side-lining the ideas from other materials. I included the textures and used a table to relate the origin and textures.*

Thus, the research shows that the typical expression of uncertainty peculiar to the initiation phase was not evident in this study, contrary to the findings of Kuhlthau (1996, 2004, 2008), Kahlal (2011), and Orlu (2016).

One could infer from the chats with Group D that they were concluding the assignment on the first day of the WhatsApp chat which was the fifth day of the assignment.

> *S46 (Group D): Please for the report for geologic consideration and engineering practice, the group members contributing should please submit their part on or before 6 pm (Day 6) on Wednesday so that we can proof read and prepare for the presentation.*

And then a caution from a fellow student who thought the group should not be in a hurry to submit:

> *S47 (Group D): Hello my group leader! Good morning sir. I want to suggest that we should not rush and print our report work today, even though the soft copies are ready. Let all the group members have the soft copies first, so that they (we) can go through it during weekend. Then any error noticed should be communicated to the people in charge of the arrangement to be corrected. Then we can print on Monday and submit. This is to ensure that we have error-free report notes submitted. I also strongly recommend that we should thoroughly read the instruction for the report assignment to ensure full compliance to our distinguished lecturer demands and requirements for the reports work. Thank you all!*
>
> *S61 (Group F): I happen to be doing the compilation of the different contributions of the group members and I what have discovered so far is that most of us do not know how to arrange and make our information consistent.*

From the interactions among the students above, it is also evident that not all the members were involved in the assignment writing, which is contrary to the pedagogy of group assignments that involves all members and encourages interactivity as well. Even for those who actively participated in the assignment, it appears they worked individually and then submitted to their team leader for compilation.

> *S8 (Group A): But I still have a question on how we will go about the compilation of everyone's contribution because I went through victor's own and it was already 8 pages without diagrams.*

> *S31 (Group C): Topics were shared to the 10 members of the group to summarise chapters 1,6 and 8 respectively of a book titled basic petroleum geology by Peterlink and also find some information from other source. Some members submitted their summaries to me yesterday, when compiling it, I arranged the term paper based on first topic to the last topic with the aid of the soft copy of the book we are to summarized, diagrams, presently am trying to insert the necessary diagrams which some of the group members omitted.*
>
> *S61 (Group F): Tobi Solomon submitted his assignment yesterday, while Cobany did submit this morning remaining Prince and Steven.*

These comments show students did not really work together as a group which may have been due to the manner of administration of the assignment as earlier explained. This reveals a trivialization of the pedagogy of group work which is often overlooked in the process of teaching (Sutton, Zamora, and Best, 2005).

Selection

At this stage, a general problem is identified, and the initial uncertainty often reclines due to some sense of confidence and a readiness to begin information search.

In this assignment, there was no problem to investigate. Hence, students did not necessarily go through the selection phase in which a problem is identified. The assignment question was a "read and summarise" type, a lower order thinking type assignment using Bloom's taxonomy revised by Anderson et al. (2001). The assignment encouraged students only to read, understand, explain, and summarise. The assignment did not provide room for knowledge application, analysis, evaluation, and even design and construction.

As students did not experience the feelings of uncertainty in the initiation phase, the easing of uncertainty that accompanies the selection phase could not be ascertained as a follow up experience.

Exploration

In the exploration stage, a volume of inconsistent information is encountered. Such information may be overwhelming and incompatible with the topic, hence, the person's level of confusion and uncertainty increases and low confidence level sets in.

Again, the students did not necessarily go through the exploration stage in which low confidence level is expressed due to excessive amounts of information encountered which may be incompatible with the topic. In this case, students were given the information to work with; that is, they were asked to read and summarise certain chapters of the Basic Petroleum Geology textbook by Peter Link. Put differently, there was no research problem to explore. Hence, they did not experience an intense information search, even though they were asked to seek additional information. Hence, a high level of confusion and uncertainty attributed to the exploration phase (Kuhlthau, 2004, 2008, 2012) of the ISP model and low confidence levels were not evident as students were "spoon fed" with the basic information needed. The same topics/themes could have been allotted to students without necessarily tying them to a particular textbook that narrowed their search.

Formulation

Formulation of focus is when confidence begins to increase and uncertainty gives way consequent upon a focused perspective.

Students were focused from the beginning on the end of the assignment, because their task was simple, clear and straightforward: "read and summarise". Hence, they were confident about achieving their goal of finishing the assignment in good time, if anything, the challenge expressed was that of coordinating the group and finding a convenient time to meet. Again, this did not agree with the findings of Kuhlthau (1996, 2004, 2008), Kahlal (2011) and Orlu (2016).

Collection

This stage portrays some level of certainty based on focused perspective and hence deep involvement.

This was not evident in the journals as students had no research problem to solve; hence there was no "focused perspective". They were required only to read, understand, and explain which was implied in a statement by their lecturer during the chat in Group F:

> *I expect that your report is supposed to teach me. So whether I know the terms or not, it is not important. You should understand those terms and explain them to me. This is why I said that if the constraint on pages is too tight, I must be informed first before any additional pages are included. I have extended the maximum number of pages for two groups because of this. So, research on those terms and come up with decent explanations to them.*

This level of assignment encourages lower order thinking according to Blooms Taxonomy (Anderson et al., 2001; Churches, 2009) because it addressed reading, understanding, remembering, and explaining.

Presentation

At the completion of the search, there is a new understanding which informs learning, sharing and communicating with others.

Reading and summarizing the allotted chapters gave students room to learn, share and communicate with their peers, albeit, at a lower order thinking level as occasioned by the type and level of assignment.

Assessment

A positive and conclusive information search gives a sense of accomplishment and increases self-awareness while it is contrary for an information search that is not conclusive.

At the end of the assignment, students expressed some relief, self-confidence, sense of accomplishment, and satisfaction. This aspect agrees with the findings of Kuhlthau (1996, 2004, 2008, 2012) because of the feeling of self-accomplishment, but not necessarily increased self-awareness.

> *S7 (Group A): I felt a bit confused and worried, that lasted till yesterday. I feel better now that I am done. At least I can rest easy now.*
>
> *S44 (Group D): Actually fully satisfied, all work completed.*
>
> *S59 (Group E) we are satisfied with the work and also confident in our work, to cap it all, we really did a great job. Thanks to all those that really helped to make the compilation easy for us!*

Some students expressed gratitude for the opportunity to interact with the researcher who provided them with some helpful tips.

The journaling also provided a rare opportunity to both students and lecturers alike to interact during the assignments. Students were able to chat freely with their lecturer on social media for the first time. The experience set a pace and standard for all parties involved especially the lecturers and the students. They told the researcher that the journaling afforded them a glimpse into the challenges that students face in the process of writing their assignments, especially in the case of group assignments when they need to meet, discuss, brainstorm, and garner their thoughts in order to fulfil the purpose of the assignment.

Students equally expressed their joy! Due to the short period of assignment writing, during which they had other competing assignments and lectures, the journaling on the WhatsApp platform gave them the opportunity to discuss what they would have otherwise done face to face even at the inconvenience of meeting.

DISCUSSION

The analysis of the journals confirms the extent to which Kuhlthau's ISP model is applicable in the students' course of conducting their assignments.

A major challenge faced in the research is that students had a number of shorts term assignments, with a time frame from three days to about two weeks. A total number of 77 students took part in the dialogue journaling; divided into seven groups, each group opened a WhatsApp platform. The lecturer and researcher were present on all platforms. Though not all the students had phones compatible with WhatsApp Messenger, the lecturer advised that they make their comments through their group members. Hence, the platforms were a bit rowdy because it appeared as though it was primarily set up for students to discuss and work out their assignments, rather than interact with the researcher on their day-to-day experiences with the group assignment. Most group members did not have the opportunity to meet as a result of time constraints, coupled with the fact that they were having lectures and other assignments to attend to.

Students were in seven groups: The researcher is of the view that the short time span and the later submission date given during the course of the assignment must have affected the pacing and the quality of the assignment. If the assignment was well planned and scaffolded in a way that students are guided to do certain tasks, for example, reading the prescribed textbook, taking notes, scouring for information from other sources, writing, etc., it would have helped in no small measure to keenly observe the information seeking process in line with Kuhlthau's model.

Not scaffolding or planning the assignment in order to enable students to tackle specific parts and portions of the assignments at specific timelines under supervision implies that students may not necessarily follow a research or enquiry process as they go through their assignment, or this may invite plagiarism. However, Kuhlthau's model, which forms the basis of this discussion, shows that information seeking is a process of knowledge construction with different cognitive and affective stages (George et al., 2006; Kahlal, 2011; Kuhlthau, 1993, 2004, 2008, 2012; Orlu, 2016; Serola & Vakkari, 2005; Wang & Soergel, 1998; Yang, 1997).

During the period of interaction with the class on WhatsApp, a common phrase among the students was "compile the assignment" which appeared as though some individuals had put some information together within such a short time. For a research assignment that needs to be reported with the various parts of a typical report, it is questionable to have completed this report within such a time frame while, other lectures and assignments were still on. The same students also had a Thermodynamics and Phase Behaviour (PNG 313) assignment which was due the same week and the Entrepreneurship course group assignment, among others.

Despite the shortcomings in the assignment question and its poor mode of administration which did not involve planning and scaffolding, students showed certain cognitive abilities, and they engaged in some physical actions during the course of their assignment.

IMPLICATIONS OF RESEARCH FOR THEORY

Kuhlthau ISP model is the primary model used as a lens to examine how students search and use information in their academic tasks. The model could not be applied in its entirety to the study's particular context of teaching and learning because in the nature of the assignments, elements of a guided approach to learning, under which Kuhlthau's ISP may be employed, are missing. Hence the information seeking process of undergraduates could not be ascertained; students were served the information to they used for the assignment which was not significantly challenging.

Alternative theory, such as Theory of Change (Quality Education in Developing Countries [QEDC], 2008) could explain the poor quality of education and the type of intervention that would enhance students' learning. For quality assurance in teaching and learning, Quality Education in Developing Countries strategies and QEDC theory of change under the Hewlett Foundation's Global Develop-

ment Program (HFGDP) affirm that (1) if more attention to and accountability for student learning exist in a country, (2) if governments and educators have knowledge about effective instructional models that can be scaled, and (3) if the necessary resources are in place to ensure student learning, policy and practice within the system (from donor practice to teacher behaviour) will change to produce improved student learning (QEDC, 2008, p. 11).

This theory will serve as invaluable at the point of evaluation and genuine intervention in teaching and learning.

Implications of Research for Practice

Policy changes: The research reveals that students are faced with too many assignments that appear counterproductive. It appears assignments are given randomly without coordination from the Academic Planning Unit (APU), faculty, and department. To address this problem, the APU should set a benchmark for all faculties and, by extension, the departments. Such benchmarks should form part of the discourse during Faculty Board Meetings (FBMs) that are held before the commencement of every semester, where the general academic welfare of the students and strategic planning for the implementation of the curriculum are discussed. Such meetings should bring on board the type/scope and number of assignments including learning outcomes.

Concluding Remarks

The students worked on a group assignment. They were 7 groups of 11 students per group making a total of 77 students. Each group was assigned sections in the textbook titled "Basic Petroleum Geology" by Peter Links to read, summarise, and present in the format of a research report. But they were also asked to source for more materials with similar subject matter.

First of all, having up to 11 students in a group is a much too large for a group assignment. This negatively impacted on their assignment writing as it was obvious in the interactions of the students during the journaling that the work was shared among a few members and compiled by the group leaders while some students did not even engage in the group work at all. This reveals a trivialization of the pedagogy of group work which is often overlooked in the process of teaching (Sutton, Zamora, & Best, 2005).

The students were required to read and summarise a portion of a textbook and also source for other materials with similar a subject and context. Therefore, the assignment did not give room for knowledge application, analysis, and evaluation, not to mention design and construction, something that should be seriously considered since they were engineering students; though the aim might have been for students to read before the class meeting. However, the assignment type simply narrowed their information seeking process. There was no research problem to investigate; no scaffolding that would have guided them to carry out tasks in specific parts. Therefore, it was a challenge to keenly observe their information seeking process in line with Kuhlthau's model either face-to-face or in the journals. It is in the process of investigating a problem that Kuhlthau ISP model (Kuhlthau, 2004, p. 82) can be more readily utilised as a lens to study and understand students' information seeking process.

The apparent level of uncertainty, optimism and confusion/doubt common in the initiation, selection, and exploration phases (Kuhlthau, 2004, 2008, 2012) of the ISP model respectively and low confidence levels were not markedly evident as students were "spoon fed" with the basic information needed. Perhaps, the assignment writing might have impacted them differently if they were given the same themes without a prescribed textbook to work with; although they were also encouraged to seek more information online. Some students did not source for additional information resources but only used the book prescribed as observed during one-on-one chat with S6, S33, S45, and S61.

From the analysis of the WhatsApp journals with the 300 level students of Petroleum Engineering Department on PNG 315 assignment, it was clear that they did not necessarily experience Kuhlthau's

ISP because the assignment was not an investigation or an exploration of a problem which is a process of enquiry. An assignment that requires investigating a problem would have adequately revealed students' experience in terms of the physical, cognitive, and affective domains captured in ISP model. On the other hand, the mode of administration of the assignment may suggest that there is a challenge with teaching and learning which may hinge on the curriculum and the way it is delivered.

The ability to use emerging technologies is a form of literacy that is required by the 21st century work place. Hence, the study demonstrates students' adaptation to emerging technology; however, the ability to critically examine information and use it ethically is crucial to the progress and developing society that is inundated with myriads of information.

The study was limited to only one case site. It would be more helpful to the Nigerian society to have this study extended to other universities for the purpose of generalisation and appropriate intervention.

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THE IMPACT OF UTILISING MOBILE ASSISTED LANGUAGE LEARNING (MALL) ON VOCABULARY ACQUISITION AMONG MIGRANT WOMEN ENGLISH LEARNERS

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ABSTRACT

Aim/Purpose	To develop a framework for utilizing Mobile Assisted Language Learning (MALL) to assist non-native English migrant women to acquire English vocabulary in a non-formal learning setting.
Background	The women in this study migrated to Australia with varied backgrounds including voluntary or forced migration, very low to high levels of their first language (L1), low proficiency in English, and isolated fulltime stay-at-home mothers.
Methodology	A case study method using semi-structured interviews and observations was used. Six migrant women learners attended a minimum of five non-MALL sessions and three participants continued on and attended a minimum of five MALL sessions. Participants were interviewed pre- and post-sessions. Data were analysed thematically.
Contribution	The MALL framework is capable of enriching migrant women's learning experience and vocabulary acquisition.
Findings	Vocabulary acquisition occurred in women from both non-MALL and MALL environment; however, the MALL environment provided significantly enriched vocabulary learning experience.
Impact on Society	MALL offers an enriched and interactive medium of learning, and positive, enriched learning experience
Future Research	A standardised approach to measure the effectiveness of MALL for vocabulary acquisition among migrant women in non-formal setting
Keywords	MALL, migrant women, vocabulary, tablet, language app

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INTRODUCTION

This paper presents an approach for utilizing Mobile Assisted Language Learning (MALL) to assist migrant women in Australia to acquire English vocabulary in a non-formal community learning setting. MALL has been demonstrated to be feasible for language learning (Burston, 2014; Stockwell & Hubbard, 2013; Viberg & Gronlund, 2012); however, this is based on learning that takes place within academic contexts where participants are either school children or university students who are literate in their native language, familiar with English, and are in a formal and structured environment. Little research has been undertaken on using MALL for participants who have unique backgrounds, such as migrant women English learners (K. S. Ahmad, Sudweeks, & Armarego, 2015). The research reported in this paper is part of a larger study investigating the learning experiences of migrant women who used an app downloaded on tablets for learning vocabulary in a non-academic community learning context.

The women in this research could be characterised as (i) entering Australia via either the "voluntary/economic" stream (e.g., following their husband's new employment or looking to build a new life) or "forced/humanitarian" stream (e.g., due to war, thus seeking refuge and resettlement); (ii) having varied native language (L1) backgrounds from pre-literate to highly literate; (iii) having levels of English proficiency from pre-beginner to beginner; (iv) voluntarily attending the community conversational English sessions due to its flexible, non-formal and free program; and v) the majority of participants are fulltime stay-at-home mothers due to sociocultural and personal reasons, some isolated from the wider Australian society.

BACKGROUND

The causes of migration into Australia are either 'voluntary' or 'forced' (Kunz, 1973; UN, 2013; UNHCR, 2011; Ward, Bochner, & Furnham, 2001). While both have a similar purpose, which is for a better life and future for families, the latter is due to unsafe conditions in their own homeland as a result of political turmoil, war, religious persecution, or some other form of oppression. Upon arrival, families have to adjust into a new life and culture in modern Australian society whilst dealing with emotional and psychological issues, sociocultural and socioeconomic challenges, and learning English as a new language for communication (OMI, 2012).

Coates and Carr (2005), Colic-Peisker and Tilbury (2007), Fozdar and Hartley (2012), and Miralles-Lombardo, Miralles, and Golding (2008) identified one of the common barriers for migrants' ease of settlement as the lack of English language proficiency. For men, the responsibility of seeking financial stability for the family forces them to go out into the workforce and into society, therefore overcoming the barriers and challenges more quickly than women. Typically, women assume the responsibility of undertaking household duties and engaging in full-time care of families, leading to isolation from the broader community, usually over several years. These women's lives are strongly influenced by personal and sociocultural factors both pre- and post-migration (AMES, 2011; ECCV, 2009; McMichael & Manderson, 2004). As such they are ready for further education or to find work only when their children are old enough (RCOA, 2010). Meanwhile, an avenue that is available for them to participate in some form of learning and socialising, with the flexibility of bringing their children along, is by going to local and non-profit community-based centres that offer programs on life-skills and also some form of English learning (K. S. Ahmad, Armarego, & Sudweeks, 2013). Even though these programs are non-accredited and short term in nature, they provide the kind of learning opportunity and space that suits the women's need for a friendly and non-rigid learning environment.

SUPPORT FOR ENGLISH LEARNING

In Australia, funded support for migrant and refugee English learning is provided through the Adult Migrant English Program (AMEP) that aims to help develop the English language skills needed to access services in the community, provide a pathway to employment, training or further study, and

participate in other government programs offered (DIAC, 2008). Learners who are enrolled in this program enjoy a stable and permanent operation that applies state of the art technology to teaching and learning English (Chiu, 2013; Grgurović, Chapelle, & Shelley, 2013).

However, some eligible women have had to forego this opportunity due to personal and sociocultural factors (K. S. Ahmad et al., 2013), migration histories, and fear of engaging in formal education (AMES, 2011; ECCV, 2009; McMichael & Manderson, 2004). Instead, they opt to attend non-formal learning settings at community centres. These programs do not require commitment and run for short durations (for example, two hours weekly, in the morning during the school term). They are intended as a meeting place for migrants and refugees to learn and practice English in a relaxed and fear-free environment. The lessons are somewhat structured but no assessments are imposed. Depending on the availability of funding, some of the community centres also provide a crèche facility so that small children can be near their mothers. Attending these programs is a valuable way for these women to go out and socialise with other people while learning English.

Significance of Vocabulary

A learner with diverse vocabulary can connect with a greater variety of people in their particular areas of interest (Lightbown & Spada, 1993) and become proactive in talking and dealing with issues in detail. Being confident gives these learners the ability to voice their opinion clearly, share ideas and thoughts, or simply make conversation (J. Ahmad, 2011; Elgort, 2011; Nation & Newton, 2009). This increases the chances of having other people understand what is expressed. Learners would be able to grasp ideas and think more rationally, incisively, and become more informed and involved by possessing vocabulary knowledge. This knowledge refers to the size – breadth and depth – of the vocabulary, which includes spelling, pronunciation, syntax, morphology, context, whether it has multiple meanings, and how a word combines with other words (Qian, 1999). In addition, Nation (2000) said that the nature of acquiring vocabulary starts with a new word, then it is enriched and established as the words are met again; in other words, it is a cumulative process. Eventually, as learners' knowledge becomes more established, they are able to see how words are related. Nation and Newton (2009, p. 135) suggested that teaching vocabulary to beginners is more effective if words are pre-taught before they are used in context, and words are explained in the context of listening to a story compared to incidental learning without directly focused attention. Nation and Newton also suggested various ways to teach learners based on their proficiency levels: *beginners, intermediate,* and *advanced*.

K. S. Ahmad et al. (2015) found that vocabulary learning is a significant component of acquiring conversational proficiency and competence for migrant women learners. Considering their educational background, English level, native literacy level, and native language system, vocabulary acquisition centring on the speaking and listening branch of language development is seen as useful and beneficial. This could be achieved by way of developing their word bank. A rich word bank facilitates a learner's fluency in speaking and effective writing (J. Ahmad, 2011). A greater number of words in a learner's word bank provide more instruments to work with when putting forward their own ideas and dissecting and examining the ideas of others (J. Ahmad, 2011; Elgort, 2011). These instruments are also useful for reading comprehension, where readers could try and comprehend unfamiliar words that they encounter in the text (Krashen & Terrell, 2000; Lightbown & Spada, 1993).

Adult English Learner's Literacy

Literacy is about a person's ability to read, write, speak, and listen, and to apply these skills to communicate effectively. The literacy levels of adult English language learners are varied and can be grouped based on their sociolinguistic backgrounds. Burt, Peyton, and Schaetzel (2008) categorised the variety of L1 literacy that is typically found in an English class for non-native English speaking adult learners into the following: pre-literate (learner's L1 has no written form or is in the process of developing a written form, e.g., Aboriginal Australian); non-literate (learners have no access to literacy instruction); semi-literate (learners have limited access to literacy instruction); non-alphabet literate

(learners who are literate in a language written in a non-alphabetic script, e.g., Chinese and Japanese logographic); non-Roman alphabet literate (learners who are literate in a language written in a non-Roman alphabet, e.g., Arabic, Greek, Korean, Russian, Thai); and Roman alphabet literate (learners who are literate in a language written in a Roman alphabet script, e.g., French, German, Spanish).

The L1 literacy is one of the factors that may have an impact on English language learning (Bigelow & Tarone, 2004). Other factors that generally affect English and other second language acquisition include the following: 1) the level of oral and written proficiency in L1, exposure to and experience with literacy in and outside of formal education settings (e.g., the number of years of formal schooling in the home country), 2) learner motivation (Bigelow & Tarone, 2004; Dornyei, 2002; Masgoret & Gardner, 2003; Tarone, Bigelow, & Hansen, 2007), and 3) age, intelligence, aptitude, personality, learning styles, and age of acquisition (Lightbown & Spada, 1993). Bialystok (2002) and (Cummins, 1991) state that L1 literacy helps learners become literate in L2. Collier (1989) found that it took longer for a non-literate L1 learner to learn L2 (7 to 10 years) compared to a literate L1 learner, who took a lot less time.

Designing MALL-integrated Vocabulary Lessons

In designing MALL integrated vocabulary lessons for adult learners, the principles of andragogy (Knowles, 1984) that are widely used for developing adult learning curricula should be considered. These principles are based on five crucial suppositions about the characteristics of adult learners that differ from children's pedagogy (Smith, 2002). These include the following: adult learners are independent and self-directed individuals; they are equipped with experience; they are ready to learn; they are oriented toward being problem-centred rather than subject-centred; and they are motivated (Knowles, 1984). For adult learners, their decision to learn English as a second language in general, and any particular target skills, is influenced by factors such as level of literacy in their native language, culture, past experiences, age, and opportunities to speak English. Fozdar & Hartley (2012) emphasized that there is also the need to consider the learner's previous psychological and emotional concerns such as trauma, settlement and family priorities, or confidence and motivational issues.

MALL integrated vocabulary lessons for varied L1 level learners should also consider Krashen's Input Hypothesis of second language acquisition. The hypothesis proposes that learners acquire language by receiving comprehensible input, that is, by understanding words in context (Lightbown & Spada, 1993). K. S. Ahmad et al. (2015) designed a MALL lesson that addresses Krashen's approach by including vocabulary content that used listening texts and authentic texts to provide more impact to learners, specifically, low literacy learners. Listening texts refers to recorded conversations while authentic texts are those texts found every day, such as takeaway menus, advertising flyers. and bus timetables.

Learning vocabulary can be an incidental process where something is learnt without the intention of doing so. It is also learning one thing while intending to learn another, that is, learning contextually. In contrast, intentional vocabulary learning disregards the context and focuses on word lists or word groups such as antonyms, crossword puzzles, scrambled words, and so forth. Flashcards are also a way to learn vocabulary by using a card with a word, sentence, or simple picture. Another way of learning vocabulary is the use of dictionaries – monolingual, bilingual, and multilingual. In addition, some learners prefer rote learning, which is simply repeating new words until they can be recognized by memory (Nation & Newton, 2009). Applications or apps that are used for language learning, such as vocabulary, can provide rich and varied language experiences (Nisbet & Austin, 2013). According to Graves (2006) learners should be immersed in a wide variety of language experiences so that they learn vocabulary while stimulating their listening, speaking, reading, and writing skills.

Methodology

This study was conducted in a small suburban community centre in Western Australia. The centre provides community services and learning programs to the surrounding community members. One

of its learning programs is conversational English, a non-formal learning space for people who want to practise basic spoken and survival English. The program is free of charge and open for two hours on every Tuesday morning during the public school term. Most attendees are women even though the program is open to the public. Mothers are allowed to bring along their small children. Women attend this program as a way to be able to leave the house, thus reducing isolation and allowing them to interact, engage, and socialise with other women. Countries of origin of these women include Afghanistan, China, Iraq, Malaysia, Indonesia, the Democratic Republic of Congo, and Japan.

As the coordinator of this program, the first author has regular contacts with the attendees. Due to this convenient accessibility and proximity of the researcher to the participants, the most suitable research approach to use was case study design with convenient sampling technique. Case study design was described by Adelman, Jenkins, and Kemmis (1980) as a 'user-friendly' research method and popular among teachers as the data are 'strong in reality,' with the complexity of 'social truths' acknowledged. These observations and interactions provide a valuable general view to the researcher of the beliefs, values, and attitudes of the participants. The researcher had the opportunity to enjoy a good rapport, to observe how the participants act, speak, and engage with each other naturally, as well as with other people in the community centre. Data for this research was collected through semi-structured interviews with participants. The 6 participants selected for this research were part of (on average) 15 women who attended the weekly conversational English session. Interview data was collected from all 6 participants (Groups 1 and 2), while MALL data was collected from 3 participants (Group 2).

INTERVIEWS

Semi-structured interviews were used as a method of collecting data because they allowed for greater flexibility and leeway (Creswell, 2012; Yin, 2011). In this study, to achieve more extensive follow-up of responses from participants, the order of questions was sometimes changed and some questions probed further. This created richer interactions and more personalised responses (McDonough & McDonough, 1997). According to Miralles-Lombardo et al. (2008), an established rapport between the interviewer and the participants encouraged the latter to speak more openly. To achieve this, help from other participants in the sessions who could speak English a little better was also sought to interpret for the participants. This allowed participants to express their views more deeply and freely in L1. The interviews were audio-recorded then transcribed for analysis.

All six participants attended at least 5 of 10 non-MALL sessions that were conducted. Each participant was interviewed individually before beginning the first session (pre-non-MALL). The participants were interviewed again after they attended a series of 5 non-MALL sessions (post non-MALL). Pre-non-MALL interviews collected demographic data about participants' migration histories, country of origin, the main language (L1) and other languages they speak, their level of education, the ways they learn English, their view of the importance of English, and their perceptions of their own English skills. The post non-MALL data revealed if participants had acquired any vocabulary that was introduced or taught and any changes that had occurred in their perceptions of their English skills. Group 1 (non-MALL experience) provided a baseline for the comparison with Group 2 (non-MALL plus MALL experiences). The themes of the pre-non-MALL questions and prompts were as follows:

Demographic Questions

- Migration to Australia - arrival in Australia, country of origin, age
- Everyday language use and literacy - L1, L2, L3
- Education and work experience pre and post-migration

Pre-non-MALL Interview

- Learning/acquiring English skills – ways to learn English (watch TV/movie, read books)
- Ways of finding the meaning of new vocabulary – use dictionary or ask someone?
- English interaction with family, friends, neighbors, schools, and health and government institution

Post-non-MALL

- Vocabulary acquired from attending non-MALL sessions
- Ways of finding the meaning of new vocabulary – use dictionary or ask someone?
- English interaction with family, friends, neighbors, schools, and health and government institutions

The themes of the pre- MALL and post-MALL questions and prompts are as follows:

Pre-MALL Interview

- Familiarity with tablet, laptop, smartphones, and desktop computer
- Mobile devices – uses, language, and script

Post -MALL

- Ways of finding the meaning of new vocabulary – use dictionary or ask someone?
- English interaction with family, friends, neighbors, schools, health and government institution
- Experience of using the tablet – ease of use; engagement; features – interactivity, videos, audio

Group 2 participants then extended their involvement in this study by attending at least 5 out of 10 MALL sessions that were conducted. Individual participants were interviewed before they began their first MALL session (pre-MALL) and were interviewed again after they attended a series of five MALL sessions (post-MALL). The pre-MALL data was about participants' familiarity with mobile devices while the post-MALL data revealed participants' experience of learning English vocabulary in a MALL environment within a non-formal setting and if any changes had occurred in their perceptions of their English skills.

Non-MALL and MALL Vocabulary Sessions

The non-MALL and MALL sessions were held within the regular weekly conversational program at the community centre. A total of 10 non-MALL sessions were held, one every week for 10 weeks. This was followed by a 2-week school holiday break when the community centre was closed. Following the reopening of the centre for the new term, the 10 MALL sessions were conducted, one every week for 10 weeks. The time allotted for each session was 2 hours, with 30 minutes used for administrative tasks and tea break, leaving approximately 90 minutes for non-MALL/MALL sessions.

Non-MALL sessions

An example of a topic of conversation in a non-MALL session was grocery advertisements in the community newspaper. Krashen's Input Hypothesis of second language acquisition stated that learners acquire language by receiving input that are comprehensible and impactful (Lightbown & Spada, 1993) . Using a grocery advertisement, which is a form of authentic texts (those texts found in our everyday lives) helped learners, especially low literacy learners, to understand words in context a lot better.

An introduction to the community newspaper was made to attendees. The activities included recognising the front page and title of a newspaper, describing pictures on the front and back page, finding advertisements and inserts, and identifying page numbers. Each attendee was given a current community newspaper available free in the community (Figure 1).

The follow-up discussion revolved around the prices of grocery items, comparison of prices (where one is cheaper or more expensive in one store than in another), in-season fruit, learning to describe items by the weight or the quantifier/container in which they were sold. The examples of vocabulary were a kilo of ___, a bag of ___, a carton of ___, a dozen of eggs, grocery list, cheaper and expensive. The discussion triggered follow-up questions and elicited other vocabulary. Attendees then tried to make a grocery list and shared it with the group.

Front page	Page 14	Page 19

Figure 1. Community newspaper that was used for non-MALL sessions.
From left to right: front page of 2 September 2014 issue; grocery advertisement on page 14; another grocery advertisement on page 19 (Community Newspaper Group, 2015)

MALL sessions

The community centre supplied ten tablets that were shared among all attendees of the English conversational program. The introduction of the tablet into the program was done gradually to maintain the naturalistic and non-formal feel to the program as much as possible. The following is a sample of how a MALL lesson (K. S. Ahmad et al., 2015) on the topic of Your Health from the *ThinkEnglish!* (AMES, 2016) app was conducted.

Step 1 *Pre-teach vocabulary (words/phrase).* This step helps learners to understand the meaning and become familiar with the vocabulary (Nation & Newton, 2009). Example of vocabulary for this topic: "sore throat", "headache", "backache", "stomach ache" and "hay fever".

Step 2 *Drilling.* This step is used to help attendees practice fluency and become familiar with how the words and phrases are used (Nation & Newton, 2009). The following corresponding sentences are drilled: "I've got a sore-throat", "I've got hay fever", "I've got a backache", "I've got a stomach ache", and "I've got a headache".

Step 3 *MALL activities.* This is when attendees are given a tablet to work with and paired to undertake vocabulary exercises. Figures 2(a) and 2(b) are examples of the user interfaces on the tablet that the attendees of the MALL lessons were presented with to work on. Figure 2(a) shows the screen capture of a completed matching statement and pic-

ture and Figure 2(b) shows the screen capture of the video part of the exercise. By tapping on the video, a learner could watch the characters having a dialogue between them.

The *Activity* part lets a learner answer the solve questions based on the dialogue. Three answer choices are given, and the selection can be made just by tapping on one of the choices. The *Transcript* part of the activity lets a learner read the transcript of the conversation. The transcript can be read independently of the video, while listening to the conversation when the video was playing. This is useful for reading, listening, and pronunciation practice. Tapping on the play button lets the learner listen, pause, forward or repeat the audio. The exercise can be refreshed and repeated as many times as needed.

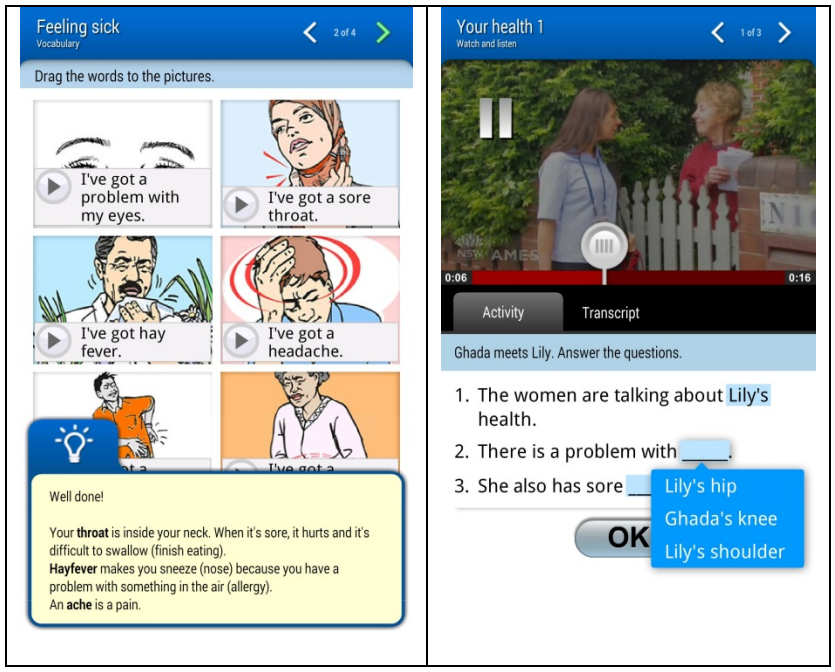

Figure 2: (a) Matching exercise; (b) Video

RESULTS

DEMOGRAPHIC INFORMATION

All six participants were non-native English speaking migrant women. Selection was made using purposive sampling identified through the English conversational program from the case study site. Three participants can be grouped into younger (age range 25-34 years old) while the other three as older (age range 40-60 years old). They have lived in Australia between 2 to 12 years. All participants experienced school in L1 in their home country. Four participants completed high school while one experienced interrupted education and one had 3-4 years of informal primary level religious schooling experience. The confidentiality of the participants is protected by using code names. Demographic data were collected about participants' country of origin and residency status (Table 1).

Table 1. Participants' demographic information

Code name	Age	Country of origin	Years living in Australia	Chronology of residency
Suki	25-29	Afghanistan	4	Citizen of Afghanistan; refugee in Iran; permanent resident of Australia
Rea	55-59	Iraq	12	Citizen of Iraq; refugee in Iran, Malaysia and Indonesia; citizen of Australia
Feeda	25-29	Libya	2	Citizen of Libya; lived in Libya; student visa (spouse) in Australia
Liddy	40-44	China	7	Citizen of China; lived in China; citizen of Australia
Rose	40-44	Congo	7	Citizen of Congo; refugee in Zimbabwe; citizen of Australia
Rina	30-34	Indonesia	2	Citizen of Indonesia; refugee in Malaysia: temporary (protection) visa in Australia

PARTICIPANTS' BACKGROUND

Suki

Suki was a refugee from Afghanistan who experienced delayed and interrupted education. Suki went to an informal religious school in her village and only started formal schooling in the refugee transition camp in Iran at the age of 12. She completed high school at the age of 20, just before she migrated to Australia. In Australia, Suki enrolled in the AMEP and obtained the Level IV Certificate in Spoken and Written English (CSWE). Suki then enrolled in an adult learner preparatory program to obtain Year 11 and 12 qualifications so that she could enroll in a Vocational Education and Training (VET) course. However, due to personal reasons, Suki had to abandon her studies and career plans momentarily.

Rea

Rea had already lived in Australia for 12 years. Rea, her husband, and five children fled from Iraq and had lived as refugees in Iran, Malaysia, and Indonesia. From Indonesia, Rea and her family travelled by boat to Christmas Island. They lived in refugee detention centres in Christmas Island and Adelaide before eventually settling in Perth. Rea continued her role of a stay-at-home mother caring for her 5 children while her husband went out to work. Rea wanted to be able to speak English at least at the "survival level". Rea could utter "pre-formulated" information when asked to introduce herself: her name, home address, date of birth, year she came to Australia, her age, number of children, and the name of the area where she lived in. This information was memorised by her as it was always asked of her.

Feeda

Feeda, her husband and their two children, aged 5 and 7, came to Australia from Libya. Her husband was on a student visa, while Feeda and their two children were on the family dependent visa. Feeda was pregnant with her third child when she participated in this study. She completed a bachelor degree in Mathematics in Libya, but she said she could not use it here as it was in Arabic. Feeda would like to do a master degree and become a teacher; however, she felt that it would only happen if her youngest child was old enough, her permanent residency status was approved, she had sufficient finance, and her English was good enough. Feeda expressed feeling constrained when communicating in English as she could not communicate as fluently as in Arabic. Feeda had to form sentences in Arabic in her mind and translate them into English before she could utter them out loud.

Liddy

Liddy migrated from China to Australia with her husband and twin sons. The reasons they migrated were for better jobs, better education for their sons, and improved quality of life. In Liddy's opinion, the quality of life in Australia was much better because of low pollution levels, no overcrowding of people, and the natural landscapes made it a beautiful place. Before settling in Perth, she and her family lived in New South Wales and Victoria for 6 years, and Liddy worked as a meat packer when in Victoria. Liddy wanted to explore a new career in the child care industry but she had to obtain the CSWE Level IV before she could enroll in a child care course. At the time of her participation, Liddy was studying for Level III.

Rose

Rose, her husband, and their five children, fled for safety to Zimbabwe from The Democratic Republic of Congo (DRC). Settling in Perth required them to adjust to life in a new country, adapting to urbanised and modern living, and getting accustomed to western culture. Nonetheless, Rose and her family's lives changed for the better; they were happy and felt safe living in Australia. Rose had completed CSWE Level III and Certificate III in a Health Services Assistant course. She worked in the aged-care industry but had to stop working for a while, and had been trying to return to work but could not find a job. Rose planned to study and then work in the child services industry.

Rina

Rina, who was an Indonesian, and her husband, who was a Burmese Rohingyan, were refugees who came to Australia to build a new life and better future for their family. Their oldest son was 10 years old at that time and Rina was pregnant with their second child. They started their journey by boat from Kupang, Indonesia to Christmas Island. They lived in detention centres on the island and in Darwin before they were allowed to live in Perth under the Humanitarian Protection Visa. Even though Rina spoke with "broken English", she spoke confidently. Rina had to speak for her family, since she was more proficient than her husband. Accompanying her husband, Rina played a major role when engaging with the Red Cross, which provided the support for Rina and her family while they resolved their immigration status, the Immigration Office, the Immigration lawyers, her son's teachers and school, the housing agent, the doctor, and so forth.

Participants' Literacy

Data were also collected about participants' first, second and third language (Table 2). L1 is the mother tongue or native language (Lightbown & Spada, 1993). The six participants are a heterogeneous group of migrant women learners with varied linguistic backgrounds and experience with English, which is considered L2 for some participants but L3 for others.

Table 2. Participants' everyday language use

Code name	L1		L2		L3	
	Language	**Script**	**Language**	**Script**	**Language**	**Script**
Suki	Dari	Arabic	Farsi	Arabic	English	Roman alphabet
Rea	Arabic	Arabic	English	Roman alphabet	-	-
Feeda	Arabic	Arabic	English	Roman alphabet	-	-
Liddy	Mandarin	Logographic	Cantonese	Logographic	English	Roman alphabet
Rose	Lingala	Extended Latin	French	Roman alphabet	English	Roman alphabet
Rina	Malay	Roman alphabet	English	Roman alphabet	-	-

The participants' L1 literacies are classified as semiliterate, non-Roman alphabet literate, Roman alphabet and non-alphabet (Bigelow & Tarone, 2004; Burt et al., 2008).

Rea is a *semiliterate learner* as she had limited access to literacy instruction. Rea attended school only between 7 and 9 years old. The school's medium of instruction was Arabic. Even though informal, it could possibly have provided Rea with basic literacy skills. Rea could recognise the Arabic alphabets and the sounds, but was not able to read very well.

Feeda and Suki are n*on-Roman alphabet literate learners* as they are literate in a language written in Arabic. Feeda's L1 is Arabic, while Suki's is Dari. Both languages are based on Arabic alphabets and writing system. Feeda had a complete formal schooling experience in Arabic. Suki's education was interrupted by the war. Both use L1 to make notes in their notebooks and worksheets during non-MALL sessions.

Rina and Rose are *Roman alphabet literate learners* as they are literate in a language written in a Roman alphabet script, which are Malay and French, and read from left to right. Rina completed high school with Malay as the medium of teaching and learning. Rose also completed high school where French was the teaching and learning medium. Being familiar with the Roman alphabet helped Rina and Rose in copying what was on the whiteboard to their notebook, making their own notes in L1 and reading English texts, though adjustments in pronunciations, sounds, and so forth were needed.

Liddy is a *non-alphabet literate learner* as she is literate in a language written in a non-alphabetic script, which is Chinese. Liddy would easily make notes in Mandarin in her notebook or on the worksheet that was given in the sessions, for example, to remind her of the pronunciation, syllables in English, and so forth. Liddy dropped out of high school when she was 15 years old, but had the opportunity to learn basic English and the Roman alphabets before that. As such Liddy could copy English words easily and read simple English texts.

It was observed that participants' L1 literacy level played a role in participants' vocabulary acquisition. The ability to acquire vocabulary and vocabulary skills depends on their L1 ability and how quickly they can adjust to the differences in their L1 literacy and their English literacy level.

Vocabulary Acquisition

All participants were asked to recall the vocabulary that they had learnt after they attended the sessions. The vocabulary was either in the form of a word or a combination of words that made up a phrase. All participants had somewhat acquired the vocabulary after they attended the sessions. Nation and Newton (2009) suggested teaching vocabulary based on the proficiency levels of the learners: *beginners*, *intermediate*, or *advanced*. All participants in this study were at the beginners' level. According to Qian (1999) and Nation and Newton (2009), at this level, a learner should be able to know how each word was spelled and pronounced and the context in which it is most likely to be used. The higher proficiency level learners would know how the word changes if it is a verb, noun, or adjective as well as other grammar information about it and other words that are often used with it (collocation). These were not asked of the participants as their target was only learning for basic conversational skills.

Non-MALL

Each Group 1 participant (Suki, Feeda and Rea) was able to recall some of the vocabulary from the five or more non-MALL sessions they attended.

> Some of the vocabulary that Suki recalled included "occasionally", "sometimes", "often", "always", "seldom" (from the topic on how to express frequency); "may", "please" and "could" (how to ask questions politely); "sideburn", "blonde", "long", "curly" and "wavy" (how to describe types of hair). Being able to recall one word enabled Suki to recall and utter other words.

Suki easily created her own simple sentences using the vocabulary, "Sometimes I come here with my mum" and "The little girl has blonde hair".

Feeda was able to recall the topic about phoning for a taxi quite easily. She remembered that when making any call, it should begin with polite greetings, such as "Good morning" or "Good afternoon". Next, the caller should request a taxi politely, such as "May I have a taxi…" or "Can you send a taxi to …" She also remembered a few of the words that were discussed, such as "location", "destination", "drop-off" and "pick up." Feeda also easily created sentences such as "I drop off my children at school before I come here" and "I pick up my children at 3pm."

Rea recalled a topic about describing body parts and illness. While pointing to parts of her body, she said the words out loud, such as "knee", "back", "shoulder", "chest", "thigh" and "ankle", followed by "back pain", "shoulder pain", "stomach ache", "head ache" and "ear ache". Rea then tried to recall some phrases but struggled to make sentences (corrected grammatically by the researcher) such as "I have bad back", "I have pain in my shoulder", "…very bad pain" and "I have bad headache". Though struggling, Rea was able to utter these because she was suffering from such illnesses and used them when seeing the doctor. Rea would also use these expressions, though in uncoordinated chunks, when sharing her bad weekend with the conversational group when she had to stay home due to the pain.

Group 2 participants (Liddy, Rina and Rose) were also able to recall some of the vocabulary that they learned from attending five or more non-MALL sessions.

Liddy recalled the vocabulary from a topic that described a person's facial features: "sideburn", "part", "moustache", "beard" and "jaw". Liddy found this topic relevant as she said, "It's important to know how to say these things, for instance, when you get mugged, you have to tell the police what the mugger look like". Liddy also highlighted a related discussion on how to describe a person's hair; for example "black, straight and shoulder-length", "curly, long and blonde", "short and spiky", and "bald". Liddy said she then knew how to describe her sons' hair: "My sons have short and spiky hair".

Rina said the activity that she liked was the one where the researcher used the community newspaper to look at supermarkets' weekly catalogues (Figure 1). Rina was able to remember the activity and some words and phrases: "We use the newspaper, we compare how much the price and we see which one cheap", "a kilo of meat", "a bag of potatoes", "a carton of milk", "a dozen of eggs" and "shopping list". Rina also offered these sentences: "I want to buy two bags of potatoes from the grocery store" and "Can you buy for me three cartons of milk?" Rina was easily able to make sentences that used these phrases in the right context.

Rose recalled the topic on "asking permission politely" and the phrases that were discussed: "Is it OK if . . ." "Do you mind if . . ." "Can I…" and "May I…" Some of the possible answers to these requests would be, "Sure", "No problem" or "It depends". Part of the lesson was to make their own questions/requests and the other person to answer, using these phrases. These phrases were new to Rose and most of her peers. Rose found this vocabulary useful as it made questions sound polite. Rose was also able to use the new vocabulary in the correct context.

All participants had somewhat acquired the vocabulary after they attended the sessions. As semi-literate in L1, Rea could not demonstrate great depth or breadth of knowledge about the vocabulary as suggested by Qian (1999). This is in line with Collier's (1989) study that found it would take a long period of time for a non-literate or semi-literate person to learn L2, and some could never catch up with their L1 peers. However, J. Ahmad (2011), Elgort (2011) and Nation and Newton (2009) said, though with this limitation, a learner is able to become proactive and can talk in some detail about a relevant and particular issue if it is a recurring situation. The health issue was relevant and significant to Rea, so with this little knowledge and words embedded in memory, she was able to communicate confidently with her doctor and her peers in the group.

Being literate in L1, though at varying levels, it was easier for Suki, Feeda, Liddy, Rina, and Rose to acquire the vocabulary for the beginners' level proficiency learner as they demonstrated they knew the spelling and the pronunciation of the vocabulary and were able to use them in various situations or contexts as suggested by Nation and Newton (2009) and Qian (1999). More exercises at this beginner level on various topics should be undertaken by all six women for more exposure, more accumulation of words for their word bank, and also more opportunities to use the vocabulary and speak English. As Collier (1989) found, it is easier for L1 literate individuals to acquire L2. Bialystok (2002) and Cummins (1991) said that L1 literacy plays an important role in helping learners become literate in the L2.

MALL

Following the series of 5 non-MALL sessions, Liddy, Rina, and Rose extended their involvement to at least 5 MALL sessions. The MALL integrated vocabulary lessons followed the three steps described above: Step 1 pre-teaching, Step 2 drilling, and Step 3 app based exercises. All three participants recalled activities and vocabulary that were notable to them. The app on the tablet for the exercise was *ThinkEnglish!*

> Liddy recalled that the vocabulary activities she did with the tablet was on the topic of describing people. She remembered listening to an audio announcement about a boy missing in a mall. Some of the information that was given by the announcer was that the boy was Chinese, had spiky hair, and was six years old. She also remembered the next exercise on matching statements with the correct pictures; she said "I just drag to the pictures, no need to use pen and paper". Liddy said she enjoyed this particular lesson because it was similar to the lesson she had in the regular (non-MALL) session about describing facial features. However, this time, she could do more activities with the tablet, such as matching exercises and flashcards while listening to audio of related words/phrase/statement, and they were all repeatable. Some of the phrases that Liddy could recall were: "She's got short, blonde hair", "He's got spiky hair", "He's got a beard and a moustache". Liddy explored other exercises on the app when she finished the one that the researcher tasked the group to do for that day. Liddy also mentioned that she liked the part before she started using the tablet where she learnt about the words first (referring to the pre-teaching vocabulary stage).
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> Rina recalled a video from the exercise "about two woman talking … one have knee and hip problem". Rina said she watched the video a few times because she did not catch all that was being said. She then tapped on the Transcript tab to listen while reading what the people were saying to each other and listening to the correct pronunciation. Some words that Rina recalled were: "I've got a sore throat", "I've got hay fever", "What's the matter?" and "Thanks for asking." Rina recalled another topic about listening to a phone message. It was a message from a car mechanic who was letting "Sam" know the cost for Sam's car repair. Rina recalled the words: "This is a message for ..." and "Call me back". Rina recalled that she did a lot of matching exercises where she could listen to the audio when she "dragged" a statement to match the answer. Rina also attempted a lot of flashcard exercises where there was audio when a statement or a card was swiped. Rina explored and attempted other sections and exercises on the app when she was finished with the one assigned for the day. She also liked that she could stop, pause, continue, and replay everything on the app.
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> Rose recalled the vocabulary from two different topics: one was about describing broken things in the home and one was about how to place an order at a café. Rose thought the activities were not boring her, but she was distracted by the noise and the children in the room. Rose thought it was good that there were many exercises and she could repeat them numerous times. Rose shared the words/phrases that she remembered from the lessons (corrected grammatically by the researcher): "The computer is broken", "The tiles are cracked", "The stove's not working", "Can I have my receipt, please?", "What would you like today?", "I'll have a coffee, please?"

Rose expressed that she was happy attending the non-MALL and MALL sessions because she learnt many useful words but she did not always remember to use them.

Liddy, Rina, and Rose had somewhat acquired the vocabulary after they attended the MALL sessions. They could recall some of the vocabulary that they encountered. As all three were L1 literate, it was easier for them to understand the vocabulary. They were considered to have somewhat acquired the vocabulary because they knew how each word or phrase was spelled, pronounced, and the context in which it was most likely to be used. Being Roman-alphabet literate was an advantage for Rina and Rose because, although they struggled in English, they could practice and try to adjust their L1 and English. Although Liddy used Chinese for reading and writing, her earlier brief exposure to English helped her in reading instructions or texts on the tablet (Liddy was an excellent speaker but struggled to read and write). This is in line with Collier's (1989) study which found it would take a shorter period of time for L1 literate learners to learn L2 compared to non-literate or semi-literate L1 learners. Bialystok (2002) and Cummins (1991) said that L1 literacy plays a significant role in helping learners become literate in the L2.

MALL Learning Experience

For Group 2 participants (Liddy, Rose, and Rina), data on familiarity and use of mobile devices were collected (Table 3 and Table 4).

Table 3. Liddy, Rose and Rina's familiarity with computers and mobile devices

	Number of years of using device			
	Desktop Computer	Laptop	Mobile phones	Tablet
Liddy	12	10	2	-
Rose	7	1	2	-
Rina	-	1	2	2

Table 4. Liddy, Rose and Rina's use of smartphone

	Liddy	Rose	Rina
Make calls	√	√	√
Video chats	√		√
Texting/messaging	√	√	√
Watch movies/videos	√	√	√
Use social media	√	√	√
Navigation - Maps/GPS	√	√	√
Email	√	√	√
Use apps	√	√	√
Listen to music	√	√	√
Play games	√		
Take pictures	√	√	√

Liddy

Liddy did not own a tablet, but after the first MALL session, she was considering purchasing one for herself. She thought owning one would be convenient "so that I can learn something in my spare time." She said the size of the tablet made it easy to carry around compared to her laptop. She could also slip it in her handbag and even use it in bed. She found the tablet easy to use since it had similar features to her smartphone. Since the tablet could access the Internet, Liddy used the online dictionary instead of using her regular electronic dictionary.

Liddy had thought of downloading the *ThinkEnglish!* app to the smartphone, but that would use up a lot of memory and storage. Liddy also commented that the audio and video components of the app provided good visual and listening exercises because it let her listen to a wide range

of conversations by Australians. The various accents let her hear how Australian native English speakers talk. Liddy thought that the presence of the researcher as the "teacher" was important as sometimes she needed to ask questions or clarify some things. The other issue Liddy had was the noise in the room. She preferred if the children could be located in another room so that there would be less noise and everyone could focus better.

Rose

After experiencing the tablet in the MALL sessions, Rose thought that it was easy to use, even though she had never owned or used one before. Rose said, "It's easy to use… quite (the) same with my phone. But it's bigger, I can read the Bible". Rose added, "The tablet (works) like the laptop but cannot type letters. I can get Internet ... I can get a lot of information and answers ... can watch YouTube too. Can watch how they speak English in the videos." Rose also said that it was good that she did not have to write anything down for the exercises; instead, she could select the right answer just by tapping on a picture or icon, or she could *drag* an answer for the matching question or just *swipe* when practicing with the flashcard.

Rose commented that she could not focus much on the tasks because the room was too noisy. The noise came from the attendees of the session who were talking and/or discussing, the children, the tablets when the volume of each tablet was put on high because the user(s) was doing the listening practice part of the app. Rose also had to keep an eye on two children (whom she babysat and brought with her) and the other children who were there as well, who might be playing rough with each other or fighting over a toy. In Rose's words, "I cannot focus so much. I always think about my children. I'm always aware of things because I'm a mother. And there's too much stuff in my head." Rose thought that if her surroundings were peaceful and quiet, she would be able to concentrate better on the tasks.

Rina

Rina commented that, "It's easy to use this tablet. My children have them ... like my phone". Rina said she preferred using the tablet than books for learning English because "I can just use one tablet ... I don't have to carry many books ... heavy. We can find a lot of things from the tablet, like the big computer, it has internet". By watching the videos on the tablet, Rina said she could see the people's faces while they were talking and hear how they pronounce words. She could pause or replay certain parts she missed or did not hear properly. There was also a transcript of the conversation that could be referred to (just by tapping the Transcript button) and flashcards with pictures and audio for vocabulary exercise.

When asked if Rina could do the exercises on the app independently, she said that she might be able to do it at home but was not sure she would do it. She added that she would need a teacher figure and a classroom-like environment to be able to feel like she was learning. However, Rina proudly added that she sometimes used the Indonesian-English dictionary app that she downloaded on her tablet and smartphone. Rina used the tablet interchangeably with her smartphone when finding online information such as recipes and reading the news about Indonesia and Myanmar.

Liddy, Rose, and Rina were able to navigate around the app and the tablet's functionality with ease. These skills were easier to acquire because of their familiarity with the English language (being the language used in tablet), their own English literacy level, their L1literacy and also being familiar with computing devices such as the laptops and smartphones. They also used their own initiative to do extended exercises within the sections assigned and further sections.

DISCUSSION

The study participants reported more positive and enriched learning experience in MALL compared to non-MALL. The design of the MALL lesson includes pre-teaching, drilling, and app-based activities that addressed Krashen and Terrell's (2000) approach, as it included vocabulary content that used listening texts, and authentic texts to provide more impact to learners, specifically, adult beginner level learners. Authenticity in learning should encourage learners' needs and interest to engage in real-life tasks and activities. The MALL lessons included items from both incidental vocabulary learning (J. Ahmad, 2011; Choo, Lin, & Pandian, 2012) and intentional vocabulary learning (Nation & Newton, 2009) approaches. These components of the MALL lessons provided enriched learning experiences compared to the conventional learning approach, where lessons were conducted in a traditional method using a marker, whiteboard, and printout of pictures (to provide visuals).

The app-based vocabulary exercises with embedded audio and video components provided good visual and listening exercises as the learners were exposed to a wide range of conversation topics and characters with varied Australian accents. The tablet, as the mobile device for MALL, had the features and functionality that made this possible (Ball, 2011; Klopfer, Squire, & Jenkins, 2002; Nisbet & Austin, 2013). Participants were given more activities to attempt, such as matching exercises and flashcards, watching videos, listening to the audio of words/phrase/statement or conversations, and repeating the activities. Generally, the activities did not bore participants; in fact, they explored other exercises on the app when they finished with the one tasked.

Tablets are suitable for language learning as they are mobile, portable, and lightweight and can be carried around, as opposed to sitting at a desk with a laptop/computer (Klopfer et al., 2002; Nisbet & Austin, 2013). All participants commented about how the tablets were light and, with their size, could be slipped into a handbag. Participants also commented on how the tablet is "compact" in that they could find a lot of information, they could use dictionaries or translation apps for different languages and have them all in one place eliminating the need to carry physical books or flashcards. The features and functionalities of the tablet as a mobile device are beneficial and useful as it is the tool for the MALL environment. These features and functionalities can be characterized under portability, connectivity, context sensitivity, and individuality and social interactivity (Klopfer et al., 2002).

> *Portability* refers to how both the user and the tablet is portable and that the tablet can be used online and offline. The *ThinkEnglish!* app that was used for the MALL lesson was downloaded onto the tablet, thus learning can take place without constraint, anytime and anywhere, provided the tablet has battery life available. However, for this research, the participants only used the tablet when they attended the MALL session at the community centre.
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> *Connectivity* refers to the ease of connecting the tablet to the internet for access to learning material. In this study, the app was downloaded using the Wi-Fi connection available at the community centre. The internet was used by participants to search for information such as the translation of an English word to their L1.
>
> *Context sensitivity* refers to the context awareness of the app with users' interaction. For example, participants interact with the app interface by tapping, dragging or swiping their fingers on a button or a bar. The app is designed for easy navigation for beginner English learners. The participants are also alerted, by highlights or blinking cues and prompts, for correct or incorrect answers. Alerts are also shown when participants completed an exercise and ready to move on to the next level. This feature is similar to their smartphones, only the tablet has a larger screen.
>
> *Individuality* and *social interactivity* features of the tablet refer to personalized or customized learning that the participants can choose. Participants can learn vocabulary at their own pace, repeat the lesson, replay audio or video, pause, go back, forward, or skip some parts of the app. Participants have a choice of using the tablet individually and personalizing their learning, or learning collaboratively with other participants.

However, in providing a MALL-integrated vocabulary learning environment for migrant women English learners, a number of factors need to be considered; for example, the selection of the language learning app as the learning material, the learners' target skill, L1 literacy, English literacy level, or any combination of these (K. S. Ahmad et al., 2015). As some participants said, there is also the need of a teacher/tutor figure to guide and support them to learn. The presence of the teacher/tutor figure provides some form of structure or control, to ensure the lesson goals are achieved even though the learning setting is non-formal, and so as to ensure the participants' learning needs are met.

CONCLUSIONS

This paper reported on the positive effects in six migrant women's vocabulary learning in a non-formal environment after undertaking a series of non-MALL vocabulary lessons, as well as enriched vocabulary learning experienced by three of these women after undertaking the MALL vocabulary lessons. The participants have lived in Australia between 2 to 12 years, but still struggled with English, especially spoken English. The participants' immediate concern was their speaking skill, which was their incentive for attending the conversational program. The other skills – listening, reading and writing – were not of immediate concern as these skills required a formal learning that they were not interested in.

For practitioners wanting to implement MALL, the MALL lessons offered should follow three steps: Step 1 – pre-teaching of vocabulary and phrases; Step 2 – drilling to help practice fluency and become familiar with how the words and phrases are used; and Step 3 – completing the exercise using the app downloaded on the tablet.

The findings show that some form of vocabulary acquisition occurred in women from both non-MALL and MALL environment, where the MALL environment provided significantly enriched vocabulary learning experience. The study demonstrates that it is feasible to utilize MALL for migrant women to learn vocabulary, in a non-formal environment, provided the design of the MALL lessons are based on these considerations:

- Utilise the features and functionality of the tablet and as they contribute to the enriched learning experience.
- The selection of the vocabulary app for MALL must consider L1 literacy, L2 proficiency level, target skill of learner, topics of interest to participants with authentic content, useful, and relevant for everyday use.
- How L1 literacy affects vocabulary acquisition in L2.
- The naturalistic and non-formal feel of the learning environment to be maintained even with the insertion of the tablet as a learning device.
- The learners should be given the opportunity to collaborate, engage, and interact with their peers and should also be able to use what they have learnt to communicate meaningfully with people.

A limitation of this research was that, during the tablet/app-based activity in the MALL sessions, research participants did not have the opportunity to pair themselves with partners with similar L1 literacy, English proficiency level, and experience in using a tablet. All attendees of the MALL session had varied L1 literacy and English proficiency backgrounds. Unequal pair-work resulted in slowing down of activities due to interruptions, for example, time needed to explain or translate instructions from English to another language, or explaining how to operate the tablet. A possible solution would be for each learner to have their own tablet rather than sharing with another learner.

Future recommendations for this research include:

- Developing a method for measuring the effectiveness of MALL for vocabulary acquisition among migrant women in a non-formal setting. A quantitative study with a larger number of

women could be undertaken provided that a standardised benchmark is used to group the women based on L1 literacy level and English proficiency level.

- A study on the MALL design and implementation for personalized learning for migrant women learner. This could include the development of an app that uses L1 as a supporting language.
- A comparative study on the impact of MALL on migrant women from different countries as each country has unique education system and literacy background.

In conclusion, this research has shown that MALL is feasible for migrant women language learners, not just for the usual population of studies who are literate in L1, familiar with English, and are educated in a formal and structured learning environment. This paper advances the research in MALL, where migrant women's vocabulary acquisition and learning experiences are enriched and enhanced even though they possess varying levels of L1 literacy, varying levels of English proficiency, and the only opportunity to learn and use English is through non-formal learning settings. With vocabulary acquisition, the size of their word bank is increased, therefore increasing their confidence in engaging in conversations with other people in the wider Australian society.

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THE IMPACT OF E-SKILLS ON THE SETTLEMENT OF IRANIAN REFUGEES IN AUSTRALIA

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ABSTRACT

Aim/Purpose	The research investigates the impact of Information and Communication Technologies (ICT) on Iranian refugees' settlement in Australia.
Background	The study identifies the issues of settlement, such as language, cultural and social differences.
Methodology	The Multi-Sited Ethnography (MSE), which is a qualitative methodology, has been used with a thematic analysis drawing on a series of semi-structured interviews with two groups of participants (51 Iranian refugees and 55 people with a role in assisting refugees).
Contribution	The research findings may enable the creation of a model for use by the Australian Government with Iranian refugees.
Findings	The findings show the vital role ICT play in refugees' ongoing day-to-day life towards settlement.
Recommendations for Practitioners	The results from this paper could be generalised to other groups of refugees in Australia and also could be used for Iranian refugees in other countries.
Recommendation for Researchers	Researchers may use a similar study for refugees of different backgrounds in Australia and around the world.
Impact on Society	ICT may assist refugees to become less isolated, less marginalized and part of mainstream society.
Future Research	Future research could look into the digital divide between refugees in Australia and main stream Australians.
Keywords	e-Skills, ICT, settlement, refugees

INTRODUCTION

Our society encounters many changes over time and, as a consequence, demands new skills of its members. The Internet is one of those changes that, because of the massive increase of digital in-

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formation available, plays an important communication role. As a result, our digital society has become more dependent on the information provided by the Internet, so computer and Internet skills (digital literacy) are of vital consideration (Rana, 2017; Scarcelli & Riva, 2017; van Deursen & van Dijk, 2011; Yu, Lin, & Liao, 2017). However, while digital literacy is important for society as a whole, it is particularly crucial for refugees settling into a new country and thus removed from their previous communication channels. It is, therefore, appropriate to study how modern technology assists refugees in the establishment and maintenance of social relations across the boundaries of homeland and hostland (Wahlbeck, 2002).

Defining human migration is a complex undertaking. The study of human mobility has caught the attention of scholars in social sciences, including the study of migrants' and refugees' settlements in their respective host countries (Tsagarousianou, 2004). According to Sinha (2005), there has not been an explanation of migration that is capable of covering all aspects of the scales of local, regional, national, and international migration and that could be acceptable universally. Lee (1966) defines migration as a change of residence, whether this change is temporary or permanent, regardless of any limitation in distance or whether the move has been forced or voluntary. Eisenstadt (1953) defines it as the physical move of an individual from one society to another. Bernard (1976) divides humans' movements into two sections, depending on the reasons for their movements. While he believes that moving from one place to another is humans' "age-old characteristic," those who move by choice are voluntary immigrants while those who move because they are forced to are refugees. According to Bernard, immigration as individual movements has only been a recent phenomenon; immigrants decide by themselves to plan and move, whereas involuntary migration is based on terror and fear. What is important to note is the distinction that voluntary immigrants make a confident choice of moving to a better country, with plenty of time to plan their migration "practically, psychologically and systematically" and therefore have time to gain such skills as competency in the language of the hostland as well as other skills that may help them to settle faster (Tribe, 2002, p.241). However, involuntary immigrants flee their home country in a hurry and do not have time for any immigration planning.

As part of a satisfactory settlement, refugees want to have opportunities to establish themselves in their new country. This is greatly dependent on the host country's tolerance of other cultures and whether it is a homogeneous or a multicultural country. Although refugees' backgrounds and their "cultural preferences" along with "social, political and personal factors" play significant roles for their satisfactory settlement (Colic-Peisker, 2009), refugees' level of satisfaction does not solely depend on these, as the host country also has a part to play at both the government and social level. For example, if the community is hospitable, it is much easier for refugees to integrate. The hospitality of the host country is seen to empower the refugees' sense of self-worth and dignity, assist them in finding housing and employment, become financially independent from governmental assistance, and gain full control of their own destiny.

Australia had a "white" policy since the establishment of its federation on 1 January 1901; that is, it effectively banned non-European immigrants. However, this policy was gradually phased out after World War II and the Racial Discrimination Act of 1975 ensured that migration selection based on race was unlawful. As a result, multiculturalism has become a central element of the country's identity (Bouma, 2016). According to the Refugee Council of Australia (RCOA), Australia's refugee intake is now 20,000 per year (RCOA, 2017).

The research reported in this paper is part of a larger study that aims to shed light on Iranian refugees in Australia. According to Gifford and Wilding (2013), ICT can play a significant role in refugee settlement due to the additional opportunities it provides. Thus the study examines the impact of Information and Communication Technologies (ICT) on the settlement of Iranian refugees' who reside in Australia. This paper focusses on e-skills as one component of ICT impact.

LITERATURE REVIEW

In addition to studies focussed on migration in general, research about refugees is an important topic among academia and policy makers (Allen & Morsink, 1994; Simich, Beiser, Stewart, & Mwakarimba, 2005). There are ample statistics about refugees (e.g. Crisp, 1999; UNHCR, 2014); however, while it is important to know the statistical data, they do not communicate the human experience of refugees fleeing their country of origin to escape persecution. A greater understanding is needed of how refugees are able to find a country to provide shelter, to settle and reconstruct their identity there, be able to reunite with their families, and to raise their children. There are significant differences between the two groups of immigrants; refugees have stronger political ties to their homeland which are different from the ties voluntary immigrants have to theirs (Wahlbeck, 2002). That is why e-skills are important to refugees, who are concerned about their homeland and the wellbeing of the people they left behind including their family, extended family, and friends. By the same token, the refugees' families and friends are equally concerned about the wellbeing and safety of those who managed to flee. Kunz (1973) shares a similar view by stating that the refugees' relationship with their homeland and the hostland, in which they have settled involuntarily, is distinctive as they did not want to leave their home. This relationship, therefore, contributes to the distinction between refugees and immigrants.

Refugees play a significant role on a global scale. According to Lee (1966), some people have powerful reasons for embarking on a migration process. Many migrate to another country because of changes in the political, cultural, or economic situation of their country of origin or even because of war. This is the case for Iranian refugees. A combination of these changes occurred in Iran during the 1979 Islamic revolution, followed by eight years of war between Iran and Iraq, which in turn destroyed Iran's economy and caused an Iranian diaspora around the world.

Historically, Australia has been a popular destination for immigrants. Australia facilitated the arrival of the European immigrants during the first half of the 20th century (Penman, 1979); recent immigrants, though, are from all over the world. There had been a minimal number of Iran-born immigrants to Australia prior to 1979. Those who did migrate were mostly related to the oil industries (DIAC, 2011). However, the Islamic revolution ignited an influx of refugees. Therefore, the timeline for this research covers Iranian refugees from the 1979 establishment of the Islamic Republic of Iran based on strict Islamic law to the present time, as the political situation in Iran continues to deteriorate.

In today's modern society, online technology has made it easy to have access to knowledge (Halliday-Wynes & Beddie, 2009). This may be achieved through many different platforms on the Internet, including by the use of social media and browsing the Internet. Access to ICT and the knowledge of how to use them are some of the important issues, not only in local but also in global economic developments. ICT act at the core of accessing information and participating in social life and political events. It helps a nation's citizens to gather, diffuse and share information. It also allows for better communication and group interaction. According to Selwyn (2006), researchers could see the increasing benefits of ICT and were concerned about people who were excluded, resulting in a widening gap between those with access to information and knowledge and those without. These technological capabilities facilitate opportunities for marginalized individuals to participate in social and political life (Shirazi, Ngwenyama, & Morawczynski, 2010). Refugees are no exception as they might use these platforms to learn about their new homeland, promoting social inclusion in the community (Urquhart, Underhill-Sem, & Wilding, 2009). As one example, a study conducted by Healy et al. (2004) that looked into new migrants and their experience of the labour market in Australia, found a correlation between the migrants' earning and their level of satisfactory settlement. Those who could find employment matching their skills and who earned an appropriate income experienced more satisfactory settlement than those with jobs that did not match their skills and were therefore underemployed. This could be because forced migrants, who held humanitarian visas, were not selected to settle in Australia based on their skills and, therefore, experienced more difficulty in the labour mar-

ket. Judge and Watanabe (1993) also agree that there is a correlation between life satisfaction and employment.

As part of Australia's assimilation policy between 1945 and 1975, and the Nationality and Citizenship Act of 1948, voluntary immigrants who want to become Australian citizens are expected to have a good command of the English language and to assimilate (Pietsch, 2013). Being competent in English is not only useful for new Australian citizens, but also for involuntary immigrants, that is, refugees. Therefore, English competency must be given high priority for refugees' settlement in their new home. Also, providing refugees with information about health is beneficial and this is what the Integrated Humanitarian Settlement Strategy is hoping to achieve as information could be used as a preventative factor to maintain a good degree of health status. The use of ICT could also greatly help refugees to achieve this goal as they could access relevant websites to learn about the information provided (DIAC, 2009).

However, Al-Saggaf (2011) found that people are online for reasons other than information seeking, for example, joining online communities for socialising, relaxing, improving relationships, having fun or, for some, simply filling in time. Therefore acquiring computer and Internet skills provide opportunities for social inclusion as well as information (Riding & Rayner, 1995), which is particularly important for Iranian immigrants. The Iranian diaspora in Australia is made of heterogeneous groups as they stem from different political, religious, linguistic, educational, cultural, and social backgrounds within Iran. Although they have many differences, the Iranian refugees share a common country and a common enemy, that is, the authoritarian regime from which they fled. Therefore, they have the urge to establish a social relationship with other Iranians based on common grounds as well as a "cultural heritage and sense of ethnic honour" (Adibi, 2008, p 103).

These connections could be facilitated and maintained through the use of ICT, which may enable individual diaspora communities to become globalised. Furthermore, they can link to diaspora groups in other parts of the world. The Internet is therefore an important tool and a highly valuable framework for the diaspora's construction of identity and social networking.

METHOD

There is limited literature on the ICT practices of Iranian refugees in Australia and other regions in the world. Falzon (2004) claims that anthropologists, who were researching communities such as immigrants, could see that ethnography, in its classic form, was an inadequate methodology. The multi-sited ethnography (MSE) methodology was initially proposed by Marcus (1995) and since then widely accepted by researchers, as it facilitates interdisciplinary research. According to Marcus (1995, p. 96) MSE or "mobile ethnography," steps outside the single-site and goes beyond locality. It explores the distribution of "cultural meanings, objects and identities in diffuse time-space" and is an effective way to trace the formation of cultures by establishing connections among sites. Falzon (2016) explains what an actual multi-sited research is by having two conditions met. The first is spatial displacement: a precondition that means the research must be conducted in at least two or more locations. The second is that the sites must be scattered or separated from each other. He indicates that the sites do not need to be extremely distant from one another, as in different countries, but they could be multiple locations in one country. The difference between the sites distinguishes MSE from the original ethnography.

Since this study investigates the online behaviour of refugees in different locations in Australia, MSE is an appropriate methodology. Hine (2007) concludes that, for science and technology studies, it is convenient to use MSE. She suggests the researcher has to study the differences among individuals, institutions, and identified groups, withholding judgement about the impact of location. Therefore, MSE, complemented by a thematic analysis drawing on a series of interviews, has been selected as the methodology for this research as it offers a theoretical framework for a refugee diaspora study, which is not limited to the traditional localised and single-sited ethnography. Since participants were located in different sites around Australia, MSE can explain the experiences of refugees' unique so-

cial networking and the relationships they create within each site. This connection has been strengthened by the use of technology, specifically ICT, with a focus on what e-*Skills* support refugee settlement.

Participants

Although refugees in Australia are from a vast number of countries, in order to ensure that the research was manageable, it was decided to focus on one nationality only. Since the researcher is of Iranian background, is familiar with both Iran's and Australia's cultural values, and is bilingual (Farsi and English), Iranian refugees are the focus of this study. Dwyer and Buckle (2009) believe that a researcher with insider status would be more accepted by participants and make them feel more comfortable, open, trusting, and relaxed, which would provide a better opportunity for a richer data collection. Miller (2004) believes that developing trust is a prerequisite for the researcher to conduct effective interviews. Gummesson (2000) indicates that the researcher's existing experience and knowledge for the research topic is valuable; he refers to it as "pre-understanding". The researcher can use this insight when asking the questions, knowing which topics are considered taboo or not acceptable to bring up, and which topics are considered legitimate.

In order to cover ICT and refugee settlement from different perspectives, the research focused on two different groups of participants. The first group was comprised of 51 adult Iranian refugees in Australia who were able to relate their experiences first-hand. All these refugees came to Australia between 1979 and 2015. The gender ratio was 32 (63%) males and 19 (37%) females. The age of the group was diverse, ranging from 18 to 70+. However, there were not many in the higher age range, which may be due to lack of ICT skills among older refugees. The majority of the refugee group's age range was in the 30-39 bracket (n=20). Their level of education ranged from lower than high school to postgraduate (Table 1).

Table 1. Educational level of refugee participants

Educational Level	
<High School	5
High School	20
Undergraduate	22
Postgraduate	4

The second group was comprised of 55 participants who worked either as volunteers or in a paid role for a variety of organisations including government and non-government organisations (NGOs) that dealt with refugees from any background and assisted the refugees in their settlement process. Similar to the refugee group, their ages ranged from 18 to 70+. The majority of the non-refugee group was in the 50-70+ bracket (n=18). Twenty-nine (53%) of the non-refugee group of participants worked for government related organisations, while 26 (47%) worked with NGOs. Their number of years of providing a service to refugees ranged from 1 year to 35+ years with the average being 11 years.

Instrument

In this study, semi-structured interviews were used to collect data. Since the study was exploring e-skill issues from both refugee and non-refugee perspectives, separate questionnaires were developed for each group. The questions for the refugee group were about their perception of integration, issues using ICT, their ICT usage, and how ICT could help refugees with their settlement. The questions for the non-refugee group addressed issues such as whether refugees needed to have access to ICT, whether they had sufficient e-skills to use ICT properly and, if not, what kind of training they needed to assist them in their settlement journey (see Appendix).

The interviews were audio recorded where agreed to by participants and later transcribed. The non-refugee interviews were conducted in English while the refugee interviews were conducted in Farsi, with one exception where the refugee participant was confident with English.

Both questionnaires were based on the MSE framework by constructing a series of topics that would help the researcher to look into participants' experiences and their thoughts on satisfactory settlement and integration. All interviews began with demographic questions, while the remaining questions varied for the different groups. For non-refugee participants, questions were about the refugee organisation they worked for, followed by ICT related questions. For refugee participants, the questions were concentrated around technology background, Internet costs and usage. The duration of the interviews was approximately 30 minutes but varied depending on the participants' elaboration on responses.

Data Collection

The interviews were conducted between March and August 2015. The location of interviews varied due to the preference of individual participants (public locations convenient to participants or, rarely, by phone). At the end of each interview, the interviewer provided an opportunity for the participants to amend their responses and provide feedback if needed. In line with Falzon's (2016) recommendations, the selection of interview locations was based on the concentration of Iranians. According to the Australian Bureau of Statistics (ABS), three cities in Australia accommodate the highest number of Iran-born people (Table 2).

Table 2. Iran-born distribution in Australia

Location	Number	Percentage
Sydney, NSW	14,605	42.4
Melbourne, VIC	6,978	20.3
Perth, WA	3,397	9.9
Rest of Australia	9,475	27.4
Total Australia	34,455	100.0

Source: ABS (2014)

As is seen in Table 2, 24,980 (73%) of Iran-born migrants (whether forced or voluntary) reside in the capital cities of three Australian states (Sydney, NSW; Melbourne, VIC; Perth, WA), and therefore it was decided to collect data from these cities. Data was also collected from Wagga Wagga, NSW, a city well known as a regional settlement location that accommodates refugees from all over the world, including Iran. It also has numerous government organisations and NGOs working in the city. Table 3 shows the number of interviewees in each location by state.

Table 3. Interview locations and participants

State	Number of Participants
New South Wales	36
Victoria	34
Western Australia	36
Total Australia	106

Data Analysis

The data from 106 interviews were used for analysis. The Statistical Package for Social Sciences (SPSS) software was used for basic statistics on demographic data and NVivo was used for coding and thematic analysis. Thematic analysis finds patterns in data and provides detailed explanations (Braun & Clarke, 2006). This method helps to understand the ideas that emerged during the interview (Aronson, 1994).

All the audio data were transcribed and the names and other specific identifiers were removed. Several themes surfaced and were coded and used for analysing the participants' experiences, points of views and concerns that they had come across. Once the themes were sorted, sub-themes emerged that helped further understanding of the impact of ICT on Iranian refugees' settlement.

RESULTS

In this study, data were collected, transcribed, and analysed, with several themes being identified. One main theme that emerged that is relevant to this research was *e-Skills*, which refers to the competencies Iranian refugees require to support their settlement. Under this main theme, two subthemes of *English competency* and *Acquiring computer and Internet skills* emerged (Figure 1).

Gaining these skills may provide the possibility for Iranian refugees to accelerate their journey towards satisfactory settlement. For example, acquiring English competency should assist with gaining employment in an English speaking country such as Australia. Although competency in English is not dependant on ICT, as the refugees could learn to read, write, and speak English through the traditional way of attending English language classes and reading hard copies of English language books, it can act as a facilitator.

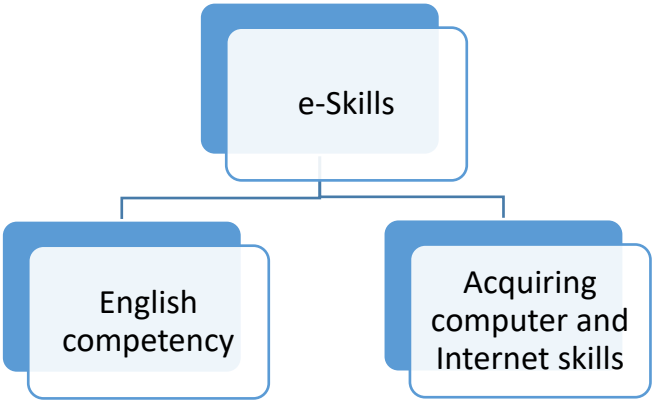

Figure 1. e-Skills theme and sub-themes

Prior to discussing the two sub-themes, it is essential to note the importance of *e-Skills*, acknowledged by both the refugee and non-refugee groups.

> *[Note: Participants are identified by a pseudonym: Iranian names refer to refugee participants; Western names refer to non-refugee participants. Location is identified by a letter (e.g., M refers to participants in Melbourne). Q refers to the survey question the comment addressed.]*
>
> > If they can teach English language and Internet skills to refugees, it will be very valuable as everything these days are done through the Internet. All the offices are using the Internet. For example, if you want to buy a ticket you use the Internet, if you want to reserve anything, you use the Internet. ICT has made life very easy (Mahmoud_M, Q6).
> >
> > Australia has everything online, anything such as applying for driver's license and anything else, you need to get online and therefore need to have skills to do it. Internet skills are always useful anywhere you are, and anywhere you go (Ahmad_M, Q6).
> >
> > I need to take up some computer classes to improve my computer technical skills (Davood_P, Q2).

> I still have a bit to learn […] [to] improve on English language skills (Taleb_S, Q1)
>
> The refugees must be given computer and Internet skills […] also teach them the English language so that they could use the Internet efficiently. English language, computer and Internet skills and access are vital to refugees (Aidah_M, Q4).

The non-refugee participants highlighted different aspects of skills. Cherry_W believed that, among other barriers that refugees may encounter, "sometimes language is the biggest barrier". Another non-refugee participant, who was working in a paid work capacity for Organisation A dealing with refugees, as well as working for Organisation B in a voluntary position assisting refugee clients, echoed these views:

> With the online self-help and self-service that now comes with the job network agencies and other services as well, like public services, language is a real barrier to our clients accessing those services (Angela_W, Q5)

An academic participant mentioned an important point about social exclusion:

> If you don't have skills, money or access, it is a serious barrier for refugees […]. It is social exclusion in the community (Lily_P, Q1).

Furthermore, these skills should be continuously updated with advancements in ICT:

> I don't think everyone [every refugee] has necessary skills […] basic skills are required but also keeping up to date [with ICT skills] is also required (Cherry_W, Q2).

Therefore, the importance of skills is appreciated in both groups of participants and indicates the perception that skills are vital to refugees' settlement. The following section reports on the findings of data collected from both refugee and non-refugee participants relevant to *e-Skills*.

English Competency

Refugees discussed the importance of English competency on multiple occasions in their interviews and it was perceived as fundamental to resolving other issues (e.g., understanding Australian laws) affecting satisfactory settlement:

> The English language is also very important. This will be an investment for the country as a whole as who knows may be one day a refugee could become a Prime Minister. Look at Obama who is Muslim[1] and African American and now is the most powerful president in the world. The English language can be very influential for refugees (Mohtaram_P)

Although the questions these refugees were asked varied, they all related their answers to English competency:

> It was very hard on first days as I did not know English language (Mahmoud_M, Q1).
>
> More important help is to teach them English language (Mahmoud _M, Q4).
>
> Mainly I have English language problem. Once I learn English properly, Australia will be just like my own country (Mamad_P, Q1).
>
> My only problem is English language (Mamad_P, Q2).
>
> If you have good command of English, it would be great (Mamad_P, Q3).

[1] NOTE: Obama is Christian

> The technology has advanced and we should advance ourselves with it too. Iranian refugees could use YouTube and learn English there (Mamad_P, Q6).
>
> Some English language issues (Rashid_S, Q2).
>
> I have learnt English through Internet (Rashid_S, Q3).
>
> Teach them [refugees] English (Rashid_S, Q4).
>
> I want to improve my English language, so only browse English websites (Rashid_S, Q8).

Language can also be critical in the choice of host country. When they were asked about why Australia was chosen as a settlement destination, one refugee replied:

> It is important that Australia has the English language. I had opportunity to go to Germany instead, but I chose Australia as I could speak some English and no German at all (Narges_S, Q5).

The above quotes indicate that refugee participants perceived acquiring English competency as imperative. The following illustrates the non-refugee group's thoughts about the importance of English competency, particularly when acquiring ICT skills:

> I think we said age seems to be quite determinant and also language if you can't read English and things are available in English. And things about health materials, a lot of them are put on the Internet in pdf, and they're translated. Searched don't pick them if you google it and put a search in your own language, it won't pull out those resources. So it's lots of problems, with that as far as using the Internet as health resource and English skills (Carol_S, Q2).
>
> I think wouldn't be a bad idea for the part of the settlement process and learning English language classes (Lesley_M, Q2).

Other comments from the non-refugee group about English competency included:

> I know that a particular, the daughter is coming to do some training here and the father is totally illiterate in Australian language and is very isolated because of that (Louise_W, Q1).
>
> Absolutely they need more training. They definitely need more time than what government now sets them up for TAFE level of going straight into an English program. There're so many people who slip through the cracks, they are not catching the language in the 12 weeks that's allotted to them. So where do they go for that, pretty much they have to pay and they can't afford to pay, so they become more and more isolated in the community (Louise_W, Q2).
>
> They need more training. Simply because most of them are struggling with the English language (Adele_P, Q2).
>
> The issues that I've seen have been more about their English language (George_M, Q3).
>
> Yeah, so much easier. I think it also assist with their language, they can. Some of my Iranian friends say oh yes, I am teaching myself English on computer. Not quite the same as if they are going to class, but I think they can utilise that (Casey_M, Q4).
>
> They can also improve their English and people can take study online (Tracey_M, Q5).

> They will be English teaching, if they can do their homework on their computer at home. If they could link into their English teaching. Greater and quicker acquisition of the English language is very important with respect to your sense of success or merging in with the dominant society (Deb_W, Q5).
>
> Learning English, learn what they want to study, find work (Kevin_P, Q5). Yeah I think it's a way for them to access information about Australia plus it's a way for them to practice English (Shirley_P, Q7).
>
> Learning English give them satisfaction that Ok, I can speak English, I can be part of this life now, I can go to the shop without fear of people looking at me in a weird way because I can't express myself (Mary_M, Q8).

Therefore, English competency is a skill that is perceived to be vital to the settlement of Iranian refugees in Australia.

Acquiring Computer and Internet Skills

The computer and Internet skill levels of refugees may vary from non-existence to an advanced level, depending on their background and what happened to them from the time they left their country until the time they were accepted as refugees in Australia and continued from then on. Although some refugees have ICT skills, it is perceived as essential that all refugees be competent in these skills to assist in their settlement. The following are comments from two non-refugee participants in relation to the refugees' situation while being kept in a refugee camp. While one emphasises education, as well as the journey taken, the other focuses on the lack of facilities during that journey:

> People who have been in the camps […] come with a very limited ICT skill. It hardly depends on the country that they have come from, but the journey that they've made and their educational level (Jude_M)
>
> A lot of the refugees that arrive here in Australia have perhaps been in refugee camps for several years before coming here […] and in that time you've not developed any skills […] many of the refugees who come, need training (Albert_P)

In response to encountering problems while using the Internet, participants said:

> I only have basic computer and Internet skills, but I am busy with work. When I find some spare time, I need to take up some computer classes to improve my computer technical skills (Davood_P, Q2).
>
> Lack of Internet skills (Taleb_S, Tahereh_S, Maha_S, Q2).

When participants were asked about how ICT could help them, these are some responses:

> It helps [refugees] to brush up on their skills and become employable and regain their independence and become more confident. It bridges the gap between Iranian refugees and mainstream Australians (Zarrin_M, Q3)
>
> Of course, it is beneficial to them, why not, although I cannot use the internet a lot due to my lack of knowledge, but many young Iranian don't even know what the internet is and what computer is and have never seen a laptop, but it takes time to learn about it (Hajar_P, Q3)

In response to a question about what ICT-related services should have been provided to refugees, 31 (60%) refugee participants agreed that they needed to be taught how to use computers and the Internet, as gaining such skills would contribute to their independence. Example responses include:

> They should learn ICT, so that they could do their own stuff, pay their bills, easily communicate with their families at home and see them online (Saghi_S, Q4).

> All of the above needs to be done for them to help them to become independent and settle (Zohreh_S, Q4).
>
> The government should provide teaching Internet to refugees to help them settle easier in Australia (Bahram_P, Q4).
>
> Computer and Internet skills and access are vital to refugees (Aidah_M, Q4).

Therefore, refugees perceive that, once they learn how to use computers and the Internet effectively, they would be able to do 'their own thing', independent of others. These comments show that refugees insist on the need for ICT skills in order to use the Internet effectively, which in turn would help them with their settlement.

When non-refugee participants discussed their views about whether refugees had sufficient ICT skills or needed more training, 18 (35%) expressed a need, for example:

> They need more training. […] if I went to Iran, I'm sure I would need training, some systems are the same, but some are not (Adele_P, Q2).
>
> A lot of them need more training on how to use the laptop; there are people that they haven't even seen a computer. (Wilma_W, Q2).

When asked about their thoughts concerning the ICT training types that would help refugees, several different suggestions were made, but the majority agreed on one thing, that is, refugees need to be taught basic Internet skills:

> Probably the basic, we do a basic keyboard skill, something like that. Understanding the Internet. (Karen_W, Q3).
>
> Training on basic skills on how to use the PC, how to use the internet and the search engine, how to create email address and write emails (Sue_P, Q3).
>
> If you are talking about basic skills, being able to browse, use the Internet to be able to access to information and also emails. Also the use of Facebook and social media things (Lily_P, Q3).
>
> May be some basic computer training, in terms of how to use programs like word and excel perhaps but social media is a really important one, Skype to connect with family, email is very important, those kind of things (Cindy_P, Q3).

One non-refugee participant said that all those refugees who contacted her already had ICT skills due to the type of assistance she was providing to refugees and a few believed that whether refugees had ICT skills or not, it did not make any difference to the nature of their jobs as the ICT skills were irrelevant. However, 51 (91%) non-refugee participants agreed that, if the refugees had ICT skills, it would have made their job easier to help refugees. The following are some examples of those positive responses:

> Would probably allow them to feel more valued because it's fairly well everyone is up with smart phones and technologies these days, for those people who are a bit older, I think they feel very left out. And not confident in coming to a training facility like this because of language barriers and lack of technology skills (Louise_W, Q4).
>
> Absolutely, look, community leaders who are good at accessing Internet, quite a lot they can do with them. They can send me documents and let me review. If they know how to use track changes, I can do track changes and send the document back to them. So the use of email and use of Microsoft Office is quite useful, in terms of community development work. Also if they know how to use social media to promote their community, I think that's the next level as well. It's

> about connecting, when you think of yourself as a community leader, you need to know how to use social media to promote the work of your community (Julie_S, Q4).

Additionally, some interviewees explained how else ICT could help refugees:

> [ICT skill] has been very valuable thing [asset] for them [refugees] coming and learn [ICT skills, e.g.] learn to Skype with their grandchildren (Louise_W, Q5).
>
> So I think if there's some way they can research Australia, look at things, find out the local area. If they have those researching skills, they can find good answers to their questions […] Probably just to help them assimilate, it would be better (Karen_W, Q5).
>
> Finding out about the opportunities available, finding out about the skills and how you develop the skills. After all, a lot of what we actually use computers for is to help people develop their knowledge and their skills simultaneously (Albert_P, Q5).

As it could be seen from the quotes above, obtaining both English competency skills and ICT skills are seen as central to the settlement of Iranian refugees in Australia.

Connecting English Competency and ICT Skills

Although most of the non-refugee interviewees' organisations did not directly teach English to refugees, a number of non-refugee participants linked the acquisition of English competency to services (specifically ICT skills) provided by their organisation. One participant responded to the question as to whether their organisation taught ICT to refugees by explaining:

> We are going to teach them English using the iPad. A lot of men and women in the community are illiterate. We are going to use games and applications uploaded to the iPad and will show them the pictures so that they can match the picture with words (Tracey_M, Q6).

Many refugees also linked English competency to the acquisition of ICT skills. The first element of this relationship addresses ICT as an aid to learning English. In response to a question regarding their thoughts and feelings about the experience of settlement and the use of ICT, 18 (35%) refugee participants referred to the importance of learning English; for example:

> The technology has advanced, and we should advance ourselves with it too. Iranian refugees could use YouTube and learn English there. The Internet is unlimited; refugees could use the Internet to advance their lives. The refugees could stay connected with their family in Iran and their friends in diaspora around the world. They could watch movies with English subtitle to learn English (Mamad_P, Q6).
>
> The refugees at first need to use ICT to learn the English language so that they could start communicating with people in the new place (Maher_P, Q6).
>
> The first and most important thing that will help to connect with mainstream Australians and also find job is to learn the English language through the Internet (Nasim_M, Q6).
>
> The Internet makes refugees socialise with Australians, and it helps refugees to learn English (Ramezan_M, Q6).
>
> The Internet helps refugees to find employment, learn English (Zohreh_S, Q6).

The second element of the English competency and ICT relationship refers to English in the use of the Internet. When asked how language deficiency impacted their daily lives, 24 (47%) refugee partic-

ipants mentioned it being a factor in not being able to fully use the Internet. This was also evident when they were asked about common problems they had experienced while using the Internet, for example:

> My only problem is English Language (Mamad_P, Q2).
>
> English language, have to use translator online (Ahmad_M, Q2).
>
> English language issues and lack of Internet skills (Tahereh_S, Q2).
>
> Some language problems that I will check the Internet to look up for English words that I don't know the meanings (Bahareh_P, Q2).

When asked about what languages they use when browsing the websites, 42 (82%) refugees used both English and Farsi and some used a third language. However, although 4 (8%) wanted to use English websites, they were restricted to Farsi language websites:

> Persian (Farsi), as my English is bad (Parvin_P, Q8).
>
> Persian (Farsi), I tried English sites but have English language problems (Davood_P, Q8).

There was just one participant who preferred English websites due to the issue of accuracy of information provided on Persian websites:

> English, I don't believe that Iranian websites provide accurate information (Mostafa_S, Q8).

When the questioned about how ICT could help Iranian refugees, these are some of the responses:

> It is very good for refugees. The use of Internet can help refugees fix their own problems and have less dependency on government, and it saves government money as for example I have learned English through the Internet and didn't need the government provides translation services for me. So this saves government money (Rashid_S, Q3).
>
> Learn English language, look for employment and settle in Australia (Jafar_P, Q3).
>
> It is a very good tool to learn the English language when I have any problems; I look it up on the Internet. English is very important to refugees (Tahereh_S, Q3).
>
> The English language is the most important thing for refugees that ICT can help them learn (Sadaf_S, Q3).

When asked about any ICT assistance that should be provided to refugees, 29 (57%) refugee participants specifically mentioned 'English language' learning:

> Teach them the English language so that they could use the Internet efficiently. English language, computer and Internet skills and access are vital to refugees (Aidah_M, Q4).
>
> The most important thing that is useful to refugees and asylum seekers is learning English and Internet can help them to learn English (Jafar_P, Q4).
>
> Everything that other people need such as language and Internet skills, the refugees need it too (Zohreh_S, Q4).

Others provided a variety of answers similar to the above, such as technical skill problems and also a lack of language skills that added to their technical problems:

> As much as I want to use all the facilities on the Internet, but due to my bad skills, I can't do a whole lot (Hajar_P, Q7).

This section showed the findings of the data from both groups of interviewees to address the main theme *e-Skills* and its two sub-themes *English competency* and *Acquiring computer and Internet skills* and their interrelationships. Both groups of participants appreciated the importance of these skills on refugee settlement.

DISCUSSION

The aim of this qualitative study using MSE was to gain a better understanding of Iranian refugee settlement by exploring the impact of *e-Skills* on their settlement in Australia. This theme emerged from data gathered through interviewing 106 participants. The theme included two sub-themes of *English competency* and *Acquiring computer and Internet skills*. Through different lenses (by interviewing two different groups of interviewees), the research found why it was so important for the refugees to learn and use e-skills to support them in their settlement. The study found that the majority of refugees admitted to their lack of e-skills and realised that it was more of a necessity than a luxury. The non-refugee group also stressed the usefulness of *e-Skills* in a refugee's settlement journey.

The results indicate there was a consensus of both groups of interviewees about the positive impact of e-skills on refugees' settlement. Both refugees and non-refugees fully understood the advantages of having the knowledge and skills of using ICT and that English competency could speed up the refugees' path towards their settlement. E-skills provide opportunities on many different levels, such as education, employment, and housing, and contributes to the refugees' feeling of social inclusion.

As part of a satisfactory settlement, refugees wanted the opportunity to establish themselves in their new country. According to Gifford and Wilding (2013), their study of youth refugees showed that ICT provided opportunities for some of this population for a positive settlement. While it is hard for new immigrants to find employment and accommodation as they settle in Australia, it is even harder if they are from a non-English speaking background (NESB) and unable to communicate with mainstream Australians due to the language barrier (Penman, 1979). Therefore, both ICT and English competency are critical for refugees in Australia. This demonstrates that e-skills could provide many opportunities for all refugees, including Iranian refugees.

As was seen in the research, both refugee and non-refugee groups appreciated the role e-skills played in the Iranian refugees' settlement journey. If Iranian refugees could gain English competency and acquire computer and Internet skills, they could learn about the new cultural values of the hostland that would bridge the cultural gap between their own community and Australia's. According to Toolo and Shakibaee (2000), Iranians experienced hostile feelings from non-Iranians, due to cultural and behavioural differences. E-skills enable them to stay in touch with their families in the homeland, which in turn assists them to cope with the discomfort caused by separation and being able to better focus on their association of values and achieving their new goals in the journey of their settlement.

The study showed the refugees' desire to narrow the gap between themselves and mainstream Australians and see themselves as equals in Australian society. If the Australian government and NGOs realised the impact of e-skills on the settlement of refugees in Australia, they could consider facilitating teaching e-skills as soon as refugees arrive in Australia so they could settle and quickly become part of the Australian community. These skills would also benefit them in areas such as housing, employment, education and health by being able to communicate effectively with all the entities that are involved.

The Internet is not all about written information; it has many more usages, such as exchanging photos, sounds, songs, videos, and "face-to-face" chats that make it real time communication. ICT could be used to encourage refugees to participate in communities. It seems to be a "significant untapped resource" to help people from refugee background to be socially included (Urquhart et al., 2009). The use of ICT allow refugees to move away from a stagnating status into a more active status

"across diverse contexts" (Gifford & Wilding, 2013) and of course provide them with a tool to communicate with family and friends elsewhere.

Traditionally, learning was linked to educational institutions such as schools and universities; however, learning at home is now recognised as equally important as it is at the work place. So is the use of the Internet (Halliday-Wynes & Beddie, 2009). Individuals can actually grow and become more successful in their lives if they learn how to use ICT and online networking effectively (Rainie & Wellman, 2012). Therefore, excluding refugees from the use of ICT equates to a social exclusion in the host community and across the globe. On the other hand, access to ICT connects people from a refugee background, not only with their host community, but also with the "transnational community" (Gifford & Wilding, 2013). Since the Internet plays a vital role for diaspora refugees by enabling them to sustain a relationship with one another (Wahlbeck, 2002), it is equally vital to understand how the Internet could act as a tool to improve a satisfactory settlement.

While refugees need to learn as much as they can about Australia and the way of life here that could better enable them to make a satisfactory living in Australia, equally the Australian government, the policy makers, and Australians themselves need to understand and acknowledge the differences between the Australian culture and that of refugees to achieve harmonious living and to share a community. The Australian Government's Department of Social Services (DSS) believes that providing assistance to humanitarian entrants as early as possible is important; these include English language, employment and education (DSS, 2014).

The number of immigrants, whether they are forced or voluntary, is increasing in Australia and in other parts of the western world. If their experiences could be heard, recorded, and converted acceptably for the Australian people as well as for the policy makers so that a better understanding of them could be achieved, then their settlement issues would be more likely to be resolved. As a result, a more satisfied community of "majority and minority population" would be mustered (Colic-Peisker, 2009).

The findings of this research clearly showed the importance of e-skills for refugees in Australia and suggest how the Australian Government may implement a systematic plan of action towards ensuring that refugees have access to ICT and the skills to use them. Acquiring these skills will minimise the gap between the 'haves' and 'have-nots' in the Australian community.

CONCLUSION

This research explored the impact of *e-Skills* on the settlement of Iranian refugees in Australia. The study looked at the data from two different groups: refugees and non-refugees. The refugees provided insight into their experience of e-skills used towards their settlement. The non-refugee group provided insight about the experience of those who had a role in the settlement journey of refugees in relation to their e-skills.

Since the focus of this study was on ICT, the interview questions were designed towards this topic and less focus was given to English competency. However, the gathered data about e-skills identified the importance of this sub-theme, particularly among the refugee group. Another limitation of this study is that the participants were from only three Australian states and therefore the findings are not necessarily representative of all Iranian refugees around Australia.

If the findings of e-skills are acknowledged as useful for the Iranian refugee population, then they may enable the creation of a model usable by the Australian Government for the benefit of all other refugees in Australia. Practically, the Australian Immigration Department could then amend their practices and policies to make e-skills training a must for refugees. Furthermore, providing the necessary training to enable refugees to use ICT efficiently may result in bringing them into the job market and minimising the digital divide between refugees and ordinary Australians. When refugees gain employment, they gain independence from government services, such as unemployment benefits, housing, and healthcare. This independence contributes to a satisfactory settlement and contributes

to the Australian economy in general. Thus, the research could provide greater understanding of the unique relationship that Iranian refugees have established between the home country and host country through the use of e-skills, as well as benefiting their settlement in Australia.

This research investigated Iranian refugees' e-skills towards their settlement in Australia only. Future research could investigate different aspects such as digital division and marginalisation of refugees without e-skills in comparison to mainstream Australians, or even a comparison to non-refugee immigrants. Furthermore, researchers could look into other groups of refugees' e-skills in Australia. Additionally, the e-skills of refugees from Iran and other backgrounds in other parts of the world could be studied as well. Although this study draws on Iranian refugees in Australia, the findings could be generalised to other refugees in Australia and could apply to Iranian refugees as well as other cultural backgrounds in other industrialised countries.

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APPENDIX

NON-REFUGEE SURVEY QUESTIONS

1. Do you think refugees need to have access to Information and Communication Technologies (ICT)? Yes/No? Explain …
2. Do you think refugees have the necessary skills to use ICT properly or need more training?
3. What kind of ICT training do you think would help refugees most?
4. Would it make your job/assistance to refugees easier if they could use ICT properly? Explain …
5. How else could ICT help refugees apart from successful settlement?
6. Does your organisation facilitate teaching ICT to refugees?
7. Do you think that if refugees are provided with a computer and internet access at home, it would be beneficial to them? Explain …
8. Do you think that the use of ICT could help refugees to a satisfactory settlement? Why/How?

REFUGEE SURVEY QUESTIONS

1. What is your perception of your degree of integration into Australia on a scale of 1 to 10? (1 being the lowest level of integration and 10 being the highest level of integration). Because …
2. What common problems do you experience while using the Internet; for example, technical, language, etc.?
3. How do you think Information and Communication Technologies (ICT) could help Iranian refugees?
4. In your view, what ICT related services should be provided to Iranian refugees in Australia, to help them with their integration; for example, ICT classes to boost their computer and Internet skills, computer hardware or SIM cards to connect to the Internet, English language classes to help refugees understand Australian websites that are mostly in English language, etc.?
5. Why did you choose Australia as a destination; for example, had relatives or friends living here, Australia is multicultural country, Australians are hospitable, etc.?
6. What are your current thoughts and feelings about the experience of Integration and the use of ICT; for example, could ICT help with your integration experience, etc.?
7. What do you usually use the Internet for?
8. Do you mostly browse Persian language websites, English or other languages websites?

BIOGRAPHIES

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ENHANCED CRITICAL THINKING SKILLS THROUGH PROBLEM-SOLVING GAMES IN SECONDARY SCHOOLS

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ABSTRACT

Aim/Purpose	Students face many challenges improving their soft skills such as critical thinking. This paper offers one possible solution to this problem.
Background	This paper considers one method of enhancing critical thinking through a problem-solving game called the Coffee Shop. Problem-solving is a key component to critical thinking, and game-playing is one method of enhancing this through an interactive teaching method.
Methodology	Three classes of Vietnamese high school students engaged in the Coffee Shop game. The method seeks outcome measurements through the use of analysis of multiple surveys to assess and interpret if critical thinking may have been improved.
Contribution	The study may help to understand the importance of problem-solving in the context of an entrepreneurial setting and add to the variation of methods used to deliver the lesson to students in the classroom.
Findings	The findings show that practicing problem-solving scenarios with a focus on critical thinking in a time limited setting results in a measured improvement of this skill.
Recommendations for Practitioners	The findings suggest that educators could use games more as tools for problem-solving to contribute to their students' learning outcomes around developing critical thinking.
Recommendation for Researchers	More research could be devoted to developing problem-solving and critical thinking skills through game-play models.
Impact on Society	Improved critical thinking skills in individuals could make a greater contribution to society.
Future Research	A comparative study between different high school grades and genders as well as between different countries or cultures.
Keywords	lesson delivery, blended learning, digital technology, learning outcomes, entrepreneurship, mixed methods, learning transfer, gamification

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INTRODUCTION

The Growth of Entrepreneurial Thinking

The use of games in the classroom has developed at a quickening pace since the 1990s but has attracted more attention recently as pedagogical methodologies have evolved and particularly even more so around business education (Greco, Baldissin, & Nonino, 2013; Hainey, Connolly, Boyle, Wilson, & Razak, 2016). Games may be used in combination with any other pedagogy to enhance its effectiveness defined as:

> …the innovative learning approach derived from the use of computer games that possess educational value or different kinds of software applications that use games for learning and education purposes such as learning support, teaching enhancement, assessment and evaluation of learners (Tang, Hanneghan, & Rhalibi, 2009, p 3).

The research and study of entrepreneurship as a discipline over the last few decades have held its own ground in academe, even upstaging other areas of economic studies due to the steady growth of interest in its field. The collective importance of entrepreneurs, particularly within the emerging economies of nations around the globe (including Vietnam), highlights the importance of an education in entrepreneurship for their citizens (Global Entrepreneurship Monitor [GEM], 2014). Entrepreneurship is the key to a country's economic growth (Faggian, Partridge, & Malecki, 2016; Minniti, 2008). Projections are leaning towards the BRIC economies (Brazil, Russia, India, and China) surpassing the big G7 economies (USA, UK, Germany, Canada, France, Italy, and Japan) by the year 2050 driven by the grassroots entrepreneurial mindset of the developing BRIC nations (Jakovljevic, 2016; D. Wilson & Purushothaman, 2003). Perhaps entrepreneurship education should not be considered as important only for tertiary level students but should also include secondary school students to provide an opportunity for those students that may not be able to attend higher education for whatever reason.

Entrepreneurial Thinking in the Classroom

The reported number of universities and colleges in the USA that offered entrepreneurship as part of their curricula had ballooned from its humble beginnings of a mere dozen or so in the 1970s to more than 1600 by the end of the 20th century (Katz, 2003) and has since increased in number to over 2100 institutions by 2010 (Seppanen & Gualtieri, 2012). At the K-12 level, progress was reported in the US that shows between 2009 and 2015 the number of schools providing standards, guidelines, or proficiencies increased from 19 states to 42 states. In that same 7-year period, the number of high schools requiring an entrepreneurship course increased from 5 to 18 states (JAUSA, 2015).

In developing nations, the number of schools offering entrepreneurship programs falls far behind the West. Vietnam is a typical example of this. Entrepreneurship is not part of the mainstream curriculum in the national universities or secondary schools around the country. Conducting a simple Internet search for Entrepreneurship programs offered at the tertiary level in Vietnam reveals only a handful of hits from the top tier institutions. In regards to the topic of entrepreneurship, the general sentiment of the university students surveyed by the Global Entrepreneurship Monitor (GEM) across Vietnam in 2014 was their 'fear of failing' in starting a business due to their lack of entrepreneurship or even a basic business education. At 55%, the number of students reporting this sentiment, compared to other students surveyed globally, is considered very high for this demographic in conjunction with their feeling of having only limited entrepreneurial capabilities. "It clearly shows that Vietnam should train and equip more business knowledge for the people, starting when they are pupils and students. And thus, it would help young people to be more confident in engaging in entrepreneurship." (GEM, 2014, p. 14).

The Research Question

Many people possess the ability and capability to think critically but have a tendency not do so for whatever reason (Sears & Parsons, 1991). It was further addressed by Wagner (1997) that it was in no way possible for anyone to become an expert in any field or specialty whatsoever without actively partaking in the processes of effortful and purposeful critical thinking. There is a desire among educationalists to implement supplementary methods of teaching critical thinking skills to students other than the traditional didactic approaches (Howard, Tang, & Austin, 2015). This paper attempts to answer the question, "Is it possible to enhance the use of critical thinking through the problem-solving elements of a game?" and suggests other possible areas for future research into the entrepreneurial mindset and entrepreneurship education. This study will consider business games in education and how their perceived learning experience, and perhaps the development of critical thinking, could be enhanced through the playing The Coffee Shop game.

LITERATURE REVIEW

Games Used in Business Studies

Active learning and student engagement have shifted contemporary pedagogical paradigms away from the outdated teacher-centered models of lecture halls and textbook lessons around the globe. Today's students demand a learning style that encompasses a full range of technologies that bring together the needs and dynamics of the individual as well as the group and link both passive and active generation and the transferal of knowledge (Ramaley & Zia, 2005). Many learners fall into the category of visual learners, thus making game-playing an ideal delivery mode for fulfilling this segment of the student population (Abedin, Rusli, Tukiran, & Rashid, 2015; Clark & Mayer, 2016; Sims & Sims, 2006).

Simulations and business games are innovative approaches to teaching that provide the learner with a supplement or even a substitute to the textbook and offer a repeatable mode of practicing real skills that were traditionally reserved for apprentices in the field (Aldrich, 2004). In the 1990s, research into business schools reported that upwards of 97.5% of all business schools were utilizing business games and simulations of some sort as a feature in their business programs (Faria, 1998; Wellington, Faria & Nulsen, 1996). Not only have games been used in Business Schools since the 1990s but serious games have become increasingly popular as a way of providing students with entrepreneurial experiences that are authentic in nature (Bellottia et al., 2012; LaGuardia, Gentile, Dal Grande, Ottaviano, & Allegra, 2014; Panoutsopoulos & Sampson, 2014; Usart & Romero, 2013).

Digital technologies are becoming more prominent in the classroom and will continue to make a larger impact as each year progresses until eventually digital methods of teaching and learning will completely dominate the classroom (Schofield, 2014). Although digital versions of business games and simulations are most prevalent in today's classrooms, computers and computer assisted instructional programs are tools used in many active learning models but are proven not as effective when used solely compared to a blended learning model involving multiple features (Brown et al., 2009). This study seeks to identify the effects of a rapidly changing environment that places the focus on the problem-solving aspect of the game. The success or failure of the outcome may be discovered through a combination of a survey analysis as well as an informal debriefing session (not part of this study) where the students are questioned about their perceived learning experience attributed to the game and how this relates to entrepreneurial thinking.

Critical Thinking and the Entrepreneur

The entrepreneurial founder of the company named Roaming Hunger stated in a recent interview that game-playing at a young age developed his entrepreneurial thinking by allowing him to try and fail, but fail "upwards" due to emerging from the defeat a wiser player and one more step closer to the goal demonstrating a mindset shared among entrepreneurs everywhere (Resnick, 2015). The

method of learning or absorbing new knowledge that appears to be most favored by the "millennial" generation of today is through game-playing in a digital environment and even more specifically video-game-playing (Smith & Clark, 2010).

Throughout most of the twentieth century, it was believed that entrepreneurship was an inherent characteristic that entrepreneurs were born with and had no practical place being in the classrooms and lecture halls of academia beyond simply being an area of interest because it could not be taught effectively (Johannisson, 1991). A recent study suggests that, even if the entrepreneurial intentions cannot be taught, the result of attending the entrepreneurship course serves a purpose in identifying personalities that may not be suitable for entrepreneurship (Chen et al., 2015). The belief that entrepreneurship could not be taught changed in the early 1980s when some began to question this belief and a paradigm shift evolved towards thinking that entrepreneurship was "not magical or mystical" at all and research began to flourish (Carlsson et al., 2013). Drucker (1985) made the claim that in fact Entrepreneurship is a discipline and therefore could be taught and learned as any other discipline.

Critical thinking skills are crucial for every day survival and are crucial to the successful decision-making that is involved in an entrepreneurial business venture (Brazeau, 2013; Krueger, 2007; Mohan, Mohan, & Ramakrishnan, 2015). Many people possess the skills necessary for critical thinking but fail to utilize them due to the unstructured or 'lazy' nature of their decision-making processes (Fahim & Masouleh, 2012; Sears & Parsons, 1991). It has been argued that entrepreneurs are specifically adept at what could be thought of as connecting-the-dots, and therefore it should be the pedagogical goal of any business program to seek ways to enhance the soft skills such as critical thinking through deliberate practice (Al-Atabi & DeBoer, 2014; Mitchell, 2005). The act of encouraging students to think entrepreneurially includes a certain amount of critical thinking, which is enhanced quite remarkably through problem-solving based exercises (Krueger, 2001). It is through these exercises that the students are exposed to real-world problems which are faced by entrepreneurs. These include the cognition of "me" into the problem itself affecting the decision-making process that relies heavily on critical thinking skills amidst a combination of extreme time pressures and a sense of extreme uncertainty (Souitaris, 2005).

Entrepreneurial Games in the Classroom

Today's students have provided an insight into their modes and habits of both learning and working, resulting in media such as the videogame to be taken much more seriously as a tool to be used in education (Greene, 2011). Serious games for students are being developed at a rapid pace to meet the contemporary demands of this growing trend (Lanyi, 2011). Young people playing videogames not only experience the thrill of playing the game but they in fact are learning through the steps needed to enable them to understand the intricacies of the game, usually through semiotics or other graphics of some sort. This learning process is not associated with the traditional methods of observation or reading about a new skill or new knowledge, but is learning through practice (Gee, 2007). Per Dale (1969) and his Cone of Experience, only 10% of learning material read is retained by students whereas almost 90% is retained through participation in activities and simulations that challenge the players with a compelling context. This concept is supported through contemporary research, when teaching difficult concepts, such as soft-skills or entrepreneurial thinking, that cannot be expressed adequately through words alone (Bellotti et al., 2012). Although the concept is relevant in certain circumstances, more recent research states that Dale's initial findings were unsupported negating his claimed validity (Subramony, Molenda, Betrus, & Thalheimer, 2014).

One of the benefits of utilizing games is the fact that they may be repeated or played over and over again allowing the players the opportunities to learn from mistakes made or learned through the practice of playing the game (Pink, 2005). Thus, this teaches players that failure as a set-back is an opportunity to learn and move forward as opposed to failure being an end-point.

In addition to the videogame, there are board-games that are equally as effective as tools for developing entrepreneurial thinking that offer the classroom teacher another option of varying the inputs,

thus, altering the way the game progresses each time it is played. By applying new stakeholder participation, the student is faced with a completely new set of parameters in which to operate resulting in unexpected variants and outcomes. An example of such a successful attempt is SIMGAME, sponsored by the EU's Leonardo di Vinci program and first launched in the 2003-2004 academic school year. Five countries participated in delivering this game to 30 schools in their jurisdiction: Germany, Italy, Czech Republic, Slovakia, and Austria and reported improvements in student learning (Hense, Kriz, & Wolfe, 2009). The purpose for this initial study was to determine if game-playing could improve or enhance the business education programs already in place in these schools, particularly in their entrepreneurial thinking skills as well as develop positive outcomes in the future employability of the students who may or may not have played this game. The success criteria came from a debriefing of the students who have played and allowed them to reflect on their experience and what they perceived to have learned through playing the game (Peters & Vissers, 2004). The following methods and approaches were used in this study in the attempt to determine if a game-playing activity enhances or influences entrepreneurial critical thinking in secondary school students.

METHOD AND APPROACH

STUDY PROCEDURE

The design of the game used was developed from prior research into effective games used for education that could assess the effectiveness of the outcome for learning opportunities. Features such as instructional tips, suggested timeframes for playing the game, instruments used for measuring and analyzing outcomes as well as suggestions for stimulating conversation and discussion following the completion of the game were incorporated into the design of the Coffee Shop game (Heineke & Meile, 1995, 2000). A similar study analyzing the effects of teaching inventory management through a game involving the production of hockey sticks was referenced to model the design concept of the game used in this study (Klassen & Willoughby, 2003).

The Hypothesis: Students are taught to think critically as an effect of playing an entrepreneurial problem-solving game.

This is testable through the established variables of the game (described in The Design) and the outcome of each survey administered as well as by eliminating other controlled variables generally found outside of the "safe" classroom environment.

The study was conducted in the following sequence: student recruitment, record demographics of each student participating, initial questionnaire conducted, game-play, second questionnaire conducted, and analysis of data collected from the questionnaires.

The recruitment for this pilot study was conducted for one 90-minute period at a private International Secondary School in Ho Chi Minh City, Vietnam in 2012. The participants were secondary school students enrolled in a Cambridge International Examination IGCSE Business Studies course. Each student was either 13 or 14 years of age, and the participants included students from three different classes resulting in a total of 72 students of which 33 were female and 39 were male. Although it was understood that active learning and using games as part of a lesson delivery in the classroom enhanced the learning opportunity for students, this study sought to show the benefit of adding time-limited problem-solving features that ultimately aimed to develop an entrepreneurial thinking mindset in the students involved in the study. The students were informed of the study prior to the playing of the Coffee Shop game and told that their participation was not a requirement and would not affect their grade if they opted out. The result was that no student declined. After conducting the pre-play questionnaire and introducing the game and its rules to play, each class spent 45 minutes playing the game one time and afterward completed a second post-play questionnaire administered by a 3rd party (another teacher). The resulting answers to the two questionnaires were collated and analyzed.

THE GAME

THE DESIGN

The game designed for this study (the Coffee Shop game) follows the basic outline for any game used to stimulate a learning opportunity for the individuals playing the game. Specific features of the game should include quantifiable outcomes that come from the use of variables that the players influence based on following the rules before playing the game. The purpose of this being that each player absorbs the underlying lesson instead of focusing on the logical conscious play of the game (de Freitas, 2006; Koster, 2005).

The game setting designed specifically for this study is based on the daily operation of a Coffee Shop, which was familiar to all participants. This adds not only a feel of familiarity but is quite common in Vietnam. Coffee is the second highest agricultural export earner after rice and is of great importance to the Vietnamese economy (Giovannucci, Lewin, Swinkels, & Varangis, 2004).

The game could be played individually or in small groups. Ideally the game would be played individually to provide a more accurate measurement of the outcome, but due to the limitation on time and equipment availability, this study was conducted using five or six small groups of four or five students each (depending on the class size) playing as a team. Additionally, group activities in school are embedded in the Vietnamese education system and more likely to be perceived favorably by the students participating in the study (Kumar & Laakso, 2016).

Each team was equipped with an electronic tablet device with Internet access that provided the platform necessary to play the game. The initial MS Excel spreadsheet, with a predetermined starting point, was displayed on each team's tablet. The spreadsheet was set up in a typical 'tabs, rows and columns' configuration. Each row represented a different commodity used in a typical coffee shop in Vietnam, such as sugar, milk, coffee, tea, as well as consumables, such as napkins, plastic cups, straws and so forth. Each row had an on-hand quantity represented by a number in the column to the right of the item's description followed by another column displaying the item's unit of measure. The second tab labelled 'Price/Lead-Time' provided the students with quantity price breaks and the various lead-times for each item listed in the first tab labelled 'The Coffee Shop' as well as with a column to enter their purchased quantities. This column had the only data that could be accessed and changed by the students as they inputted their purchased quantities. All other rows and columns were protected cells. The students had to access the second tab to determine and execute the 'best' buying decisions for their coffee shop. Each team began with a budget of 1,000,000 VND (Vietnamese currency). As each purchase was made to resupply the coffee shop, the purchased amount was deducted from this budget viewed on this same tab as well as the main game page (tab one). The game was launched by the teacher entering a 'consumption' quantity in the 'host' computer. The algorithm written into the equation affected each inventory item appropriately by the number entered as 'consumption', which was the usage per customer and the sales price of that item (each result affected the budget). The second option for the teacher was to simply reduce the on-hand quantities as a loss explained by unforeseen real-world circumstances such as pilferage, acts of nature, spoilage, rodent or pest contamination. These actions reduce the inventory items' on-hand quantities to reflect the result of this deduction, which may even reduce the number into the negative (stock out) depending on the unit of measure for that item. The teacher allowed a specified time (1-5 minutes) for each team to analyze and determine the re-order quantity of the items they chose to purchase for that period (considering the price/lead-time variables). The time was counted down on a clock projected on a wall or screen somewhere in the classroom. Once the teacher had 'entered' the new data, the time window closed for the teams to input their decision if they had not already done so possibly affecting their inventory in a negative way. Individual 'consumption' time periods entered by the teacher could be considered as a day, week, or a month determined to be appropriate for the class and the game. The game was played for the duration of the allotted period or until the teacher halted the activity.

The Objective of the Game

The objective of the game is to control the number of supplies and their quantities needed to efficiently operate The Coffee Shop from day to day, week to week, or month to month with the highest profit margins possible. The individual or team (determined by the teacher) with the highest VND (Vietnamese currency) and no 'stock out' at the end of the 30-45 minutes of play is the winner. The inventory levels, demand, order history, and costs are all recorded on the game spreadsheet containing predetermined 'starting-point' data that tracks the inputs and thereby each decision made by the players or the team, and is automatically updated by the profit/loss column in the spreadsheet. To emphasize and practice the use of critical thinking skills, the teacher or instructor may introduce various problems or crises regarding the shop's supplies or customers into the game that affect each player or team equally and ultimately affect the game's outcome (depending on their reaction to the changing scenarios). Besides the standard consumption rates of the customers, other factors, such as rodent contamination, weather effects, robberies, or errant shipments, may be introduced at any time during the play. The game progresses daily, weekly, or monthly every 1-5 minutes (adjustable) depending on the skill level of the players or teams to be determined by the teacher. The number and type of problem along with an accelerated clock (adding an element of urgency) is where the observable learning opportunity reveals itself. Repeated play and the number of interchangeable scenarios (described above) is where a contributable level of entrepreneurial thinking may be developed. The Coffee Shop game could also be used to enhance lessons related to inventory management or procurement exercises or warehouse management, but for the purposes of this study, the development of quick-thinking (Kahneman, 2011) and critical thinking skills were the targeted outcomes as these are elements associated with an entrepreneurial mindset (Gomezelj Omerzel & Antoncic, 2008).

Assessing the Learning Outcomes

Building the Assessment Instrument

To assess the game's learning outcomes, it was essential to design and combine the written "before and after" questionnaires completed by the students used as the primary instrument (Erhel & Jamet, 2013; Westbrook & Braithwaite, 2001). The questionnaire attempted to indicate any prior knowledge that each student may or may not have known regarding the subject matter involved in the game before play and use this to compare with the knowledge the same students displayed at the conclusion of the game. Answers would be compared from the two questionnaires looking for any knowledge gained as well as any improvements in performance. The challenge, as with any questionnaire, is whether the questions and answers could reveal the data needed to show evidence of meeting the objective.

Administering the Questionnaires

The students in these classes were not native English speakers but had been enrolled in Cambridge English classes for at least the prior five years at the school and had demonstrated their proficiency in English to enroll in the Business Studies course. To seek any prior knowledge, the questions asked for vocabulary definitions and other simple business operations and their concepts that had not yet been introduced to the students at their grade level. The students played the game and then were provided with the second questionnaire and a discussion debrief where students shared their experiences among the rest of the class as a wrap-up to the lesson. The results of that discussion were not part of this study. These activities took place within a 90-minute tutorial session for each of the three classes involved. This included administering the first survey, one 45-minute round of playing the game and then the administering of the second survey. The school's rigid tutorial schedule would only allow for one 90-minute (double 45-minute period) time slot for the use of this study.

THE QUESTIONS USED IN THIS STUDY

The questionnaires were designed with simplicity in mind and an attempt to cover the areas related closest to the learning objectives (Brace, 2008). Both questionnaires can be found in the Appendix. The first question asked for a short answer providing an overview of running a coffee shop for profit to check the student's understanding of the connection between effective operations and the profit made by the business. The second question asked about knowledge of maintaining levels of supplies needed to operate a coffee shop and what they knew about on-hand inventory versus demand to check for understanding of the relationship between supply and demand. The third question asked about the cost of purchasing supplies and the student's ability to grasp the idea that more than one factor contribute to a purchasing decision. The fourth question asked if it was easy or difficult to run a coffee shop operation seeking the student's initial perception of running a small business. The fifth and sixth questions asked if he or she had either worked in or read anything about running a coffee shop business before or had they ever been taught the basics of business operation at any time during their years at school to determine if this could play a part in the student's learning outcome.

The follow-up (post game) questionnaire asked more specific questions related directly to the Coffee Shop game and were used in the attempt to determine if any learning had in fact taken place. The first several questions were repeated from the initial questionnaire to check for any new understanding by comparing the 'prior to play' answers with the 'post play' answers. The new questions added to the second survey were the following. Do you feel that your decision-making skills have improved by playing this game? This is a Likert Scale model seeking gain the student's perception of their own improvement in their decision-making processes. The second question asked more generally if they felt that the Coffee Shop game was a learning experience. This too was a Likert Scale model seeking how strongly the students felt that they had in fact learned something from playing the game. The students initially beginning the Coffee Shop game had assumed that it is a simple inventory replenishment exercise and whoever has the optimal levels of inventory and the most money at the end of the game wins. The teacher/administrator may add in various elements affecting the status of supply levels or costs thus changing the direction of the play or may let the game play through to completion without these additions.

RESULTS OF THE COFFEE SHOP GAME

THE ANALYSIS USED

When the survey results were collated and analyzed, it was determined that the students improved their problem-solving/critical thinking skills through playing the Coffee Shop game. Using a matched pairs t-test in Microsoft Excel to determine the comparisons of the initial 3 questions, the alternative hypothesis was tested as to whether these students had made any improvements by scoring higher on the second questionnaire after playing the game. A similar study used this method to measure learning improvements in a healthcare game (Westbrook & Braithwaite, 2001) as well as a more recent study seeking improvements in learning because of playing a similar healthcare game (Erhel & Jamet, 2013).

The requirements of a matched pairs t-test are:

1. Data is distributed in a normal fashion
2. The scale of measurement is ratio or interval
3. Both sets of scores are matched or paired

The Null Hypothesis

H_0: $U_D = U_1 - U_2 = 0$, is where U_D is equal to the mean of a given population of differing scores or totals across two separate measurements.

The Equation

$$t = \frac{(\sum D)/N}{\sqrt{\frac{\sum D^2 - (\frac{(\sum D)^2}{N})}{(N-1)(N)}}}$$

The First Three Questions

The three questions that began the survey may be compared in a qualitative approach revealing differences between the percentages of correct answers before playing the Coffee Shop game versus the percentages of correct answers made after the game was played. It was also considered just as valid to test the matched pairs of means between individual students in a quantitative approach. The matched pairs approach tests student by student providing a better result than comparing groups of students. Table 1 lists the results of the first three questions and the t-values and p-values. The points and percentages are for correct answers.

Table 1. Matched pairs results for questions 1-3 with t-value & p-value (p >.05)

Question	Point Value	Potential Points	Points Before Game	Points After Game	t-value	One tail p-value	% Before	% After
1	3	216	77	85	2.38	0.009	36%	39%
2	2	144	57	74	4.68	0.00001	40%	51%
3	6	432	243	268	5.25	0.00001	56%	62%

Prior to taking the initial questionnaire, students were not provided with any instruction other than to answer the questions as best they could. It was expected that there would be a wide range of scores depending on each student's prior knowledge of business concepts.

Each of the three beginning questions were asked a second time after the Coffee Shop game was played and showed an indication that the students' collective improvement was evident in the way they scored higher on the individual answers given. Thus, there was sufficient evidence to reject the null hypothesis and supports the alternative hypothesis. The alternative hypothesis H_1 states: Students display an increase in their ability to learn to think critically as an effect of playing an entrepreneurial problem-solving game.

Question Four

The fourth question was based on a ranked or ordinal Likert Scale model asking the students about the ease or difficulty in making decisions based on changing scenarios and time restrictions. This method was used in a similar study to measure the outcomes of a healthcare game (Erhel & Jamet, 2013). The scale was labeled starting with 1 being 'quite easy' up to 5 being 'quite difficult'. The question was designed to test the students' perception of complexity. The results of this question (see Table 2) revealed that the students initially perceived the complexity of running an efficient business operation, would be 'challenging' or 'difficult' but after playing the game, the ranks increased towards being 'difficult' and 'quite difficult' for more individuals although not a significant change in perception. Thus, there was not sufficient evidence to reject the null hypothesis and neither was there sufficient evidence to support the alternative hypothesis. The alternative hypothesis H_1 states: Students display an increase in their ability to learn to think critically as an effect of playing an entrepreneurial problem-solving game.

Table 2. Student's perceived difficulty in running a coffee shop operation (p >.05)

Question 4	Before	After	t-value	p-value
1	0	0	0.05997	0.476825
2	1	0		
3	26	15		
4	33	41		
5	12	16		
Students	72	72		

Survey One – Questions Five and Six

The fifth question from Survey One asked the students if they had worked at a coffee shop prior to playing the game. Out of the 72 student participants, only 3 had prior experience working for family businesses that were coffee shops and reported that they only waited tables or helped with making coffee resulting in a minimal knowledge of coffee shop operations.

The sixth question from Survey One asked the students if they had studied Business Operations in any classes prior to playing the game. Only one student claimed to have had studied Business prior to playing the game and when questioned further, answered that this was a home-tutorial lesson taught by a parent. This student only scored marginally higher than the average for all three classes thus was not counted as having had any advantage over the other students while playing the game.

Survey Two – Questions Five and Six

Using the z-score for a Likert Scale analysis.

$$z_i = \frac{x_i - \bar{x}}{s}$$

The fifth question that appeared on the second survey asked whether the players felt that their decision-making skills had improved or not because of playing this game. This was also a ranked or ordinal Likert Scale model with 1 as 'strongly agree' to 5 'strongly disagree'. The results of this question (see Table 3) indicate that most students believed that their decision-making skills had improved to some extent: N=72, Mean=3.84, SD =1.217, Z%=45, CV=32%. Using a percentile rank from the Z-Score converts a raw score into a normal score as was found to be an accurate approach (Nielson & Levy, 1994).

Table 3. Results of Likert Scale analysis on improved decision-making skills

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
28	21	11	8	4

A Top Box Score method was chosen to emphasize the Likert Scale categories with the highest number of selections made in the survey (see Tables 4 & 6). This method is used to highlight favorable findings supporting the hypothesis. In this study, the Top Box Score is the highest number of responses for 'Strongly Agree'. The Top 2 Box Score is the number of responses combining 'Strongly Agree' and 'Agree' to emphasize the total number of positive responses given. This method had been used in similar studies in healthcare measuring patients perceived experiences (Elliot et al., 2015; Kennedy, Tevis, & Kent, 2014).

Table 4. Top Box Score of rating scale data

Results	Number of Responses	Percent
Top Box	28	38.9%
Top 2 Box	49	68.1%

The sixth question which was also asked only on the second survey and was answered using a ranked or ordinal Likert Scale model with 1 as 'strongly agree' to 5 'strongly disagree', tested for perceived learning. The results of this question (see Table 5) indicate that most students believed that the game had resulted in a learning experience for them: N=72, Mean=4.18, SD=1.039, Z%=56.9, CV=25%. Using a percentile rank from the Z-Score converts a raw score into a normal score as was found to be an accurate approach (Nielson & Levy, 1994).

Table 5. Results of Likert Scale analysis on perceived learning experience

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
39	13	15	4	1

Table 6. Top Box Score of rating scale data

Results	Number	Percent
Top Box	39	54.2%
Top 2 Box	52	72.2%

DISCUSSION AND CONCLUSION

DISCUSSION

After an analysis of the data collected, it could be determined that the results point to an improvement in the students' ability to think critically before making important decisions affecting the Coffee Shop game's outcome. An understanding of basic business concepts was sought through the initial three questions on the survey. All three questions revealed an improvement in the students' understanding from one survey to the next after playing the game. These questions were important to gain an idea of how quickly the students gained the experience or knowledge to answer the questions better with the second chance to do so but the last three questions between the two surveys revealed more of what the study was seeking to test. The answers revealed to the researcher that the students began to grasp the complexity of problem-solving and doing so in what was believed to be through analysis and critical thinking as was determined by the answers they provided. The surveys also revealed that learning takes place through repetition as well as trial and error with rewarding outcomes as an end-goal. During a class discussion about the game conducted directly after completing the second questionnaire, it was determined that the students generally enjoyed the experience and asked to play the game again seeking to better their outcomes and, in the competitive spirit of this age-group, they wished to outscore and outperform their peers. This sentiment could suggest another element for further study focused on the competitive spirit and its influence on decision-making.

LIMITATIONS

Although it appeared the game itself may have improved the students' ability to think critically to make their decisions, it also may have been due to other factors not taken into consideration. Several assumptions had been made that could lead to further studies to account for the following: perhaps

the students had prior experience with similar games, perhaps they had exposure to other material or experiences related to business concepts not discovered through the survey, perhaps skills other than critical thinking were used to determine decisions made during play, perhaps gender played a role in the outcomes, or perhaps other factors not mentioned here. It was determined that the more reliable measure of the objective being met was to repeat the exercise two or more times to gather much more data and provide a larger sample size. Multiple plays of the Coffee Shop game were not possible in the classroom setting at the school used in this study due to the time limitation of an inflexible curriculum schedule and the fact that the number of students could potentially change from one game-playing session to another if played on different days making it a challenge to accurately compare using the same student-by-student model.

The design of the survey used is also limited to a selection of questions that must somehow link to the learning outcome that was intended to take place during the play of the game. Therein lies what is believed to be the foundational weakness of any assessment instrument.

Conclusion

The study concludes that the prior research identified in the Literature Review regarding the effectiveness of games played in the classroom, with a learning objective designed into the experience, was in fact confirmed through the play of the Coffee Shop game used in this study and lends to its credibility. The Coffee Shop game along with the lesson tutorial brings together a range of learning styles that contemporary students have been demanding which satisfies both the passive and active learner (Aldrich, 2004; Ramaley & Zia, 2005). Due to the nature of testing students for their learning outcomes using multiple assessments, it is difficult to assume one pedagogical method or technique is measurably better than another because there are determining factors in every measurement that may be overlooked (Gee, 2007).

As already pointed out in earlier sections of this paper, students are more apt to recall their learning experiences if gained through an enjoyable delivery of the lesson (Smith & Clark, 2010). It has been proven through much research that games deliver a positive learning perception to students and should be used more often in the classroom (Griffiths, 2002; A. Wilson, Hainey, & Connolly, 2013). One negative aspect to game-playing in the classroom is the time taken to set-up, play, and assess the outcomes while checking for understanding but is still viewed favorably among educators. The tutorial may be limited to a single learning objective but if games are used prudently they could be a valuable tool for lessons that may be more challenging to teach using a traditional textbook-lecture approach due to the nature of repeated play and further learning opportunities realized (Pink, 2005).

The games or simulations that may be considered as authentic and are used in the classroom as a supplement to didactic teaching standards have been well established since the 1990s with over 97.5% of all business schools adopting this practice (Bellottia et al., 2012; Faria, 1998; LaGuardia et al., 2014; Panoutsopoulos & Sampson, 2014; Usart & Romero, 2013; Wellington et al., 1996).

The Coffee Shop game itself could serve a dual purpose. The first being that students learn about some basic aspects of operating a small business venture such as a coffee shop and the second being that they learn to develop their problem-solving/critical thinking skills which are difficult concepts to teach in the traditional lecture style format (Deng, 2011; Kong, 2014). An additional benefit, if played in teams, is that students may learn from each other's feedback or inputs into the decision-making process while building rapport among fellow teammates and realizing learning opportunities not involving the teacher (O'Donnell & King, 2014).

The use of this game in classroom business lessons may contribute to the growing consensus that digital technologies are becoming more prominent in today's academic environment and will continue to increase its presence to eventually dominate the teaching methods of lecturers and learning methods of students in the coming future (Lanyi, 2011; Schofield, 2014). The soft-skillsets practiced through playing the Coffee Shop game include but are not limited to critical thinking and problem-

solving, which may be viewed as being crucial to the survival and successful decision-making processes needed in today's entrepreneurial business venture (Al-Atabi & DeBoer, 2014; Brazeau, 2013; Krueger, 2001; 2007; Mitchell, 2005; Mohan et al., 2015; Souitaris, 2005).

Although most research into this topic has been conducted at the tertiary education level, this study focused on a younger demographic at the secondary education level and thus may conclude that exposing these students to entrepreneurial skillsets earlier rather than later may better prepare them for business studies in higher education and into their future careers (Hense et al., 2009; Peters & Vissers, 2004).

The Coffee Shop game may be revised to change the settings or the additional inputs to make the rules of play either easier for certain groups or more challenging for others. It was designed to keep the play somewhat simple to administer and maintain in Microsoft Excel. The only changes that additional research may discover is that it may be more beneficial to the players if the game could be shortened but still deliver the same learning outcomes. If a specific lesson could be learned in a shorter time, then perhaps the game could be played more often thus providing the opportunity for greater critical thinking and problem-solving practice and development to take place. Perhaps after further study the opposite would be found to be true and a longer playing time could be more beneficial to the students who play the Coffee Shop game.

A future direction of this research may seek to identify, isolate, and enhance, through game-based learning, specific factors defined as critical thinking such as the rationale, reasonability, and empathy behind the thinking and outcomes expressed by the students, through the Coffee Shop game or a similar game, that was not incorporated in this pilot study. Other factors to consider may include: gender/age differences, country/culture differences, or more specific demographics not identified here. Further research may determine how students may analyze, assess, and improve their thinking processes and develop their virtues of integrity, humility, civility, sense of justice, and confidence (Elder, 2007) which may not only affect their critical thinking skills but also their entrepreneurial skills linked to this mode of thinking.

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APPENDIX

APPENDIX A

Mr. Scott's Business Game 1 Student ID Number ____ Class ____

All the questions in this survey must be completed before playing the Coffee Shop Game. These questions will help to determine what the students learned from playing the game. In no way, will your answers affect the outcome of your grade in this class. Please answer each question as honestly and as completely as you can.

1. Describe ways that business operations can affect the profits of a company.
   _____
   _____
   _____
   _____
2. What is the difference between buying supplies based on price breaks or discounts versus buying according to customer sales demand?
   _____
   _____
   _____
   _____
3. When keeping your business supplies at the optimal level to maintain your operations, you may need to buy these supplies each week or each month. Circle which factors (more than one is possible) you need to determine to make this decision.

   Price breaks Delivery costs Handling costs Item price Cash flow Lead time
4. How easy or how difficult do you think it is to operate a Coffee Shop? Circle the answer from 1-5 that you feel best answers this question.

   1 Quite Easy **2** Easy **3** Challenging **4** Difficult **5** Quite Difficult
5. Have you ever worked in a Coffee Shop before? YES NO
6. Have you studied Business Operations in class? YES NO

APPENDIX B

Mr. Scott's Business Game 2

Student ID Number ____ Class ____

All the questions in this survey must be completed after playing the Coffee Shop Game. These questions will help to determine what the students learned from playing the game. In no way, will your answers affect the outcome of your grade in this class. Please answer each question as honestly and as completely as you can.

1. Describe ways that business operations can affect the profits of a company.
   _____
   _____
   _____
   _____
2. What is the difference between buying supplies based on price breaks or discounts versus buying according to customer sales demand?
   _____
   _____
   _____
   _____
3. When keeping your business supplies at the optimal level to maintain your operations, you may need to buy these supplies each week or each month. Circle which factors (more than one is possible) you need to determine to make this decision.

   Price breaks Delivery costs Handling costs Item price Cash flow Lead time

4. How easy or how difficult do you think it is to operate a Coffee Shop? Circle the answer from 1-5 that you feel best answers this question.

   1 Quite Easy **2** Easy **3** Challenging **4** Difficult **5** Quite Difficult

5. Do you feel that your decision-making skills improved?

   Strongly Agree **1 2 3 4 5** Strongly Disagree

6. Was this a learning experience?

   Strongly Agree **1 2 3 4 5** Strongly Disagree

BIOGRAPHY

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LET'S TELL A STORY TOGETHER

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ABSTRACT

Aim/Purpose	The teaching solution presented in this paper was implemented to overcome the common problems encountered by authors during years of practice of applied business studies teaching.
Background	In our school, we have deep multicultural environments where both teachers and students are coming from different countries and cultures. The typical problems encountered with students include: not reading the case studies, language problems, different backgrounds and cultures, a different understanding of leadership in teamwork related to various management traditions, lack of student participation, and engagement in teamwork.
Methodology	The above problems were solved on the basis of the novelty use of several tools usually used separately: a combination of case studies with visualization and current representation of knowledge related to the case study. The visualization context is provided by "rich picture" (as a part of SSM methodology) to create a shared understanding among students. Another ingredient of the proposed solution is based on Pacific storytelling tradition and the Pacific methodology of solving problems.
Contribution	It was suggested the new delivery model strengthening advantages of case studies.
Findings	Studies and surveys made from 2009 to the present are promising. There is a visible improvement in students' grades and observed changes in students' behavior toward more active in-class participation.
Recommendations for Practitioners	This paper focuses on implementation and technical aspects of the presented method. However, the application of the presented method needs robust and time-consuming preparation of the teacher before the class.
Recommendation for Researchers	The current results show that the proposed method has the potential to improve students' experience in applied business courses. The project is ongoing and will

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	undergo progressive changes while collecting new experiences. The method may be applied to other types of courses. By focusing on the storytelling and rich picture, we avoid technological bias when we teach business problem-solving. We focus instead on teaching students the social-organizational interactions influencing the problem solution.
Impact on Society	Implementing of cultural sensitivity into the teaching process. Making teaching process more attractive for multicultural students.
Future Research	Reducing teacher overload when using the method presented by the development of computerized tools. This is undergoing through utilizing Unreal Engine. Also, it is planned to enhance our team by artists and designers related to computer games.
Keywords	case study visualization, Pacific storytelling tradition, teaching methodology, computers in teaching, knowledge transfer, knowledge representation

INTRODUCTION

The method of instruction presented in this paper was primarily used for teaching project management courses (Kelsey, & Zaliwski, 2014; Zaliwski, & Kelsey, 2015). However, we also successfully tested it on Strategic Human Resource courses. The presented method can be implemented successfully at any applied business course and is not only limited to business.

The research question addressed in this paper is: *How to teach effectively applied business in a multicultural environment?*

The characterization of the problem is twofold. On the one hand, any business course inherits its complexity from the business domain as most business problems may be characterized as so-called "wicked" or non-structured problems, meaning problems where it is hard to define the problem itself. Additionally, this kind of problem may not have "the" best solution but some more, or less, satisfactory solutions.

On the other hand, the multicultural environment adds additional complexities such as the cooperation among individuals coming from different cultures and various ethnic backgrounds. The students bring to their team's various traditions of problem-solving (if correctly utilized this may be a source of creativity), and the different traditions of doing business. The students often have experienced various social and business traditions in their home countries (e.g., authoritarian style of management and leadership). Frequently the students do not feel obligated to be creative due to their country traditions, so they leave problem solutions to their leaders. Additionally, even if students read the business cases independently of our efforts, international students still have some difficulties with the English language. Surprisingly, the English language is not the same in each country.

Initially, to find the solutions for the above problem, we considered many factors influencing student behavior like student laziness, the influence of NZ climate, and student difficulties in adapting to a new place. But with deeper research, we find deep cultural reasons as the background to the difficulties. Thus, we started to think in categories of deep cultural differences and cultural sensitivity applied to teaching.

The proposed solution is based on the effective fusion of the following:

1. **Storytelling** – practical, interesting, and deeply embedded in historical and cultural contexts. Suitable for human's way of reasoning. Storytelling is important in the Pacific area because of the special meaning of stories in Pacific traditions. The stories are the connective tissue that keeps the facts together and makes them memorable (Kosara & Mackinlay, 2013). We refer to the Pacific tradition (e.g., Samoan, Tongan) independently, as the Pacific learners are about 11% of students of our school (Thompson, McDonald, Talakai, Taumoepeau, & Te

Ava, 2009). The Pacific cultural tradition is suitable for teaching other students from different cultural areas since most our students come from India and China.

2. **Case Studies** – multiple intertwined stories with an additional twist. The case study idea itself is not new. Probably the case study first was used at the Harvard Business School Lecture on "Commercial Law" scheduled 1908 (Kersten, 2014). A good case tells a story (Herreid, 2007, p. 46) with an interesting plot related to audience experiences. It must have a beginning and a middle. The end may not exist until students create it at the end of discussion. Case Studies are naturally intertwined with storytelling (Herreid, 1997, p. 93): "*Humans are story-telling animals. Thus, the teacher using the case method has an immediate advantage. It is the advantage of gaining the attention of the audience.*"
3. **Common Visual Language** – symbols and methodology used to realize in-class visualization.
4. **Knowledge Perspective** – building knowledge through the constructivist learning process. Knowledge is retrieved from the case study and enriched by the additional knowledge required to solve the case problem. In this way, addressing the problems gives teachers the opportunity to inject additional teaching material.
5. **Visualization** (drawing pictures like Rich pictures) – through the creation of a map visualize where the members of the group are at a given moment (in the weeds or closer to the solution). The map, displayed on the large screen, delivers to the instructor-facilitators control over the discussion. They represent the current knowledge about the problem and guarantee that students focus after any distractions to the correct point. They introduce discipline into the teaching process. The map illustrates the current progress of the discussion, and it is dynamically updated during the debate – creates a center and a central repository core for the discussion. Most of all it is the communication tool.
6. The process of instruction where students can tell and **create stories together** with us.

These six factors above are further elaborated below in the sections following, and how the factors are interrelated is explained in the section "Putting Everything Together." The section is then followed by an explanation of our research methodology, and the paper closes with the results and conclusions reached.

A Storytelling Approach

A storytelling approach connects facts together into a logical stream to present information and to make a memorable conclusion seem like an aspect of human nature. Stories entertain, educate, and teach us moral values. "Human knowledge is based on stories, and the human brain consists of cognitive machinery necessary to understand, remember, and tell stories" (Mileski, Schneider, & Bruegge, 2015).

According to Pacific storyteller Emil Wolfgang (2010; 2015), stories are used both as a way of sharing knowledge about the environment and cultural identity. Deans et al. (2002) suggest that for many Pacific cultures, oral tradition and storytelling is a part of everyday life and endemic to the cultures. Further, they point that "All Art is about stories. All forms of Art are narratives and contain the stories of Humanity" (Deans et al., 2002). Storytelling plays a significant and central role within cultural value systems. To Deans et al. (2002), stories, then, are enablers of social interaction: "they are the "glue that binds us." The sharing of stories creates a bond between the teller/writer and the listener-reader. Stories can entertain, teach, facilitate the exchange of knowledge, introduce the listener to another language and another culture, and give authority to the teller.

Stories have found wide applications in education, science, and business. Several authors (Deans et al., 2002; Hill, 2001; Koki, 1998; O'Brien, 2002; Salas & Indelacio, 2000) argue that teaching curricula should embed more storytelling tradition. Scientific applications comprise using stories as narratives to research data visualization (Kosara & Mackinlay, 2013; Rodríguez, Nunes, & Devezas, 2015). From the other side, technology is more often used to preserve the ancient stories, arts, culture, and herit-

age to provide cultural sustainability for indigenous people. Some digital heritage projects exist that use digitalization or augmented reality (Irving & Hoffman, 2014; Kutay, Howard-Wagner, Riley, & Mooney, 2012; Leavy, Wyeld, Hills, Barker, & Gard, 2007; Wyeld, 2007; Wyeld et al., 2007).

Business applications of storytelling are thus far comprised of marketing applications to raise customer interest in new products and to improve advertising (Monarth, 2014). Our approach to storytelling is different from the approaches discussed above. Rather, we use the ancient tradition of storytelling as a vehicle to embed cultural sensitivity into our teaching.

In the Pacific Islands, and in any other areas of the Pacific Rim, stories were used for the passing of life lessons long before the development of the written word. The Pacific Island's culturally-related storytelling is best expressed by the concept of *Talanoa* (Chu, Abella, & Paurini, 2013; Vaioleti, 2006), where stories are part of the cultural storyteller frame and are related to the concepts of the storyteller's language. The *Talanoa* can be understood as a type of a face-to-face conversation, a talk, or an exchange of ideas both formal and informal. *Tala means* to inform, tell, relate, to ask, or to apply, and *Noa* means ordinary, nothing special, imaginary, or void. *Talanoa*, then, means talking about nothing in particular and interacting without a rigid framework (just like "rich picture" discussed below). On a good *Talanoa* meeting, *noa* creates the cultural space and context. *Tala* holistically merges researchers' and participants' emotions, their knowledge, and experiences. The *Talanoa* allows participants to engage in social conversations, eventually leading to the critical discussion or knowledge creation, which may allow "rich contextual and inter-related information" to flow and to be extracted from the surface of the meeting, creating a base for constructing stories (Vaioleti, 2006, 2011). *Talanoa* additionally describes the attitude of teachers and directions to build relationships with students in terms of cultural sensitivity. Culturally responsive teaching accepts students' previous experience and knowledge relating to their culture (Sheets, 2005), where cultural references are used for the creation of innovative teaching strategies. This approach enforces a role swap between the teacher and the student wherein the student becomes a storyteller, and the teacher is a moderator and person representing the process in graphic form.

Another related concept utilized is the "learning village," which is a safe, culturally strengthening place appreciated by virtually all Pacific ethnicities (see Chu et al., 2013; Vaioletti, 2006, 2011)). Both concepts, *talanoa* and learning village, provide the context of cultural sensitivity for our teaching. Culturally responsive teaching includes validation of prior student knowledge and prior experiences using cultural references (Sheets, 2005), helping students engage in their learning (Meyers, 2003), and facilitating students coming together to share their knowledge with each other and helping other students to learn (Samu, Mara, & Siteine, 2008).

Use of Case Methods for Applied Business

Case studies are a common tool for learner-centered teaching (Herreid, 2014; Ickis, 2013; Strachan, 2013). The benefits of active involvement of students into learning process are widely recognized (e.g., Sivan, Leung, Woon, & Kember, 2000).

Case studies immerse students deep into real problem situations. Case studies give students the opportunity to struggle with real life concerns, give them more confidence about their own skills, and allow students to obtain real life experience, faster. In a real job, they can apply experience based on several potentially similar situations and gain a potential competitive advantage in the workplace. Students can show their ability to apply theory to real-life situations, identify problems and challenges, analyze and review facts, analyze the "big picture," and develop analytical and problem-solving skills.

A case study is not just a story, however; it may contain some intertwined stories, where not everything is clear, and not all information is accessible from the beginning. Case studies immerse students into typical real-life business situations and reflect the compound nature of the business. Business problems are not well defined in opposition to mathematical or technical problems (Table 1). A significant problem in business is a diagnosis of the problem from symptoms with incomplete infor-

mation, making it difficult to make correct decisions. Business problems are usually complex and may not have a single best solution, but several satisfactory solutions instead. The teaching process of solving business problems must closely resemble the real-life problem-solving process. The case study usually presents ill-defined (e.g. Gill, 2010) or so-called wicked (or hard, or unstructured) problems (Table 1).

Table 1. Non-structured vs. structured problems.

Technological/Technical/Mathematical Problems (structured or well-structured).	Business Problems (not well structured or non-structured, wicked, or ill-defined).
Usually, full necessary data accessible (or it is possible to obtain these data by experiments). Clear objectives – this is evident from the beginning what we want to achieve. The problem is how to achieve the final result from input situation. There is usually only one best solution.	Incomplete data. Lack of full data necessary to solve the problem but also is difficult to define the problem itself. Something is wrong but what and why? What is the problem? (Wrong communication also can make difficult to understand the problem). Sometimes it's hard to define the problem correctly. Usually, many satisfactory solutions exist. It's hard to see immediately that a selected solution will work. Results of actions are delayed.

A full case story depicts a decision-maker (a Hero), who faces a problem situation that needs to be solved (Figure 1). This hero has antagonists and protagonists (case actors) and must operate in each organizational context creating margins for decisions or enforcing utilization of a specific business knowledge (related to the previous material of the course or injected during the case processing). Stories of this type have begun with an introduction to the situation, middle, and end (Segel & Heer, 2010). Literature theory suggests that the story should follow the Freitag pyramid (Figure 2). The frame schema is used for drama design in literature theory (Dobson, Michura, Ruecker, Brown, & Rodriguez, 2011) to keep the audience highly attentive from the beginning to the end of the story.

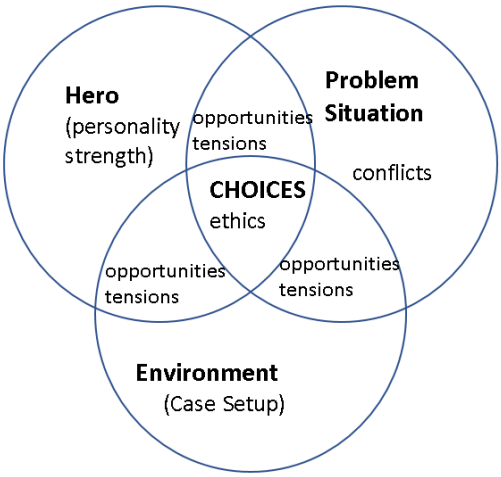

Figure 1. Typical building blocks for each story and case study.

The case study additionally may need professional domain characteristics knowledge to resolve existing conflicts. An additional difference is that typical storytelling contains one stream which must be delivered as one stream. However, from a case study, several storytelling streams may be extracted.

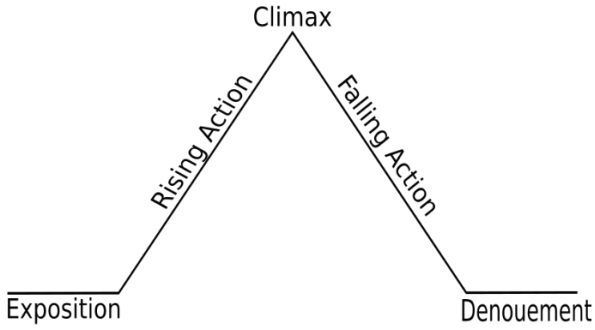

Figure 2. Freytag Pyramid (Source: public domain).

Christensen and Hansen (1987) note **three major levels of student's involvement in the case study**:

Level one. Students explore a problem, collect relevant facts, and develop logical conclusions that are presented to other students and the instructor (Christensen & Hansen, 1987). The students are only commentators or observers, observing a case situation and keeping their psychological distance

Level two. Students start to identify with the case characters, and, when arguing, students adopt the selected character's point of view and perspective.

Level three. Students fully identify with the case situation and behave as if they are fully immersed in a real-life situation.

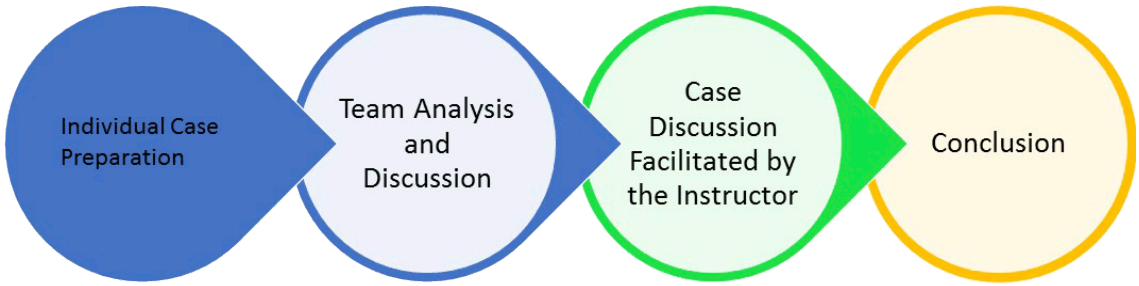

Figure 3. Traditional Case Study usage on a Business Courses

Figure 3 shows the traditional use of case methods in MBA courses and business schools. After reading an individual case, students are divided into small teams that prepare and undertake analysis and discussion. Team members present results of the debate in the plenary session of all teams, where the teacher acts a facilitator. Next, teams finalize and present their main results that have often been corrected by the teacher.

Common Visualization Language and Teaching Methodology

"Stories also provide the connective tissue between facts that make them memorable" (Kosara & Macinlay, 2013; Page 2). "The use of elements from storytelling is, therefore, the next logical step in visualization research, specifically, because storytelling can offer an effective way to present data" (Kosara & Macinlay, 2013, p. 1).

In our case, graphical visualization is used to perform the role of common interactive communication language. The authors re-purpose the so-called "rich picture" (often mistaken with mind maps)

usually used along with Soft Systems Methodology (SSM). The Soft System Methodology (SSM) was developed by Checkland (1981, 2000) (Armson, 2003; Checkland & Scholes, 1990). The methodology was initially designed for IT analysis of not well-defined business and social systems to avoid technological bias that can overcome human-oriented or social-oriented solutions.

The "rich picture" was primarily designed for system analysis and design of information systems but was also later adapted for teaching, including business education (e.g., Fogliasso, Baack, & Box, 2007). However, there are only a few examples of utilizing this method for single specific non-IT projects or teaching non-IT courses.

The rich pictures are used in our approach to putting everything together (e.g., storytelling, case studies, and visualization).

KNOWLEDGE MANAGEMENT PERSPECTIVE

The next item of the solution is the knowledge management perspective of teaching. In addition to being up-to-date with presented/transferred knowledge, the teacher should be looking for the best method of knowledge transfer to avoid a situation where the lecture may be defined as a transfer of a professor's notes to students' notes with omissions of all brains. A learning process must be two-fold. First, teachers must keep their own knowledge up-to-date; teachers should learn themselves. Second, the teacher, besides transferring knowledge, should implement in students' minds the need for the creation of "knowledge hungry" structures. S/he should, following Chris Argyris (1991), teach intelligent people how to learn for themselves. Teaching from this perspective is not only a matter of transferring facts but also showing the students a way of thinking. The whole project management teaching process may be thought of as a knowledge creation process facilitated by the teacher and supported by the computer based tools.

PUTTING (ALL) THE STORY TOGETHER

The case study process conducted on our lesson generally follows the standard schema presented in Figure 3. However, in our case, the discussion of a case study in teams (Figure 4; Phase 2) is repeated several times along with following its overall analysis of partial results and visualization (Figure 4; Phases 3-4). In phase 4 what we already know (facts) is represented in a formal way to avoid ambiguity.

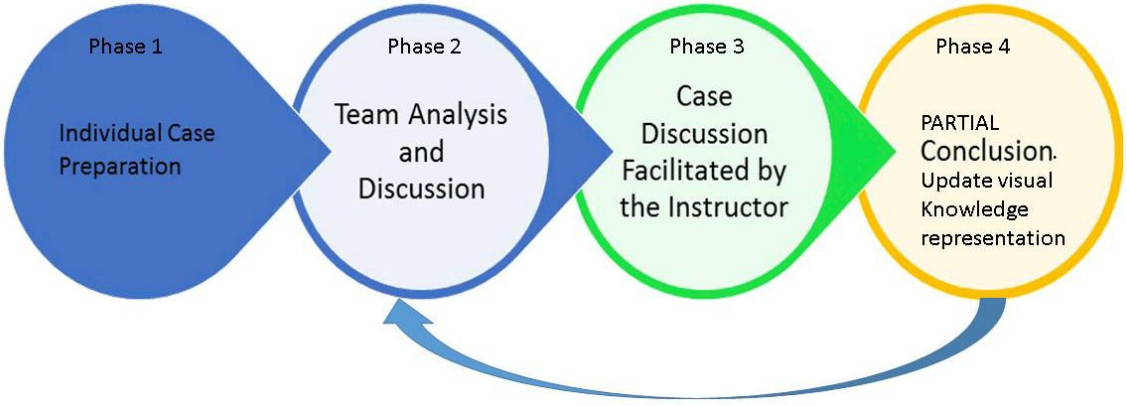

Figure 4. Modified case study (Multisession with instant visualization).

The more detailed process from Figure 4, involving all items discussed earlier, is presented in Figure 5.

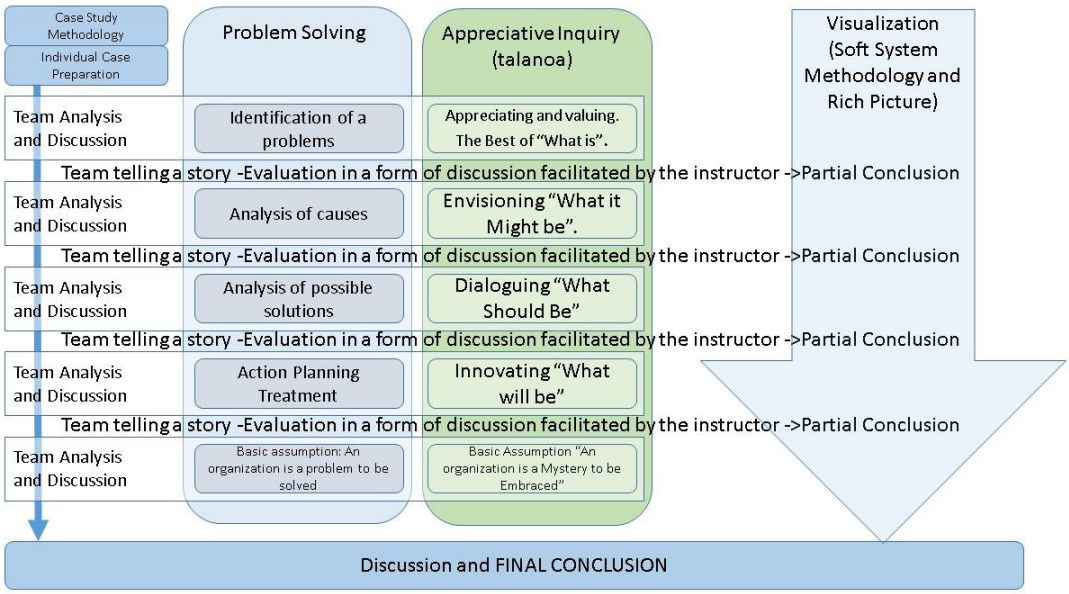

Figure 5. A further development of the case study approach proposed in Figure 4.
The middle part of the picture "Problem Solving" vs. "AI" is based on Cooperrider and Srivastva (1987).

As it was mentioned before the Phase 2, (Figure 4) (the session Team Analysis and Discussion – later referred as TAD) is repeated several times. Each repetition of the TAD is shown in Figure 5 as a row. Each TAD has different topic presented on the right side in the column "Problem Solving" and next column entitled "talanoa" (e.g., the first one has topic "Identification of problems" and "Appreciating and valuing" respectively, the second one "Analysis of Caused" and "Envisioning" respectively, etc.).

After each TAD is a joint session of "Team telling a story – Evaluation in the form of discussion…" (referred later as TTS and containing partially overlapped phases 3 and 4 from Figure 4), where teams present their own results and participate in the general discussion while building the relationship between teacher and students (storytellers) leads to the realization of a "learning village" - a safe, culturally strengthening place appreciated by Pacific communities (Chu et. al., 2013). What we learn together from a story and discussions is instantly reflected as pictorial knowledge representation (marked as "Partial Conclusion" in column rich picture on Figure 5).

Stories are predefined and delivered as one complete piece without interaction in opposition to the analysis process (Kosara & Mackinlay, 2013). Stories naturally lead to questions that lead to discussions, which then leads to deeper analysis. Kosara and Mackinlay (2013) also note that data analysis is faster and more efficient due to interactivity during visualization. During TTS, the instructor is documenting this ongoing process in a way visible to students. The documentation is a visualization of the current knowledge state retrieved from the case, a map showing where we are, and a background for further discussion. The map is an initial base knowledge structure that is extended by incorporating, piece by piece, new information retrieved from multiple teams and full discussions, and information coming from all interactions of the instructor with the students. With time, and along with the discussion, the picture becomes more accurate and more refined. The picture becomes a knowledge base for the knowledge collected from the verbal case. The fact that there are no rules related to rich picture methodology allows students to have their own interpretation and enables their creativity. Pictures give a common understanding shared among all group members of where the problem is, with space for team members' individual opinions.

Each TAD session is a combination of two approaches (Figure 5): traditional formal problem-solving method (column "Problem Solving" on Figure 5), and so-called Appreciative Inquiry (AI). The AI approach has been added to make a whole discussion less formal and allows culturally sensitive teaching. Appreciative Inquiry (Chu et al., 2013; Coghlan, Preskill, & Tzavaras Catsambas, 2003) is an alternative approach to traditional action research because it starts from imagination or verbal visualization of the best situation for system stakeholders, with the subsequent step identification of the problem. AI is based on qualitative, narrative analysis, and storytelling (Whitney & Trosten-Bloom, 2003). AI is also frequently criticized (Bushe & Khamisa, 2005), for example, Appreciative Inquiry does not directly address the problems (Coghlan et al., 2003) and may lead to the unrealistic perception of the problem (Rogers & Fraser, 2003). We believe that some negative consequences may be prevented by fusion of AI (third column in Figure 5) with the problem-solving method – second column on Figure 5 entitled "Problem Solving."

As many cases are complex, it is good to first extract the basic facts together with the students. Those basic facts are, for example, organization details, actors of the drama, problem outline, and additional data, and set up the scene (the story context). In our approach, these facts when visually represented create a basic frame for in-class discussion. When we agree on the interpretation of most of the basic facts, we can proceed to the more advanced issues. More detailed information on visualization contains the next section.

THE EXPERIENCES WITH COMPUTERIZED TOOLS

As mentioned in the previous section, the way of building living interactive and iterative visual representation of the knowledge retrieved from the case requires a particular style of visualization. The visualization process should allow creating a new story, by placing elements, things, relationships between items, to see hidden connections not normally seen after only reading the text. A case study is not a linear, sequential story. It is a bunch of stories, related problems, hidden connections, and not immediately visible dependencies; some items even may be linked to individual experiences of audience members.

There is no one right solution for the case, but instead, there may be several satisfactory solutions. Just simply a reflection of real life. That way of understanding the case study process is about shared experiences of the group making an analysis. The visualization of results should be non-linear similarly to the nature of the case study. It is not just a sequential MS PowerPoint presentation illustrating static facts from the case study. This is also not prepared previous infographics.

The non-linear presentation is partially created by the class and teacher (mostly ad-hoc), what enables discussion, creating a solution together, showing the internal structure of knowledge, and the way of the knowledge construction. The application of this process in practice requires an infrastructure. This may require picture or slide preparation, entering new slides during the presentation, and providing corrections on the fly that are the result of interactions between presenter and audience.

The computerized tool was used at Phase 4 (Figure 5) for documenting the case solving process and creating a visual representation of the actual state of the knowledge collected from the case. The proposed methods require using the appropriate tool for the task. The basic core of the method is the use of continuously updated visualization.

The in-class discussion is parallel to discussion visualization. The tool supporting this process must allow for quickly representing, in graphic form, the result of the discussion to prevent breaks in the stream of the discussion.

Initially, the authors used standard tools like MS Visio (Figure 6) and later Prezi. MS Visio was too slow for quickly representing interaction changes in the structure. Later, when Prezi first appeared, it allowed for the creation of new possibilities for making visualization.

To achieve the advantage and to bring new quality to the classroom, it is necessary to pull up a deep structure of the presented lesson topic to make it visible to the audience by showing the structure of the subject or, even better, to allow students to discover it by themselves, which allows seeing deeper relationships in the presented material. Prezi's advantage is the ability to present knowledge structure in the form of a rich picture from a "bird's eye view" and going in closer at a given point of the structure to see more details. This is possible because Prezi uses the concept of the zoom (or zoom-able) interface that dynamically scales the picture from an overall view of the details, and back and forth.

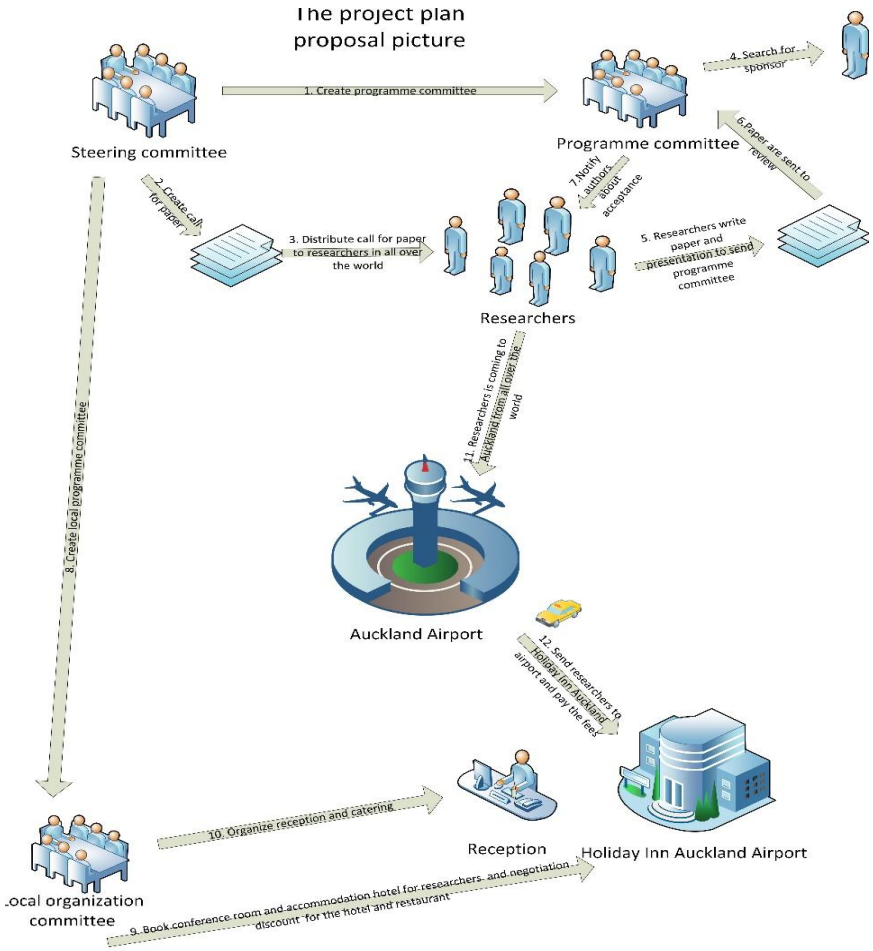

Figure 6. A part of the rich picture for conference organization project made together with students using MS Visio (Zaliwski, 2013)

The zoomable Interface allows users to change the scale of the viewed area to see details. This is a graphical user interface that uses "infinite" virtual desktop and vector graphics for presenting various items on the desktop. The user may move freely in two dimensions, plus zoom the elements on the desktop to see additional details. However, the idea of zoom-able interface dates from1962, an idea by I. E. Sutherland (2003) that does not exist in many applications. The most known are *EagleMode* (http://eaglemode.sourceforge.net/), which thus far is without practical application, *Big Picture* (http://bigpicture.bi/demo), *Topicscape* (http://www.topicscape.com/topicscape-wiki/index.php?title=Topicscape_3D_mind_mapping_structure_explained), and *Prezi* (http://prezi.com), a potential competitor of *MS PowerPoint*.

Prezi's advantage lies not in the attractive form of changing slides because most presentation tools can do that. Most MS PowerPoint users who switched to Prezi still make presentations using the MS

PowerPoint's same sequential philosophy with some additional special effects provided by Prezi. Prezi's advantage that we sought to exploit is its ability to make the non-linear presentation because of zooming. This allows creating presentations (case visualization) in the form of the layered network, which we need to modify on the fly during case discussion facilitated by the instructor. We can go up to more general concepts or go down to see the details. However, to fully exploit these new features it is necessary to see the taught knowledge area as a network of concepts and build-up the new concept upon existing structures. Updating the current state of visualization becomes a problem as we need to switch Prezi from presenting to edit mode, together with picture update; this takes time. If it takes more than a few seconds, students will lose their focus on the discussion topic and make the whole debate (along with instant visualization of current results) less smooth. Similarly, current graphical editors are unusable or tough to use for the visualization purpose. In fact, all of them have two distinctive modes: presentation mode and editing mode. For the update of displayed information, therefore, one must switch back and forth between the modes. To address this problem, we are developing a new tool based on procedural objects generation on *Unreal Engine 3D* (https://www.unrealengine.com/what-is-unreal-engine-4). This tool will not require differentiation between edit and presentation mode.

METHODOLOGY

In 2009, the initial research on two classes of the non-compulsory project management course was undertaken with one group of business students and with one group of IT students. However, both groups took the same project management course. Students in both groups received the same project assignment to realize in 4-5 member teams in about a four weeks' time frame.

Before the assignment, one group was presented a case study where the problem was solved using rich picture methodology visualization created interactively with the participation of all students. (This column is marked as "using the practice" in Tables 2 and 3). The second group was a control group, and the case study was delivered to them in the way usually used to deliver content on MBA courses. The IT group in Table 2 was the "using the practice" group, and the business group was the control group. The next trimester, the business group was the "using the practice group," and IT students the control group (Table 3).

In the year 2009, we searched only for temporary solutions for our current problems without desire to further development of the presented method, so all the results were based only on the comparison of assignment grades (for the groups who used the described practice during the class against the groups which was not used) several weeks after the assignment. On the early years of using the practice also there was no way to create different experimental setup due to lack of enough number of students enrolled.

The research was repeated in 2015, this time in the form of an extensive survey repeated several times, and covering 80 students each time. So far, we use presented practice in a limited manner. Ten weeks (8 hours a week) of a compulsory course in project management was repeated each trimester for about 50-80 students. Each time we made a traditional case study session, after which a survey was done. A week later we made two 2-hours sessions (on two consecutive days) using learning practice described in this paper. For testing purposes, we used the popular "Woody 2000" (Wideman, 2017) case study as this case contains many intertwined streams and allows for the discussion to start on variety topics related to project management. During the sessions, students fill in a team dynamic survey (10 questions). After the second session, students also fill-in a survey containing 53 questions (Likert-type) about individual learning style, teamwork, a way of co-operation and communication, information about the level of understanding of the material, and overall impressions. For the traditional case session and new proposed case session, the same student's groups and teachers were used. The results for some selected questions are presented in Figures 7 and 8 in the next section.

RESULTS

The following results (Tables 2 and 3) are from the 2009 preliminary research based only on the grades achieved by the students after using the suggested practice against the groups of students who didn't use the practice.

Table 2. June 2009 Trimester 2

	Information Technology group (using the practice)	Business Group (not using)
Number of students	14	29
Average grade for the project	78.5	56.5
Standard deviation	3	25.4
Minimum	75	13
Q1	75	52
Median	79	62
Q3	82	80
Max	82	86

Students of information technology learn many various diagrams; it was possible that this skill worked as an advantage for IT students and biased the results. So, the experiment was repeated (Table 3) with reversed initial conditions. All results in Tables 2-4 are based on the students' assignment project grade and stored in our computer system.

Table 3. Sept 2009 Trimester 3

	Business group (using the practice)	Information Technology group (not using)
Number of students	21	14
Average project grade	63.2	57.9
Standard deviation	8.3	5.2
Minimum	55	50
Q1	55	50
Median	68	60
Q3	71	62
Max	74	62

Students' results in the third-trimester results were worse than those of students in the second trimester. However, the difference in results for students using the practice was still visible. IT students even without proposed practice, already do better in various diagramming techniques due to IT courses specific. However, IT students do not have better grades than business students using the practice. So, the difference in result is related to use of the proposed practice, not to previous diagramming skills possessed by the students. Results for the second research made in 2013 are presented in Table 4. The research compared this time only two groups of business students. A project given to students this time was individual – the same project for each student in this semester.

Table 4. Only Business students. 2013

	Traditional way	Using the practice
Number of students	50	41
Average project grade	60.8	65.6
Standard deviation	16.2	13.2
Minimum	32	50
Q1	50	53.5
Median	58.5	64
Q3	74	77.5
Max	100	95

The results of 2015 research are presented below. These results were based on extensive surveys described in the previous section. Among the overall improvement of grades of about 5-6%; we also noticed some interesting results like the improved perception of a teachers' knowledge. The students would perceive the teacher as more qualified more often than before, even if the teacher had not made any progress with his/her qualifications in the meantime. And, we observed the relationship between hearing stories as a child and greater sensitivity of a student for our method. The processing of a large amount of survey data is still in progress, and results will be soon published. Similar results were obtained for human resource courses delivered in 2015.

The selected questions from the survey and their results are shown in Figures 7 and 8. (Five points is the best. The scale is 1-5.)

Questions 1-5 (out of 53):

1. The instructor encourages the student to think.
2. The Instructor is knowledgeable about the subject matter.
3. Freedom to ask questions and express opinions.
4. The effectiveness of instructor in demonstrating the significance of the subject matter.
5. The response from instructor to student's questions.

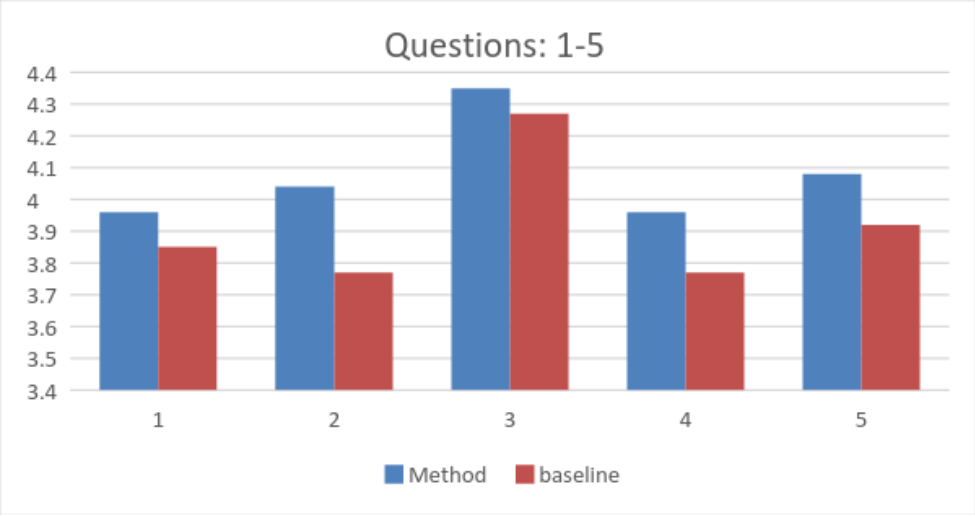

Figure 7. Survey Results (Part 1) (Scale from 1 to 5. Five points are the best).

Questions 7-13 from the same study as above:

6. *Not used in this research.*
7. I feel satisfied when our team performs well.
8. Working on the team expands my personal knowledge and skills.
9. Team members are too different to work together. (In team environment differences of opinions and conflicts becomes more visible, but at the same time appreciation for multiculturalism is visible in the results of the next question).
10. This is a diverse team of people who bring different perspectives and experiences.
11. Finishing the group assignment requires excellent communication and co-ordination (There is no difference because students were told from the beginning about the importance of communication in project management).
12. I learn better when I work or study with others than by myself.
13. I remember things better if I discuss them with someone.

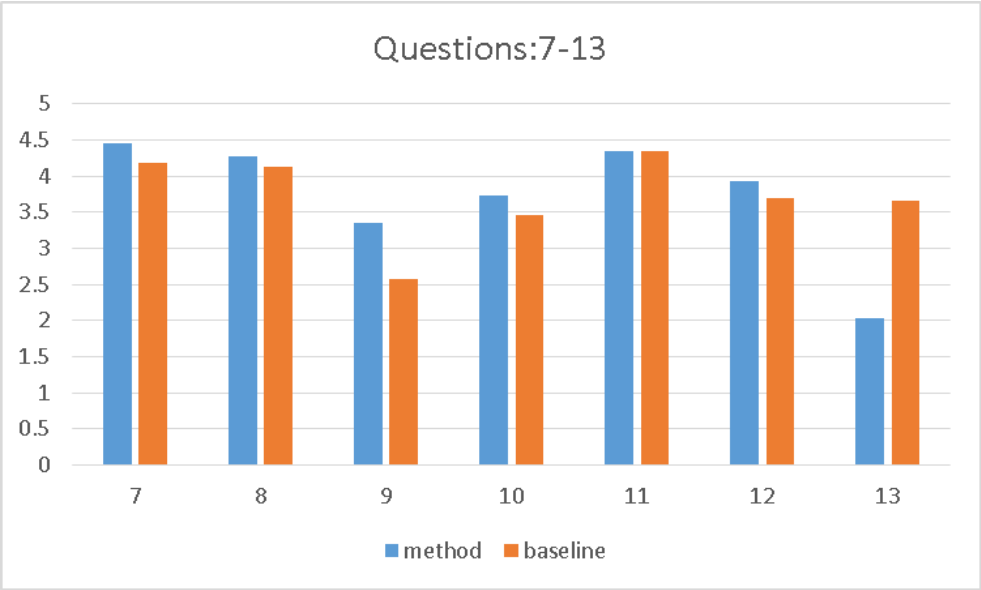

Figure 8. Survey Results (Part 2)

In the list below are presented the experiences and the further development plans collected when using our proposed practice for the last several years:

1. Using zoomable user interfaces like Prezi to allow non-linear presentation where the topic is represented as a network of concepts is too slow and too complicated to make it parallel with in-class discussion. We started to develop our graphical tool for in-class visualization where there is no difference between edit and presentation mode.
2. Preparation of teaching material to allow for non-linear presentation and knowledge construction together with the audience is difficult and time-consuming for the teacher. In our case to provide a proper dynamic of class work, we delivered the practice using two teachers at the same time. What looks like teacher's improvisation during the class is in fact well prepared before the class. We started work on graphical computerized tools helping teachers with in-class preparation. However, "Current technology is changing the nature of stories, but it is not going to make us all a Mark Twain or Steven Spielberg" (Jain & Slaney, 2013, p. 90).
3. We are going to examine in greater depth the potential for blended learning and flipped learning.

4. Few case studies are suitable as background for presented teaching practice. The case study should contain many threads and allow the teacher to be flexible in selecting topics and driving the case discussion. These case studies must be written in further practice.

Further research will describe the presented teaching practice in the context of the theoretical framework provided by the Informing Science discipline. The presented practice will fit to the Informing Science definitions given by Cohen (1999), "the field of inquiry that attempts to provide a client with information in a form, format, and schedule that maximizes its effectiveness", by Gackowski (1982) "informing systems are a class of work systems whose basic output is information that affects recipients' actions", and, "the essence of the Informing Science philosophy is the transfer of knowledge from one field to another: breaking down disciplinary boundaries that hinder the flow of knowledge" (Cohen, 2009). The Informing Science perspective also fits teaching business as in many cases it is teaching decision-making in ill-defined situations.

CONCLUSION

The presented teaching method is not a new way of in-class presentation; rather, it is about controlling and driving the interaction between students and teachers that consider culturally related aspects of the audience behavior. This is about the most efficient realization of teaching goals, improvement of student's educational experience, and improving the employability of our students.

The task is to create a living presentation which will evolve together with our knowledge about the problem and will reflect our struggle with the issue and our position on the way to a solution. The structure should allow seeing both the detailed view of selected fragments and "bird's eye view."

Preparation of education material to allow for non-linear presentation and knowledge construction together with the audience is difficult and time-consuming for the teacher. What looks like a teacher's improvisation during the class should be the result of proper preparation prior to the start of class. The teacher should analyze different variants of rich pictures and choose the most suitable for the given audience, which requires a guess at the range of possible discussion tracks and the imagining of interactions with the public.

The current results show that the proposed method has the potential to improve students' experience in applied business courses. The project is ongoing and will undergo progressive changes while collecting new experiences.

By focusing on the storytelling and rich picture, we avoid technological bias when we teach business problem-solving. Instead, we concentrate on teaching students the social-organizational interactions influencing the problem solution.

Additionally, the proposed teaching solution embedding the cultural sensitivity into teaching process builds upon previous knowledge structures of cultural contexts. Also, using graphical language makes it possible for everyone to understand and to visualize the knowledge creation process and shows where we are now. We apply a Pacific social concept, e.g., *Talanoa*, to teaching business and later technological issues. These concepts together with SSM allows for keeping the balance between the social and technical approach to the system to avoid technological bias. Otherwise, strict application of the IS methodology to business problems may be risky due to technological bias in proposed solutions.

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BIOGRAPHIES

Karishma Kelsey has her Bachelors of Technology (Honors) in Design and Business from the Durban University of Technology in South Africa, a postgraduate in education from the University of South, and postgraduate work in the English language as a foreign and second language.

She is also an active entrepreneur, who runs the fair-trade women empowerment Design Company, where the focus is on the ethical production and sustainable practice of clothing whilst building communities through skills development and several other sustainable practices.

She has successfully created two workshops for women in Thailand and South Africa and is currently creating a workshop in Sri Lanka. She has been an educator of primary and secondary education in six different countries and has been challenged by many of the learning issues discussed in this paper. For the last 16 years, Kelsey has been researching and implementing creative methods of teaching and is passionate about the improvement of education for the empowerment of people. She is currently teaching e-Commerce and previously "Strategic Human Resource Management" at Whitireia NZ. Her current research interest includes analysis of supply chains in fashion industry companies, research commercialization, 3D graphics, and the adoption of game technologies into blended learning.

Andrew J. Zaliwski received an M.Sc. in Mathematics from the M.C. Sklodowska University (Poland) in 1986, and a Ph.D. in Computer Science from the University of Mining and Metallurgy (AGH), Krakow (Poland) in 1992. 1984-1990 he worked at UMCS Lublin (Poland), 1990-2000 as a lecturer at the Computer Science; the University of Economics, Krakow (Poland), and he worked 2000-2001 as the lecturer at the Computer Science Dept., University College Cork (Ireland). 2001 - 2006 he worked at the CUNY New York (CSI) as the business information systems lecturer.

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CLOSING THE DIGITAL DIVIDE IN LOW-INCOME URBAN COMMUNITIES: A DOMESTICATION APPROACH

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ABSTRACT

Aim/Purpose	Significant urban digital divide exists in Nairobi County where low income households lack digital literacy skills and do not have access to the internet. The study was undertaken as an intervention, designed to close the digital divide among low income households in Nairobi by introducing internet access using the domestication framework.
Background	Information and Communication Technologies (ICTs) have the potential to help reduce social inequality and have been hailed as critical to the achievement of the Sustainable Development goals (SDGs). Skills in use of ICTs have also become a prerequisite for almost all forms of employment and in accessing government services, hence, the need for digital inclusion for all.
Methodology	In this research study, I employed a mixed methods approach to investigate the problem. This was achieved through a preliminary survey to collect data on the existence of urban digital divide in Nairobi and a contextual analysis of the internet domestication process among the eighteen selected case studies.
Contribution	While there have been many studies on digital divide between Africa and the rest of the world, within the African continent, among genders and between rural and urban areas at national levels, there are few studies exploring urban digital divide and especially among the marginalized communities living in the low-income urban areas.
Findings	Successful domestication of internet and related technologies was achieved among the selected households, and the households appreciated the benefits of having and using the internet for the first time. A number of factors that impede use of internet among the marginalized communities in Nairobi were also identified.
Recommendations for Practitioners	In the study, I found that use of differentiated costs internet services targeting specific demographic groups is possible and that use of such a service could help the marginalized urban communities' access the internet. Therefore, ISPs should offer special internet access packages for the low-income households.

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Recommendation for Researchers	In this research study, I found that the urban digital divide in Nairobi is an indication of social economic development problems. Therefore, researchers should carryout studies involving multipronged strategies to address the growing digital divide among the marginalized urban communities.
Impact on Society	The absence of an Information and Communication Technology (ICT) inclusion policy is a huge setback to the achievement of the SDGs in Kenya. Digital inclusion policies prioritizing digital literacy training, universal internet access and to elucidate the social-economic benefits of internet access for all Kenyans should be developed.
Future Research	Future studies should explore ways of providing affordable mass internet access solutions among the residents of low-income communities and in eliminating the persistence urban digital divide in Kenya.
Keywords	digital divide, internet domestication, low-income households, digital literacy, Mathare slum

INTRODUCTION

Over the last few years, Kenya has witnessed a phenomenal growth in the use of the mobile internet as affordable mobile internet technologies have been made available for home and office users (Wamuyu, 2015). The availability of cyber cafés in residential areas and low-cost fiber optic cable connectivity to the homes have also resulted in increased use of internet services. Statistics from Communications Authority of Kenya (CAK) indicate that Kenya had 37.4 million mobile data/internet subscriptions by March 2016 (CAK, 2016). The availability of 4G networks, cyber cafés and fiber optic cable connectivity in some of the residential areas in Nairobi has allowed many Nairobi residents to access the internet from the comfort of their homes. This has resulted in increasing demand for knowledge-intensive services as the residents take advantage of the opportunities available in this information-based society. For Nairobi as county to fully leverage the availability of the internet services, all her citizens need to be able to access and use the internet and related services.

The Organization for Economic Co-operation and Development (OECD, 2001) defines digital divide as "the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies and to their use of the internet for a wide variety of activities" (p. 5). Ono and Zavodny (2007) also indicate that digital divide can occur between income groups. Due to the existence of conspicuous social inequalities in Nairobi, and with the absence of any research on the urban digital divide in Kenya, this study started as an open-ended exploration of whether there exists a significant urban digital divide in Nairobi County. Kim (2015) suggests that cities should provide basic infrastructure services such as clean water, sewage, roads, electricity, and telecommunications. Gulyani and Talukdar (2008) studied the infrastructure services available in Nairobi slums including water supply, electricity, drainage, sanitation, and street lighting. Gulyani and Talukdar (2008) concluded that Nairobi slum residents' access to basic infrastructure is appalling. Such social inequalities are said to be the root of the digital divide (Ragnedda, 2017). Consequently, if access to the telecommunications infrastructure in Nairobi slums is also appalling, then there is a growing digital divide between the low-income slum residents who do not have access to the internet and the wealthy middle-class residents who use the internet. The study by Gulyani and Talukdar (2008) did not investigate the presence of the telecommunications infrastructure in Nairobi slums. Ali (2011) suggests that "we should not dismiss the digital divide simply because other divides exist" (p. 219). Thus, this study tries to fill this gap by investigating the extent of internet use among the residents of Mathare Slum as one of the low-income urban communities in Nairobi.

Shenglin, Simonelli, Ruidong, Bosc, and Wenwei (2017) indicate that the digital divide has two aspects: the supply of digital infrastructures and the levels of internet use and abilities in using Information and Communication Technologies (ICTs) and internet services. Telecommunications infrastructure, personal computers, and digital literacy skills are prerequisites for internet access. Thus, the study posits that "the absence of digital infrastructures can be explained by the levels of internet use and abilities in using ICTs and internet services." Grounded on this proposition, the study surveyed digital divide in Nairobi.

Nairobi is the capital city of Kenya and has different residential areas, each of which depicts different housing conditions. According to the 2009 population and housing census (Kenya National Bureau of Statistics, 2010), Nairobi County has a population of 3,138,369. Umoja and Mathare were purposely selected as the study locations. Mathare Sub-Location of Nairobi County has a population of 20,463, while Umoja has 50,739 residents. From the city center, Umoja is situated about fourteen kilometers, while Mathare Slum is approximately six kilometers away. These two distinct electoral areas in the Nairobi County have different socioeconomic populations. Umoja is a middle-income housing estate whereas Mathare is a low-income slum area. Currently, 60% of Nairobi residents live in slums (Candiracci & Syrjänen, 2007). Provision of essential public services in Nairobi's slums is lower compared to what is offered at the County-level. A report by UN-HABITAT (2003) indicates that government agencies see slums as temporary or illegal and, hence, they are reluctant to invest in extending public services such as water supply, electricity, drainage, sewerage, garbage removal, and street lighting.

Digital divide occurs when there is a marked gap in access to or use of ICT devices (Campbell, 2001). The existence of digital divide in Nairobi slums could have an adverse impact on the residents' prospects as governments (at county and national level) and businesses are increasingly delivering their services online. Studies have also shown that regular computer use is positively correlated with self-esteem, motivation (Reaux, Ehrich, McCreary, Rowland, & Hood, 1998), and problem-solving (Mayer, Quilici, & Moreno, 1999). The success of youths from low-income communities such as Mathare Slum in the labor market is also attributed to their ability to use, adapt, and transfer technology and knowledge-based skills (Harris, 2005). Computer skills are also part of the prerequisites for many jobs in today's job market (Mor, Laks, & Hershkovitz, 2016). Thus, being on the wrong side of the digital divide can be devastating for any individual, and efforts must be made to achieve digital inclusion for all.

Rao (2005) suggests that any endeavor to reduce digital divide should take care of access, knowledge, and content. To understand how the internet and related technologies could become part of the Nairobi residents' everyday life, in this research study, I chose to use the domestication approach. This method has been applied in the past to investigate the adoption of households' media technologies such as the telephone, radio, and television (Pierson, 2006). It has also been proved to take a wider range of variables and application contexts than the other information technology adoption models such as the Davis's Technology Acceptance Model (TAM) (Davis, 1989) and Roger's Diffusion of Innovations Theory (Rogers, 2003). Equally, use of the domestication approach suits the study as the domestication model is sensitive towards the technology user, the social conditions, and the environment of use (Hynes, & Richardson, 2009).

In this study, I used a sequential explanatory strategy, which is characterized by the collection and analysis of quantitative data followed by the collection and analysis of qualitative data. Qualitative data was collected through observations, in-depth semi-structured interviews, and the records on internet access and usage by the household members. Quantitative data collection method was a survey using a pre-tested questionnaire.

In this study, my main objective was to investigate the existence of digital divide among the Nairobi residents and to explore how the domestication approach can be used to close the gap. Bhuiyan (2011) indicates that the development of a country can be mainly achieved through the improvement

of the socio-economic circumstances and quality of life of the marginalized and poor citizens. By choosing to close the digital divide, this would improve the living conditions of the Mathare Slum residents and hence the general economic development of Nairobi.

The next section is a review of the literature. The third section describes the study's methods while the fourth section gives the study results. The fifth section discusses the study finding, and the sixth section reflects on the success of the study, its conclusion, and directions for further research.

LITERATURE

Over the years, Information and Communications Technologies (ICTs) have become more affordable in most of the developing countries while internet access has become increasingly ubiquitous. The internet has continued to change the way people go about their daily lives, especially in areas such as learning, shopping, and communication. However, the opportunities afforded by these advances in ICTs are only available to a few as the technology access gap between wealthy and poor exists (Collier, 2008; Ochara & Mawela, 2015; Wamuyu, 2017). This Information and Communications Technology (ICT) access gap is commonly referred as the digital divide. The digital divide between the developed and the developing countries has continued to decrease as most developing countries continue to invest in expanding their ICT infrastructure. This increased investment in ICT infrastructure is evidenced by increase in the number of internet and mobile phone users in many developing countries such as Kenya. However, a digital divide between different demographic groups within the developing countries persists.

DIGITAL DIVIDE

The Organization for Economic Co-operation and Development (OECD, 2001) defines digital divide as "the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access ICTs and to their use of the internet for a wide variety of activities" (p. 5). Campbell (2001) defines digital divide as "situations in which there is a marked gap in access to or use of ICT devices" (p. 8) and concludes that there is clear evidence that such a divide exists between and within countries. Ono and Zavodny (2007) indicate that digital divide can also occur between genders, ages, education groups, income groups, racial, and ethnic groups. Wijers(2010) defines digital divide as the inequality in use and ownership of computers and the internet across nations, while Vehovar, Sicherl, Hüsing, and Dolnicar (2006) describe it as the socio-economical difference in the use of ICTs. Rao (2005) suggests that digital divide could be explained by the differences in "access to information, the internet, and other information technologies; in skills, knowledge, and ability to use information and other technologies based on race, gender, geography, economic status and physical ability" (p. 3).

Since the liberalization of the Kenyan ICT sector in 1998, Kenyan economy has had massive ICT infrastructure investments by local and international investors offering a broad range of telecommunication services (Wamuyu, 2015), thus reducing the costs of ICTs access and ownership. The presence of mobile data/internet services has also led to growth in data/internet subscriptions. Statistics from Communications Authority of Kenya (CAK, 2016) indicate that there are 24.8 million internet subscriptions with an estimated figure of the number of data/internet users at 37.4 million. Even though these numbers are estimates using the recommended International Telecommunication Union (ITU) formula, urban internet divide in Nairobi is huge. An initial survey done in February 2016 in the course of this study (see Table 4 later in this paper) showed the existence of urban digital divide in Nairobi. The preliminary study indicated that the number of households accessing the internet in Mathare Slum is very low compared to the households accessing internet in Umoja Estate. Thus, this indicates that urban digital divide exists in Nairobi. Digital technology is known to intensify existing inequalities and to create new inequalities (van Dijk, 2005). Closing this digital divide could open a list of *e-everything* (including e-business, e-learning, e-commerce, e-government, and e-participation) for the residents of the Mathare Slum. It also could promote e-inclusion and an in-

crease in the number of digitally included and digitally empowered people in Nairobi. In this study, I use the term digital divide as defined by Belanger and Carter (2009) as a distinction between individuals that have access to ICTs and skills in ICT use and those without, within various demographic groups.

Digital Literacy

Digital literacy is defined as the ability to find, evaluate, utilize, share, and create content using information technologies and the internet (Cornell University's Digital Literacy Resource, 2016). Digital literacy is usually associated with digital competence and computer user self-efficacy. Ferrari (2012) indicates that digital competence is a combination of information skills, communication skills, content creation skills, safety skills, and problem solving skills. Computer user self-efficacy is an individual's judgment of one's capabilities to use computers (Bandura, 1986). Regular computer use has been found to be positively correlated with problem-solving (Mayer et al., 1999). Positive computer self-efficacy has been shown to be related to willingness to choose and participate in computer-based activities (Holcomb, Brown, Kulikowich, & Zheng, 2003). Computer self-efficacy is also essential to access and benefit from the internet. Vaičiūnienė and Mažeikienė (2016) point out that "when people have digital and media literacy competencies, they recognize personal, corporate and political agendas and are empowered to speak out on behalf of the missing voices and omitted perspectives in our communities" (p. 84).

In the context of this study, digital literacy refers to the ability of an individual to create and exploit digital contents to meet the demands of a dynamic digital society. It considers the broader definition by Hobbs (2010) which describes digital literacy as "the ability to use computers, social media, and the internet" (p. 17). Computer literacy skills are crucial to success in today's economy. Tharanganie, Wickremasinghe, and Lakraj (2011) posit that "computer literacy is a mixture of awareness of the computer's importance, knowledge of what computers are and how they work, and ability to interact with computers" (p. 15). The study elected to conduct digital literacy training as Kher, Downey, and Monk (2013) indicate that computer training positively influences computer self-efficacy. Laganá, Oliver, Ainsworth, and Edwards (2011) also suggest that computer self-efficacy is usually increased after computer training.

The Domestication Approach

Studies on technology adoption and use falls in three schools of thought: diffusion, adoption, and domestication (Pedersen & Ling, 2002). Domestication is defined as processes whereby people encounter the technologies and deal with them, either rejecting the technologies or fitting them into their everyday routines (Haddon, 2006). Domestication approach focuses on the process in which technology becomes an integral part of a user's everyday habits (Manueli, Latu & Koh, 2007). It emphasizes on the process by which a technology finds its way into individuals' daily lives and becomes part of their day-to-day activities. As opposed to the other technology adoption models, Haddon (2006) indicates that the domestication framework explores adoption, usage, gratifications, and the roles the new technologies come to play in the new user's lives. Fischer (1992) used the domestication approach to analyze how the telephone technology permeated and transformed the essence of daily activities. Silverstone and Haddon (1996) used the same method to study the use of television and personal computers at home.

Y. Chen (2013) used the domestication framework to study tablet computers and e-readers adoption and usage in the United States and Taiwan. Chigona, Chigona, Kausa, and Kayongo (2010) also used this approach when conducting an empirical survey on the domestication of ICTs in schools serving the disadvantaged communities in a developing country context using the case of South Africa. Another study that the researchers have used the domestication approach is by Hijazi-Omari and Ribak (2008) where the approach was used to explain mobile phone usage among Palestinian teenage girls in Israel. Bolin (2010) used the approach to compare the use of voice calls and texting by youths in

Sweden and Estonia. Letsie, Kabanda, and Chigona (2015) applied the methodology to explore how economically disadvantaged families were domesticating mobile devices in South Africa. Kibere (2016) employed the domestication approach in an ethnographic case of how the youth of Kibera appropriate new media and ICT technologies. Using the domestication theory, Hahn and Kibora (2008) found out that there was unexpectedly rapid process of domestication and appropriation of the mobile phone by both rural and urban populations in Burkina Faso. Richardson (2009) used the domestication theory to probe the domestication of ICTs in gendered UK households. Richardson (2009) indicates that "the domestication of ICTs remains a neglected area of academic research" (p. 607). Therefore, this study is an endeavor to add to the literature on technology domestication.

Frissen (2000) describes the domestication approach as a three stage model including Commodification, Appropriation, and Conversion, while Habib (2005) suggests a four stage process by splitting the appropriation stage into objectification and incorporation stages. Silverstone (1994) identifies six moments of domestication: commodification: imagination, appropriation, objectification, incorporation, and conversion. These six stages are described in Table 1.

Table 1. Six Stages of the domestication approach

Stage		Definition
Pre-domestication	Commodification	The industrial and commercial processes of bringing products to market
	Imagination	The work of advertising in rendering commodities as objects of desire and the way a product enters the consciousness of consumers
Appropriation		The product comes into the home and is adapted to the household – Actual usage
Objectification		How the product is used in the household
Incorporation		How the product is used as it becomes embedded into daily routines of the household
Conversion		How the product fits into the household and family

Source: Habib & Cornford, 2001; Silverstone, 1994; Silverstone, Hirsch, & Morley, 1992.

Domestication theory has not been applied in studies on narrowing the digital divide among the low-income urban communities. By studying the introduction of computers and the internet using the domestication model, I will be helping in the understanding of how these technologies could get into a low-income household, become embedded into the household's daily routines, and be adopted by the low-income urban communities. I will also be contributing in identifying the impacts of the household internet domestication among the low-income urban communities.

HOUSEHOLDS

For the purpose of the study, a household as a whole was the focus of the analysis. Scott (1997) defines a household as "a group of people living together under the same roof and sharing basic accommodation facilities" (p. 593). The choice of a household as the study object was guided by Aarsand, (2007) and Mesch (2006), where it is suggested that ICTs are known to have a positive impact on households' relationships by uniting and bringing family members together, an indication that ICTs can help to develop resilience in a family unit. Each study household was provided with a laptop, offered digital literacy training and unlimited internet access.

Use of computers, social media, and the internet is essential for everyday work and life in our connected, globalized and digitalized world. Abuiyada, Rauff, and Eteiwi (2016) indicate that most families use home internet for e-mail, entertainment, education, news, and online discussions. Hence, to get a snapshot of the household's use of the internet, each household was requested to record its members' online activities and the duration of their everyday online events. The activities to be registered included the time spent online, a number of domains visited, social networking sites used and sending e-mail messages.

In this paper, I seek to contribute to the dialogue about digital divide in developing countries and how internet domestication among marginalized communities living in the urban slums can be used in addressing the persistent digital divide in most developing countries' cities.

METHODOLOGY

In this research study, my main objective was to investigate the existence of digital divide among the Nairobi residents and to explore how the domestication approach could be used to bridge the digital divide. The researcher used a mixed study approach, which involved collecting both quantitative and qualitative data in two-phases. This was achieved through a preliminary survey to collect data on the existence of digital divide and use of the domestication approach to narrowing the divide using multiple descriptive case studies. The use of multiple case studies was to have a context analysis of the internet domestication process in a contemporary real-life situation among the selected study households. The decision to use the case study approach is because the case study methodology is considered a robust research method, particularly when a holistic, in-depth investigation on community-based problems such as poverty, unemployment, drug addiction, and illiteracy is required (Johnson, 2006). In this study, I would like to have an in-depth investigation on the digital divide among the Mathare community.

PRELIMINARY STUDY

The preliminary survey was accomplished using a hand-delivered questionnaire (Appendix A). The questionnaire was developed to collect data on the computer proficiency skills and use of the internet based on the basic computer literacy guide by Tharanganie et al. (2011). The questionnaire was modified to match the objectives of this research study. To enhance the validity of the questionnaire, a pilot study was conducted. The pilot study was a try-out of the questionnaire to identify any unclear or ambiguous statements in the questions. During the pilot study, a pre-tested survey questionnaire was hand-delivered to twenty respondents selected randomly from the two study locations. Sixteen questionnaires out of the twenty delivered during the pilot study were filled out properly and were used for piloting the questionnaire. After the pilot study, the respondents from Mathare Slum and Umoja were approached and informed about the purpose of the survey, and they were given the questionnaires. Two hundred and forty questionnaires were delivered to the residents in the two study sites.

CASE STUDY

Any endeavor to reduce digital divide should take care of access, knowledge, and content (Rao, 2005). To achieve this, the study was to provide the households with the necessary ICT resources, including internet access devices, digital literacy skills training, and free internet access. For the context analysis of the internet domestication process, data was collected through record keeping, observations, and in-depth semi-structured interviews. The case study households were selected based on the data collected during the preliminary study and was based on the following criteria.

- The household did not have a mobile phone that could access the internet;
- The household did not have anyone accessing the internet;
- The household did not have anyone with an email address;

- The household did not have anyone using social media;
- The household did not have a computer;
- The household had someone interested and willing to undertake the digital literacy training;
- The household was willing to participate in the study voluntarily.

From the Mathare Slum's preliminary survey questionnaires that were properly filled out by the respondents, seventy-eight households met the above-specified criteria. Eighteen households were randomly selected as the case study households. The empirical data was collected from the eighteen case studies using record keeping, observations, and in-depth semi-structured interviews over a period of three months. The interview guide is attached as Appendix B. Voluntary participation forms were provided as "informed consent" from the participants was required as several visits were to be made to the participants' private settings in their households. During the study period, the research team were overt participants as described in Silverman (2007). The subjects were informed prior to the study that they had the option to decide on whether to participate in the study or not. The participating households were then allowed to choose one of the family members to take part in the five weeks' digital literacy training. Throughout the study process, research ethics and regulations provided by the study team's University were adhered to. The participants were also informed of the purpose and significance of the study to the marginalized communities in Nairobi. Table 2 gives the compositions of the eighteen households selected as case studies.

Table 2. Characteristics of the eighteen selected households

Household	Ages: Lowest to the Highest	No. of Males	No. of Females	Household Composition	Digital Literacy Trainee
Household 1	15 – 52	3	5	2 Parents, a Grandmother, 5 Adult Children	Son
Household 2	6 - 45	2	3	2 Parents and 1 Adult Child and 2 Children	Daughter
Household 3	2 – 28	1	2	2 Parents and 1 Child	Mother
Household 4	8 – 38	1	4	2 Parents and 3 Children	Father
Household 5	18 – 58	1	3	1 Parent, a Grandmother, and 2 Adult Children	Daughter
Household 6	7 – 45	3	3	2 Parents, 2 Adult Children, and 2 Children	Son
Household 7	8 – 47	2	2	2 Parents and 2 Children	Mother
Household 8	9 - 48	5	1	2 Parents and 3 Adult Children and 1 Child	Cousin
Household 9	22 – 59	3	2	2 Parents and 3 Adult Children	Son
Household 10	17 – 64	2	5	1 Parent, a Grandmother, and 5 Adult Children	Daughter

Household	Ages: Lowest to the Highest	No. of Males	No. of Females	Household Composition	Digital Literacy Trainee
Household 11	12 – 48	2	2	2 Parents, 1 Adult Child and 1 Child	Daughter
Household 12	17 – 65	4	2	2 Parents, a Grandmother, and 3 Adult Children	Father
Household 13	4 – 30	2	2	2 Parents and 2 Children	Mother
Household 14	24 - 60	1	3	2 Parents and 2 Adult Children	Daughter
Household 15	2 – 28	2	3	2 Parents and 3 Children	Mother
Household 16	1 – 31	1	2	2 Parents and 1 Child	Mother
Household 17	19 – 52	1	3	1 Parent and 3 Adult Children	Son
Household 18	8 – 46	3	3	2 Parents, 2 Adult Children, and 2 Children	Daughter

PROCEDURE

The study participants were provided with the necessary ICT resources, including internet access devices, digital literacy skills training, and free internet connectivity. The selected households were supplied with the following resources:

- 1 Laptop (Google Chromebook)
- 1 Internet access dongle (Telkom Modem) with unlimited internet
- 1 Logbook to record their overall daily internet use (household internet usage record book)

Due to the challenges of lack of adequate requisite infrastructures such as electricity, arrangements were made to collect the laptops every morning for charging and returning them to the households early afternoon when fully charged. The digital literacy trainees were provided with a five-week digital literacy training program. The training program was guided by the following Learning Outcomes, Table 3.

Table 3. Digital literacy training outcomes

No.	Description
1	Describe the role of computers and the internet in today's society and provide examples of their impact on businesses, communities and individuals.
2	Identify different internal and external components of computer hardware.
3	Demonstrate the use of Word-processing (Microsoft Word Online and Google Docs).

No.	Description
4	Demonstrate the use of Spreadsheets (Microsoft Excel Online and Google Sheets).
5	Discuss the importance of internet privacy and security.
6	Demonstrate the use of Presentations (Microsoft PowerPoint Online and Google Slides).
7	Demonstrate the use of Social Media (LinkedIn, Google +, Facebook, Twitter) and blogging (to build a *blog*).
8	Demonstrate use of Calendar to organize appointments, update agenda, plan events, and stay on time.

The learning outcomes were meant for the trainees to acquire five of the six key skills of computer literacy as defined by Tharanganie et al. (2011). These six skills are:

1. Skills in basic hardware and basic operating system functions – Identifying computer parts, powering up and powering down the computer, open/save files, recognize different file types
2. Skills in word processing – Create/save/print documents, insert tables/charts/ labels/symbols, format page layout (margins, page numbers, page borders)
3. Skills in spreadsheets – Create/save/print spreadsheets, insert tables/charts, insert functions/formulas
4. Skills in presentation graphics – Create/save/print slide shows, insert new slide/layout/tables/charts, create animations
5. Skills in databases – Design basic databases with queries and reports/forms
6. Skills in internet and e-mail – Surfing the internet and sending e-mail messages.

The skill number five (5) was deemed an advanced proficiency which would require extra training lessons. Instead, use of social media and personal information management using Social networks sites and calendar respectively was taught. This included training on the benefits and uses of social media in participants' daily lives, awareness on how users of social networks share their personal information consciously or unconsciously, and how to use calendars to coordinate and schedule activities.

Closing the Digital Divide

After the five weeks' digital literacy training program and another extra three months in which the members of each participating household had the internet access resources to use the internet, semi-structured interviews were used to collect data. This was done at the end of the intervention through the domestication process. Since the study adopted the Hobbs (2010) definition of digital literacy as "the ability to use computers, social media, and the internet" (p. 17), the interviews were used to measure the use of digital literacy skills, internet access, and use of social media. Use of these three measurements was to assist in assessing digital and media literacy competencies of the members in each of the particular household.

Households Intentions to Continue using the Internet

Bhattacherjee (2001) suggests that continuance intention is influenced by user satisfaction and post-acceptance usefulness perceptions. The study did interrogate the intentions of the household mem-

bers to continue using the internet beyond the project. Successful reduction in the urban digital divide in Nairobi would occur if the study household members continued to use the internet when the ICT resources provided for by the project were removed from their homes. Therefore, the study examined the challenges that could impede the members of the study households' use of the internet outside the study project.

FINDINGS

DESCRIPTIVE ANALYSIS

In this study, descriptive data were collected using a questionnaire during the preliminary survey. Record keeping, observations, and in-depth semi-structured interviews with the members of the participating households were used to collect data for the duration of the internet domestication process. During the internet domestication procedures, the interviewers provided an opportunity for the participants to amend their responses and provide feedback if needed.

Preliminary survey

Two hundred and eight questionnaires were properly filled out by the respondents, yielding an 87% response rate. This included one hundred and one duly filled responses from Mathare Slum and one hundred and seven properly filled responses from Umoja. One hundred properly filled-out questionnaires were randomly selected for use in the data analysis for each of the study sites.

The preliminary study indicated that the number of households accessing the internet in Mathare slum was very low compared to the households accessing internet in Umoja. Table 4 shows the number of households with a household member accessing the internet, while Table 5 indicates the presence of digital literacy skills in the households. Table 4 indicates that in all the households in Umoja, there was a household member accessing the internet using one of the many internet options available, while in Mathare, inadequate digital infrastructures such as lack of electricity installations and broadband connectivity limit the choice of internet subscriptions the residents can access. Only sixteen households in Mathare Slum had a member accessing the internet. Use of cyber café was included as an internet connectivity option as accessing the internet in cyber cafés is probably still more economical than acquiring domestic facilities for some people. Internet access at cyber-cafés is also a way of sharing the cost of internet access amongst several users (Wamuyu, 2015). Therefore, the study results indicate that the existence of internet divide in Nairobi is characterized by lack of computer literacy skills, low internet access, and inadequate ICTs and related infrastructure.

Table 4. Internet Access Divide in Nairobi

Type of internet Access	Umoja n=100	Mathare n=100
Home Mobile Data	100	12
Home Fixed Wireless Data Subscriptions	36	0
Home Fixed Fiber Optic Data Subscriptions	44	0
Cyber Café	72	4

The preliminary study found existence of low digital literacy skills and very little post-secondary school education or training among the members of the households in Mathare slum as indicated in Table 5. It was noted that in Umoja estate the number of households using fiber data connection was 44%. This could be attributed to the fact that an Internet Service Provider (ISP) is offering a cost differentiated internet access service at the cost of one thousand Kenya shillings per month per household (approximately, nine US dollars) for 1Mbps service to the residents. Some respondents

were also using social media without necessarily having to connect to the internet. They were using a service provided by a telecommunication company which allows the use of "UNLIMITED SMS service" to access Facebook and Twitter SMS services.

Table 5. Digital literacy skills

Residence	Households with a family member with digital literacy skills n=100	Households without a family member with digital literacy skills n=100
Mathare	22	78
Umoja	100	0

Case study results

Each household was considered as a separate unit of investigation. A total of eighty-nine respondents were interviewed from the eighteen participating households. The cumulative internet usage of the members of each participating household during the study period is shown in Table 6. Four measures of internet use were continuously recorded for five days a week over a period of three months in each participating household including the time spent online every evening the house had the Chromebook (hours per day), number of domains visited, social networking sites used, and number of emails sent (per day). To allow participation from every family member of a household, in-depth semi-structured interviews were conducted with the family as a group. Similar to Abuiyada et al. (2016), most of the study households spent more than three hours online as shown in Table 6. The households were also using the internet for online communication, with most households using the internet to visit different social internet websites and for sending and receiving e-mail messages as presented in Table 6.

Table 6. Members of the participating households' ICT resources usage per day

Measure		Frequency
Time spent online hours per day	>=3 Hours	14
	<3 Hours	4
Average Number of domains visited per day	>=3	11
	<3	7
Social networking sites used per day	3>=	16
	<3	2
Number of e-mails sent per day	>=3	12
	<3	6

At the end of the intervention, the study measured, the types of activities for which the participants were using the internet. Table 7 summarizes the online activities of the study participants. The study found that most of the study participating households were using the internet for getting the local news, social communication, entertainment, and information search.

Table 7. Household Internet uses

Measure	Frequency
Watching news on the internet	18
Chatted online and Social Communication	18
Citizen participation (Comments on newspaper websites, political forums, open debates)	15
Contacting government agencies (e-government)	10
Online Shopping	4
Information Search	16
Games and Entertainment	18
Use of e-mails	18
Education	5

There is an array of benefits in having fast and affordable internet access. The members of the participating households were asked their opinion of whether they thought that using the internet could enhance their family life. All the participants indicated that internet usage would impact their family lives positively as they were now aware that using the internet means access to information, entertainment, and communication networks.

The individual household members who participated in the digital literacy training program were then assessed on their perceptions of their digital literacy skills level associated with the use of computers and the internet, and the results are given in Table 8. With the exception of creating a blog and using an online calendar, the study participants indicated that they had acquired the requisite digital literacy skills and could now independently use internet and computers. Two of the participants indicated that the training had *enhanced their potential for employment and future career prospects*.

Table 8. Digital Literacy skills

How would you describe your proficiency in the following activities	I cannot do this	I can do this with some assistance	I can do this independently	I can teach others how to do this
Using search engines such as Google, Bing, to search for information on the web	0	0	6	12
Creating a blog	1	3	10	4
Video streaming	0	0	12	6
Using a Word-processor	0	0	10	8
Using Spreadsheets	0	2	12	4
Using Presentations	0	1	10	7
Using Calendar	0	3	13	2
Describe components of a computer	0	1	1	16
Use of social media such as Twitter, Facebook, or Instagram	0	0	4	14

Domestication of Internet and Internet Access Resource Tools

To collect the qualitative data on the internet domestication processes, multiple informal visits to the homes of the participating families and their neighbors were done. During the visits, the interviewer would use the records documented in the *household internet usage record book*, one-on-one individual interviews, and group interviews with the family members and their neighbors to explore how the internet usage was spreading through each household and its neighborhood. To analyses how the internet usage had spread through each household, the interviewer gave the participants the opportunity to talk about the information recorded in the household internet usage record book and to share their experiences in the use of the internet. This section gives the results of how the members of the participating households domesticated the internet resources that were provided to them by the study team. The section uses the four phases of the domestication methodology, namely, appropriation, objectification, incorporation, and conversion.

Appropriation

According to Silverstone et al. (1992), an artifact is appropriated at the point at which it is sold, leaves the world of production, and is taken possession of by an individual or household and owned. The study team did spark the households' desire to use the internet access resource tools by introducing the project to the members of the households through the distribution of information on the purpose and benefits of the study to the Mathare Slum community. The households did appropriate the devices by accepting to have them in their homes with the perception that the tools will help the participants achieve something new and, hence, the need to have the technology integrated into the daily habits of their homes. The family in Household 6 was excited to have a computer with internet connectivity at home. The father excitedly said, "My children have a chance to be like my employer's kids." He had over the years seen the children of his employer using computers in one of the affluent neighborhoods in Nairobi where he has been working as a gardener for 12 years.

Prior to the Mathare Slum internet domestication project, the selected study households did not have access to the internet or any of their family members using the internet. Most of the households had only remote knowledge of uses and applications of the internet. The grandmother in Household 5 said, "I can't believe that I will have this device at home, I have only touched it once, and that is during the last general election registration exercise." The young adults in Household 10 were very excited and enthusiastically accepted the ICT resources and were eager to use the internet. However, their grandmother was very hesitant. The grandmother had to be convinced that the internet is useful, has a number of advantages, and those without access to it are missing out educationally and socially. The respective study households' members were trained on how to use the computers, access the internet, and social media fundamentals. Training and counseling were done to reduce the anxiety and ageism stress associated with the introduction of the ICT resources to individuals who were less technologically literate among the study households. Appropriation of the technology was achieved when the study households started to objectify the ICT resources delivered to them.

Objectification

This is the stage where the internet access resource tools were placed within the homes and the study households encouraged to get used to them. For example, instead of listening to the radio, Household 17 could now stream live prime time news. Enthusiasm and excitement were evident, and the members of the household were eager to share their experiences with the ICT resources. The households' members recognized that they were spending most of their evenings using the internet productively.

Most household in Mathare Slum cannot afford the ICT resources necessary to access the internet. Therefore, having the ICT resources at home gave the household members something more than just the functional significance of the ICT resources. The young man from household 17 said, "It is cool to have the internet at home. I now think that I should pursue a career in computer science. I

am really enjoying the digital literacy training." This was an indication that the presence of the ICT resources at home was giving a sense of academic optimism among the young study participants. It also shows the perceived social status attached to owning ICT resources among the marginalized communities. A teenage daughter from Household 5 was happy to have internet access as she was planning on starting a career in modeling and performing arts. She said, "I am using the internet to search information on how to pursue a professional modeling career. I have even sent emails to modelling agencies and am now learning new modelling skills online. I am also using the internet to grow my talent through videos and motivation talks from other fashion models. I am even considering having my own 'slums fashion blog." This is an indication that the participants were proud of themselves and their households.

Incorporation

At this stage the participants were actively using the internet every evening that they had the internet access resources at home. The digital literacy training provided to the members of the participating households contributed to the objectification and incorporation of the internet access resource tools. Members of the households were now exploring and discovering new ways and aspects of using the internet at home. The mother from Household 3 was happy that she now had the skills that once had her miss a job opportunity. She was excited to have the basic computer literacy skills and said, "I was given a good job offer, only to lose it because I didn't have computer skills." She was now using online recruitment websites and also emailing her job applications to her prospective employers. Like the mother from Household 3, most of the study participants had confidence in using the digital skills they had acquired from the digital literacy training program.

In most households, families took turns using the ICT resources. In Household 18, family members were using the Internet for different online activities. The children aged 8 and 11 were enjoying playing online computer games and watching pre-downloaded videos. The two teenagers were checking out for interesting academic materials and random online chat with friends and relatives. The father would be watching the news, searching for information on what is happening in the slum, or updating his social network status. The mother would be using the internet to look for interesting designs for her road-side boutique and participation in the local women group discussions. The teenagers were now ICT specialists and would invite their friends for some computer literacy lessons. Vuojärvi, Isomäki, and Hynes (2010) suggest that "successful domestication comes about when the technology is successfully embedded within the daily routine and habits" (p. 261). The diversity in the number of activities that the members of Household 18 were involved in provides the evidence of successful domestication of the ICT resources.

Conversion

Apart from sharing the ICT resources within the homes, the study participants shared the resources with their neighbors. Conversion deals with the neighbors' understanding of the household's relationship with the technology being domesticated. At this stage, the household members were using the internet for social communication, citizen participation, and seeking information. The households were also sharing the internet access resource tools with their neighbors by inviting them over to access the internet in their homes. The children would let their neighbors join them in enjoying the pre-downloaded videos or playing an online game.

After successfully finishing the digital literacy training, the father of Household 4 routinely invited his relatives residing in the neighborhood for basic computer literacy training and internet access in his house. He said, "I want all my family members to use the internet to communicate and share photos with my brother working in Uganda." His desire and determination to be a digital citizen were impeccable. He had to attend the digital literacy training every morning (9:00-11:00 a.m.) on weekdays before heading to his makeshift roadside kiosk where he was working as a cobbler. He never missed a training session. The study team had a chance to have him explain to his spouse how he had man-

aged to store their family photos in the cloud so that they could access the photos at any time and from anywhere after this study project.

DISCUSSION

The internet and social media have significantly affected the way people spend their evenings at home. Many people are using the internet to interact and share information with friends and followers outside the confines of their sitting rooms (Wamuyu, 2017). The study collected data on internet usage, internet self-efficacy, and computer literacy. The study results show that most residents of Mathare Slum lack access to the ICTs. In the current networked and globalized world, this lack of access to ICTs indicates that the people living in Mathare Slum have been denied the opportunity to adequately participate in this information-based society. The study has demonstrated the utility of the domestication theory in introducing internet access in the households among the marginalized urban communities in a developing country. Successful domestication allowed ICT resources to become an integral part of the study households as seen in Household 18. The increase in digital skills and levels of digital optimism among the family members of the study participating households was also another way of expressing successful domestication. The study helped the members of the study participating households and their neighborhood to develop digital resilience, opening opportunities for their effective participation in the information society and narrowing the existing urban digital divide.

By providing the necessary internet access devices and digital literacy skills to the members of the participating households, the families were able to use the internet for their social communication, citizen participation, entertainment, seeking information, and acquiring knowledge, hence nurturing positive family development. The skills acquired could also help the families to have the ability to cope with any subsequent digital challenges while navigating the increasingly knowledge based Kenyan society and in participating in both local and global digital driven events. Members of the four participating households had used the internet to do online shopping, while a good number of the other study participants had used the internet for education purposes, civic engagement, and connecting with government agencies. Therefore, this a good indication of the potential uptake of e-commerce, e-participation, and e-government services among low-income households. The participants' internet usage contradicts most studies which indicate that when underprivileged communities are provided with free internet access, they primarily use it for entertainment activities such as watching movies, playing games, or consuming adult content (Kiri & Menon, 2006; Toyama, 2011).

During the analysis of the data collected by the study team using semi-structured interviews, it was noted that all the eighteen study households had reached the conversion stage of the internet access resource tools domestication process, which is the final phase in the domestication theory. These households' family members were proud of themselves and happy to be enjoying the benefits of living in the Information Society. It was noted that the problem of limited digital infrastructure resources such as the constant supply of electricity affects the domestication of the internet access resource tools among the marginalized urban communities. The results also indicate a huge success in the study's digital literacy training program. This contradicts Chigona et al., (2010) where there was the challenge of successful progression of the study participants through the domestication process from commodification to appropriation and eventually to conversion stages. During the conversion stage of the domestication approach, sharing of ICT resources among the users is common. Similar to the studies by Hahn et al., (2008), Y. Chen (2013) and Letsie et al. (2015), the study found that the participating household members were sharing the ICT resources with their neighbors. The study also resonates with Kibere (2016) where mobile phone and mobile internet appropriation was achieved.

The study has provided empirical evidence for the successful use of the domestication approach in closing the urban digital divide in Nairobi County. In particular, it has managed to demonstrate that availing the internet access tools and computer literacy skills play a major role in influencing internet use, hence closing the urban digital divide. The study also reveals that use of the internet can con-

tribute positively to the quality of life for the residents of low-income households in urban areas. This supports earlier study where it was suggested that ICTs contribute to poverty reduction (Oxfam, 2009). Silverstone (2006) suggests that the process of conversion involves the development of skills, competencies, literacies, and the sharing of the pride of ownership. This is clearly demonstrated when one of the Household 4 family member can store the family photos in the cloud where he can still access them even when the project resources are no longer available for his household use. With the households using and also sharing the internet access resource tools with their neighbors, this is a positive way towards closing the urban digital divide.

BARRIERS TO CONTINUED USE OF INTERNET AT HOME

The participants were asked to specify any barriers to their intentions to continue using the internet. They indicated that use of the internet is expensive, while owning internet access devices is hampered by lack of electricity at home and fear of theft or losing the device. They indicated that internet safety was also a challenge as there are risks associated with how they can safely manage their online experiences and in dealing with uncomfortable and inappropriate online content.

From the study participants, the high cost of using the internet is also a major barrier to adoption of internet among the marginalized communities. This corresponds with other studies where the cost of using the internet was identified as a hindrance to its widespread usage (Wamuyu, 2017; Wyche, Forte, & Schoenebeck, 2013). Waema and Miroro (2014) also suggest that ICTs as a tool for poverty reduction is limited by the high cost of initial purchase and maintenance of ICT equipment. The study results shows that digital divide exists in Nairobi; left alone, the situation could get even worse, as Toyama (2011) indicates in his theory of technology as an amplifier that "technology helps the rich get proportionately richer, thus widening, and not narrowing, the gaps between rich and poor" (p.77).

TRUSTWORTHINESS OF THE STUDY

The credibility of a study is the degree to which the findings represent the true meanings of the descriptions of the primary participants (Lincoln & Guba, 1985). To establish the credibility of the study results triangulation and member checks were done. Creswell and Miller (2000) indicate that triangulation could be achieved by using different data collection strategies such as interviews, focus groups, or observations. The study achieved this by using different methods of data collection including surveys, record keeping, and semi-structured interviews. Member checking involves corroborating the research findings by seeking feedback from the study participants (Creswell & Miller, 2000). To complete member checking the study results were given to the study participants for a review of the accuracy of the content and to ensure that the study results and analysis reflects their views. Copies of Table 6, Table 7 and Table 8 were presented to eight different study participants, with each respondent examining whether the information they presented forms the basis of the study results. The eight participants agreed that the analysis was a true reflection of their views.

Confirmability refers to strategies used in limiting biases by ensuring that the data represents the information participants provided. Polit and Beck (2010) indicate that any study findings must represent the participants' voice. The eight study participants were also given a summary of the study results, analysis, and discussions to confirm the researchers reporting of the study findings and to establish the trustworthiness of its conclusions. The participants agreed that there was no bias or subjectivity in the study results and their interpretation.

CONCLUSIONS

Despite the proliferation of mobile internet access in Kenya, the digital divide still exists between those living in low-income neighborhoods and those living in more affluent parts of Nairobi. This digital divide could continue to increase as the government is spending millions of shillings in the

provision of Digital Learning Program in government primary schools only. Most of the children from the low-income neighborhoods are missing out on this program as they usually attend the Alternative Provision of Basic Education and Training (APBET) schools and church sponsored schools, which are the main academic institutions in the Mathare slum. These institutions lack basic facilities and cannot afford internet access or digital literacy skills training for their pupils or the neighboring communities.

Fong (2009) indicates that "bridging the digital divide has implications regarding fostering economic equality, educational potential, and earning potential" (p. 472). The study has shown that is possible to narrow the urban digital divide among the low-income communities in a developing country where there are many social and economic inequalities using the domestication approach. The selected households were provided with internet connectivity and digital literacy training and successfully went through the internet domestication process. This is an indication that urban digital divide is a social, economic problem which requires policy interventions aimed at poverty reduction and sustainable development.

This paper makes a practical contribution in that, while there have been many studies on digital divide between Africa and the rest of the world (Olatokun, 2008), within the African continent (Fuchs & Horak, 2008; Oyelaran-Oyeyinka, & Adeya, 2004; Unwin, 2005), among genders (Kvasny, Payton, Mbarika, Amadi, & Meso, 2008), and between rural and urban areas at national levels (W. Chen & Wellman, 2004; Donnermeyer, & Hollifield, 2003; Furuholt, & Kristiansen, 2007; Rao, 2005), there are few studies exploring urban digital divide and especially among the marginalized communities in the low-income urban areas such as Nairobi.

RECOMMENDATIONS

Best (2004) suggests that the "internet should be a human right in and of itself" (p. 23) and this study recommends that the government of Kenya should fill the digital divide gap that exists in its cities by providing the low-income urban communities with access to the internet. Wolcott, Press, McHenry, Goodman, and Foster (2001) indicate that the internet is not a single innovation but a cluster of related technologies that must be present together, making it not easy for households in low-income communities to get. People who do not have access to the internet should be motivated through user training, provision of the right infrastructure, and offering them affordable ICTs access packages. The government should also look for mechanisms by which low-income communities can have access to the internet and related technologies.

The Kenyan Government, non-governmental organizations, and private organizations are all investing in ICTs as they seek to provide their services online. However, these services access and usage among the low-income urban communities depends on the availability of the requisite resources including internet access hardware and digital literacy skills. The UN Sustainable Development Goals (SDGs) indicate that the global leadership is committed to endeavor for universal and affordable access to the internet in the least developed countries by 2020. Therefore, the Kenya government should seek to provide internet access services for the marginalized Kenyans by availing resources for the last mile connectivity and internet access. This could be done by introduction of affordable requisite ICT and related infrastructures among the marginalized communities with the objective of providing digital literacy and internet access for all.

Kenya is regarded as a mobile nation due to its success story in mobile money adoption (Wamuyu, 2014). The absence of an ICT inclusion policy is, therefore, a huge setback to the achievement of the Kenya vision 2030 (Government of Kenya, 2007). A digital inclusion policy should be developed to prioritize digital literacy training, to promote universal internet access for all Kenyans, and to elucidate the social-economic benefits of internet access. The policy interventions should also include the means to measure and prove the value of any initiatives aimed at closing the digital divide. Policy

makers should also explore ways of introducing digital literacy and media literacy skills training so that the Kenyan people have the requisite skills to use online services.

Through differentiated Internet services (DIS), one ISP has continued to provide internet access options that meet the small budget and personal internet access needs for individuals living among the marginalized communities while making marginal profits, a win-win approach. This is what other ICTs' infrastructure and service providers should seek to achieve by providing affordable internet services to the urban low-income and other marginalized communities.

LIMITATIONS

This study has two limitations. First, the study did not take into consideration the education levels of the participants. Oxfam (2009) suggests that the degree of education of household members positively influence ICT access and use. Lee (2001) also indicates that making internet access available, even if it is free, to people who are not literate is useless. However, the study worked with the presumption that only basic literacy was essential in being part of the project as computer self-efficacy and internet self-efficacy were to be developed in the course of the digital literacy training program.

Second, the study did not take into consideration the age differences among the participants. Age has been found to be a significant factor in influencing the use of information systems. Similar to this study, different age groups were considered to use ICTs in various ways by Y. Chen (2013). Household 18 members adopted the ICT resources to fit their individual lives and used the resources for different purposes based on their age groups. However, the study sought to examine the domestication process at the household level which meant that the ICT resources would be shared across different ages within the family.

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APPENDICES

APPENDIX A

Basic Computer Skills Assessment Questionnaire for Potential Learner

Please answer the questions honestly and to the best of your ability. Your teacher will use your answers to plan what you will learn in computer class. There are no right or wrong answers.

Demographic information

1. Indicate your gender Male [ ] Female [ ]

2. Age 15-19 [ ] 20-24 [ ] 25 -30 [ ] More than 30 [ ]

3. Education

I have finished Primary School? Yes [ ] No [ ]

I have finished High School? Yes [ ] No [ ]

I have finished College? Yes [ ] No [ ]

Access to ICTs

4. Access to Mobile Devices

I have a mobile phone? Yes [ ] No [ ]

My phone can access the Internet Yes [ ] No [ ]

My phone Number or my contact phone Number is *(Optional)*: _____

5. Access to Computers

Do you have a computer at home or have access to a computer? Yes [ ] No [ ]

Can you use a word processing program to write a letter or paper? Yes [ ] No [ ]

Are you interested in learning how to use computers? Yes [ ] No [ ]

I want to take a computer class because:

I've always wanted to know about computers and now I have the chance. Yes [ ] No [ ]

I need to use a computer to look for a job or for a future job. Yes [ ] No [ ]

I would like use computers to highlight issues in my community. Yes [ ] No [ ]

I need to use a computer to manage my responsibilities. Yes [ ] No [ ]

6. Access Internet

Do you have the Internet access at home? Yes [ ] No [ ]

Who is your Internet Service Provider? _____

Do you have any access to the Internet? Yes [ ] No [ ]

From where do you access the Internet? _____

If you are given a web address, can you go to a specific website to find information? Yes [ ] No [ ]

Do you have an email account? Yes [ ] No [ ] **email address *(Optional)*: _____**

Can you send, reply to, forward, and print an email? Yes [ ] No [ ]

7. Use of Social Media

I use Facebook Yes [ ] No [ ] I use Twitter Yes [ ] No [ ]

I use LinkedIn Yes [ ] No [ ] I use Instagram Yes [ ] No [ ]

I use WhatsApp Yes [ ] No [ ] I use Google+ Yes [ ] No [ ]

I use Snapchat Yes [ ] No [ ] I use YouTube Yes [ ] No [ ]

8. Chama membership

I am a member of a Chama Yes [ ] No [ ] Chama name: _____

APPENDIX B

Case Studies Interview Guide

1. On average, how many hours per day do you spend on the Internet?
2. What do you use internet for?
3. On average, how many webpages do you visit per day?
4. What do you like doing online?
5. How often do you use internet for the following activities?

Online Activity	Everyday	More than once a day	Once a week	Once a month
Watching news				
Chatting and Social Communication				
Citizen participation (Commenting on newspaper websites, political forums, open debates)				
Contacting government agencies (e-government)				
Online Shopping				
Information Search				
Games and Entertainment				
E-mails				
Academic and Educational activities				

6. Do you believe that internet access can help improve your entire family life?
7. How would you describe your proficiency in the following activities based on your digital literacy training classes?

Digital Literacy skills	I cannot do this	I can do this with some assistance	I can do this independent-ly	I can teach others how to do this
Using a search engines such as Google, Bing, to search for infor-mation on the web				
Creating a blog				
Video streaming				
Using a Word-processor				
Using Spreadsheets				
Using Presentations				
Using Calendar				
Describe components of a computer				
Use of social media such as Twitter, Face-book, or Instagram				

8. Where will you access the internet after the project?
9. Please state 3 challenges that could impede your intentions to continue using the internet after the project?

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BEYOND THE WALLS OF THE CLASSROOM: INTRODUCTION TO THE IJELL SPECIAL SERIES OF CHAIS CONFERENCE 2017 BEST PAPERS

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ABSTRACT

Aim/Purpose	This preface presents the papers included in the ninth issue of the *Interdisciplinary Journal of e-Skills and Lifelong Learning* (IJELL) special series of selected Chais Conference best papers.
Background	The *Chais Conference for the Study of Innovation and Learning Technologies: Learning in the Technological Era*, is organized by the Research Center for Innovation in Learning Technologies, The Open University of Israel. The 12th Chais Conference was held at The Open University of Israel, Raanana, Israel, on February 14-15, 2017. Each year, selected papers of the Chais conference are expanded and published in IJELL.
Methodology	A qualitative conceptual analysis of the themes and insights of the papers included in the ninth selection of IJELL special series of selected Chais Conference best papers.
Contribution	The presentation of the papers of this selection emphasizes their novelty, as well as their main implications, describes current research issues, and chronicles the main themes within the discourse of learning technologies research, as reflected at the Chais 2017 conference.

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Findings	Contemporary research goes 'beyond the walls of the classroom' and investigates systemic and pedagogical aspects of integrating learning technologies in education on a large scale.
Recommendation for Researchers	Researchers are encouraged to investigate broad aspects of seizing the opportunities and overcoming the challenges of integrating innovative technologies in education.
Impact on Society	Effective application of learning technologies has a major potential to improve the well-being of individuals and societies.
Future Research	The conceptual analysis of contemporary main themes of innovative learning technologies may provide researchers with novel directions for future research on various aspects of the effective utilization of learning technologies.
Keywords	learning technologies, e-learning, technology integration in education, added value of technology for teaching, learning, and assessment, diffusion of innovation, human-computer interaction, lifelong learning, educational technologies research

INTRODUCTION

"… *This is the room where we sat and learned.*
The windows of a classroom always open to the future…"
(Amichai, 1998, pp. 72-73)

This introduction to the ninth selection of the *Interdisciplinary Journal of e-Skills and Lifelong Learning* (IJELL) Special Series of Chais Conference Best Papers, titled *Beyond the Walls of the Classroom*, is a tribute to the poem *The School Where I Studied* by the Israeli poet, Yehuda Amichai (1998).

The papers in this selection investigate issues beyond the walls of the traditional classroom in multiple dimensions. First, the papers examine innovative ways of learning and teaching enabled by contemporary information and communication technologies (ICT), which are not restricted to a brick-and-mortar classroom. These include a virtual high school, massive open online courses (MOOCs), and a school where all the classrooms are paperless. Second, the papers, which are based on quantitative, qualitative, or mixed-methods methodologies, relate to more than one class. Furthermore, some longitudinal studies expand over two or more years. Third, the papers relate to skills, of both students and teachers, which are currently required and will be needed in the future for coping in the modern environment as well as for lifelong learning. More aspects of going beyond the walls of the classroom are reflected in the presentations of the papers in the following section.

However, before discussing the papers, we briefly introduce the Chais conferences and the IJELL special series. The Research Center for Innovation in Learning Technologies (formerly, the Chais Research Center), at The Open University of Israel, launched in 2006 a series of annual national research conferences on innovation and learning technologies, entitled "Learning in the Technological Era". The goal of the Chais conference is to promote the community of Israeli researchers in the field of learning technologies and the positioning of the Open University of Israel as a leading organization in the research and implementation of learning technologies.

The purpose of the special series of selected Chais conference best papers is to increase the international impact of the conference by distributing enhanced, extended versions of its finest papers to a global audience. The Informing Science Institute (ISI) supports this effort by publishing this special series in the *Interdisciplinary Journal of e-Skills and Lifelong Learning* (IJELL, formerly *Interdisciplinary Journal of E-Learning and Learning Objects* (IJELLO)). Geri, Blau, Caspi, Kalman, Silber-Varod, and Eshet-Alkalai (2015) elaborate on the mission and activities of the Research Center for Innovation in Learning Technologies and describe its synergies with the Informing Science Institute, the informing science transdiscipline (Cohen, 1999, 2009; Cohen & Lloyd, 2014), and IJELL. This preface chronicles the main themes within the discourse of learning technologies research, as reflected at the Chais

2017 conference. Geri et al. (2015) portray the objectives and themes of the first decade of the Chais conferences, along with the first seven issues of the IJELL special series of selected Chais Conference best papers. The eleventh Chais conference and its respective IJELL selection are depicted by Geri, Blau, Caspi, Kalman, Silber-Varod, and Eshet-Alkalai (2016).

The twelfth Chais Conference for the Study of Innovation and Learning Technologies: Learning in the Technological Era, was held at The Open University of Israel, Raanana, Israel, on February 14-15, 2017. The opening keynote guest lecturers were Daphna Oyserman (University of Southern California), who talked about "Using Technology to Improve Academic Success by Increasing Identity-Based Motivation", and Erran Carmel (American University, Washington DC), whose lecture title was "The Future of Work and the Workplace and Some Implications for Lifelong Learning". The first day of the conference ended with a keynote by Yair Levy (Nova Southeastern University) on "Cybersecurity and Social Engineering: Growing Threats".

Chais Conference 2017 concluded with a special discussion panel in memory of the late Gavriel Salomon, who was among the pioneers of educational technologies research, for which he received the Israel National Award for life long achievements in educational research. The session was opened with an introduction by Gavriel (Gabi) Salomon's daughter, Merav Salomon. The panel, titled "critical thinking on the integration of technology in learning", was mediated by Sheizaf Rafaeli, and included Amnon Dekel, Yuval Dror, and Yoram Eshet-Alkalai.

CHAIS CONFERENCE 2017 BEST PAPERS

This section presents the papers of the ninth issue of the IJELL special series of selected Chais Conference best papers. In its twelfth year, 93 papers were submitted for presentation at the Chais conference. The submissions went through a double-blind peer-review process, after which 36 papers and 42 posters were accepted for presentation at the conference and published in the proceedings volume of the conference (Eshet-Alkalai, Blau, Caspi, Geri, Kalman, & Silber-Varod, 2017). The Best Student Paper Award was awarded for the sixth time this year and considered 16 student-based research papers. However, none of the seven finalists for the award is included in the current IJELL special series. This selection encompasses six of the top Chais conference 2017 papers that have been expanded, undergone a full review process by IJELL's editors and reviewers, and edited for publication in IJELL.

The opening paper by Olzan Goldstein and Bertha Tessler, "The impact of the national program to integrate ICT in teaching in pre-service teacher training", demonstrates educational technologies research that goes 'beyond the walls of the classroom' in several facets. Their study is based on survey results obtained from 2,324 pre-service teachers who studied in several colleges of education, and were collected at the beginning of the program implementation in 2013, as well as two years afterwards. Goldstein and Tessler's (2017) study provides evaluation of the national change process and highlights the factors that promote successful implementation of ICT in education. Their study concludes that it is important that educators of the pre-service teachers would be skilled in using innovative methods of integrating ICT in teaching.

The second paper by Smadar Bar-Tal and Christa Asterhan, "Going behind the scenes at teacher colleges: Online student knowledge sharing through social network technologies", examined informal (i.e., behind the scenes) knowledge sharing by students at a teacher college via social networks (SNs). The qualitative study of Bar-Tal and Asterhan (2017) involved 37 participants who took part in a focus group or were interviewed. Their findings revealed that knowledge sharing via SNs is a pervasive phenomenon, which caused changes in learning practices. However, Bar-Tal and Asterhan's (2017) attempt to follow-up and discuss the findings with college instructors indicated unawareness of the teachers. The study implies that changes in teaching formats and task assignments should be considered in order to decrease the downsides of learning materials sharing via SNs.

The next paper, by Miri Shonfeld and Hagit Meishar-Tal, "The voice of teachers in a paperless classroom", also adopts a qualitative methodology and goes beyond the walls of the classroom by probing the diverse implications of a paperless school policy. The study was based on interviews of 12 teachers who teach in a paperless school. The study of Shonfeld and Meishar-Tal (2017) demonstrates that the teachers developed a rationale for justifying a paperless school, as it prepares students for their future and imparts them with 21st century learning skills. Nevertheless, the teachers are aware of the challenges and voice their critical views as well as the need to adjust teaching methodologies to the paperless classroom.

The paper of Sara Genut and Yifat Ben-David Kolikant, titled "Undergraduate Haredi students studying computer science: Is their prior education merely a barrier?" examines the issue of lifelong learning in the context of pursuing new fields of study among ultraorthodox Jewish men. Genut and Ben-David Kolikant (2017) argue that the former background of diverse students, which sometimes excludes formal general education but may include other practices and knowledge, should not be regarded only as a weakness, but also as a source of strengths that may help them acquire new knowledge. Genut and Ben-David Kolikant (2017) used a mixed-methods methodology and compared a group of 58 ultraorthodox men and a group of 139 men with a conventional background. Both groups studied Computer Science at the same college and took the same exams. Their findings showed that the grades of the ultraorthodox group did not fall below the grades of the other group over the entire period of five semesters that was examined. It should be noted that the ultraorthodox students had taken a one-year preparatory course, and further discussion is provided in the paper. Notwithstanding, the paper presents important insights that may help in successfully extending the diversity of students in higher education.

The next paper, "A learning analytics approach for evaluating the impact of interactivity in online video lectures on the attention span of students", by Nitza Geri, Amir Winer, and Beni Zaks, examines a special sort of MOOCs. Their study examined two MOOCs, developed by the Open University of Israel as an initiative of the Israeli Council for Higher Education, intended to impart Israeli students with the knowledge required for passing the national English exemption exam. Geri at al. (2017) investigated how adding interactivity to online video lectures affects students' attention span. Their study demonstrates the potential of learning analytics as a methodology for improving instructional design.

The last paper, by Yaniv Biton, Sapir Fellus, Dafna Raviv, and Osnat Fellus, "Yours virtually: Advanced mathematics and physics in the Israeli virtual high school", examines the implications of this innovative learning environment from the perspectives of both students and teachers. It describes the first Israeli Virtual High School (VHS), launched in 2012. The VHS aimed at increasing the numbers of students who opt for advanced level mathematics and physics classes, by enabling students living in peripheral areas to study these subjects online. However, Biton et al. (2017) emphasize the importance of employing a teacher-tutor model of instruction, along with ongoing evaluation of the students' work via a Learning Management System (LMS), and continual teacher-developer interaction for developing cutting-edge content. Their paper provides important insights on effective teaching and learning in a VHS environment.

The six diverse papers of this selection demonstrate some of the important themes deliberated at the Chais conference 2017. Other main themes, which were discussed at the conference included: literacy and digital learning; simulating scientific processes; psychological effects and assistive technologies for people with special needs; learning as an experience; and reading and writing in digital environments.

CONCLUSION AND ACKNOWLEDGEMENTS

The ninth selection of IJELL special series of the Chais conference best papers focused on themes and processes that occur beyond the walls of the traditional classroom. It continues the trend of research that concentrates on pedagogical aspects of learning technologies, as observed by Silber-Varod, Eshet-Alkalai, and Geri (2016). The papers in this year's selection demonstrate the progress of educational technologies research by examining broad samples of both students and instructors, as opposed to studies that analyze the effect of technological interventions on small groups of students. Furthermore, the research questions address novel aspects of integrating technologies in teaching and learning at a national level, such as extending the diversity of students in higher-education, training of pre-service teachers, MOOCs for supporting formal higher education, and a virtual high school that enables geographically dispersed students to take advanced courses of mathematics and physics.

The coming Chais conference for the study of innovation and learning technologies will be held on February 20-21, 2018, at the Open University of Israel campus in Raanana, Israel. We look forward to continuing this important discourse at the conference and the subsequent IJELL issue of the best papers series.

We would like to express our deep gratitude to Fay Sudweeks, the Editor-in-Chief of the *Interdisciplinary Journal of e-Skills and Lifelong Learning*, and to Jon Webber and Janice Whatley, the associate Editors-in-Chief of IJELL, for conducting this editorial effort and for their constructive guidance of the authors. Special thanks to Janice Whatley for leading this initiative since 2012 and for providing dozens of authors with insightful feedback. We highly appreciate the continuing support of this special series by Eli Cohen and Betty Boyd of the Informing Science Institute, and we thank Betty for the publishing work.

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Finally, we are thankful to the community of Israeli researchers and practitioners of learning technologies, for their continuing involvement in Chais conferences, and for their collaboration in developing the educational technologies research field.

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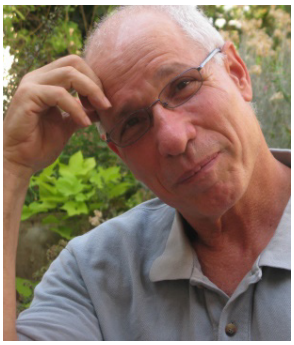

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THE IMPACT OF THE NATIONAL PROGRAM TO INTEGRATE ICT IN TEACHING IN PRE-SERVICE TEACHER TRAINING

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ABSTRACT

Aim/Purpose	This study examines the impact of the Israeli National Program on pre-service teachers' skills in the integration of ICT in teaching and discusses the influential factors of successful implementation of practices in the field.
Background	In the current Information Age, many countries relate to education as an important factor for national growth. Teacher education plays a significant role in coping with the challenge of educating a new generation of school students to compete in a technology-driven society. In 2011, the Israel Ministry of Education initiated the National Program for transforming teacher education colleges to meet the demands of the 21st century.
Methodology	The study focuses on two research questions: (1) What was the impact of the National Program on pre-service teacher training concerning the integration of ICT in their teaching? (2) What are the predictors of the pre-service teachers' practice of ICT integration in teaching? It is a quantitative study, based on data collected in two rounds two years apart that compares several indices of pre-service teachers' preparation to teach with ICT.
Contribution	The findings offer insights regarding influential factors of successful integration of ICT in education.

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Findings	Analyses showed a significant increase in most of the indices of teacher training according to the National Program, in particular in the number of ICT-based lessons that pre-service teachers taught in their teaching practice at schools. Predictors of ICT integration in teaching were modeling by faculty members and school mentor teachers, the number of ICT-based lessons taught by pre-service teachers, and pre-requisite conditions at schools and colleges.
Recommendations for Practitioners	The current challenge is to promote innovative ICT-based teaching methods among teacher educators, school teacher mentors, and pre-service teachers.
Recommendation for Researchers	The findings underscore the importance of modelling by the school mentors as well as pre-requisite conditions at schools.
Impact on Society	Being acquainted with the most influential factors of successful integration of ICT in teaching by pre-service teachers can improve teacher education as well as the education system in educating future generations.
Future Research	More research is needed to learn about the dissemination of innovative models of ICT integration in teaching by pre-service teachers and their educators.
Keywords	ICT integration in teaching, teacher education, evaluation of systemic changes

INTRODUCTION

In the current information age, many countries relate to education as an important factor for national growth in crucial areas such as: industry, economics, politics, security, and society (Kozma, 2008; P21, 2010). Education systems have to deal with the challenge of educating a new generation of students, i.e., the future human capital, who will lead, work, and live in the information society in the next decades. Models of education that fit the needs of the Industrial Age do not meet the requirements of the current Information Age. Educators must reconsider the use of traditional pedagogical models and develop new models that will better suit the education needs of the new generation, fit the frame of the minds of the students, and be based on modern modes of assessment (Johnson, Levine, Scott, Smith, & Stone, 2009). However, education systems in most countries as well as in Israel are still far from reaching these stated goals: many teachers continue to adhere to traditional teaching methods and do not use information technology in their lessons (Israeli National Education Measurement and Evaluation Authority, 2008; Johnson et al., 2009). Taking into account the current and future needs of education, many countries try to reorganize their educational systems (CERI, 2010; P21, 2010), defining the important abilities required in the 21st century: multiple literacies, expertise, innovation, critical thinking, problem solving, and collaboration.

In 2011, the Ministry of Education in Israel began implementing the National Program for the transformation of the education system to meet the demands of the 21st century (Israeli MOE, 2011). The main impetus of this program was related to the results of the PISA international survey (2009) which showed that the computerized equipment of Israeli schools and students' achievements in science and mathematics were low compared to other countries (Ben-David, 2011). This new program aims at developing important student skills, such as ICT literacy, critical thinking, problem-solving, interpersonal communication, and collaboration skills as well as self- and life-long learning skills. These goals are to be achieved through the implementation of ICT-based innovative pedagogy as well as the upgrading of the infrastructure and equipment in the schools. As part of the program, it was decided to re-design the curricula in teacher education colleges, integrate ICT-based innovative teaching methods by faculty members as well as upgrade the technological infrastructure. A three-year plan of implementation in the teacher education colleges started in 2012 (Melamed et al., 2010), with eight colleges entering the program each subsequent year. The implementation process in seven of these colleges was accompanied by a three-year evaluation study described below.

LITERATURE REVIEW

Pre-service teacher training plays an important role in systemic reorganization plans (Black & Smith, 2009; P21, 2010) since newly ICT-skilled graduates might serve as change agents in education systems. Advanced countries are trying to adapt teacher training to the needs of the Information Age through setting standards, designing teacher training programs, and strengthening the connection between teacher training institutions and schools (Rizza, 2009). A few countries have developed standards that define the required skills of teachers in the age of information technology (ICT-Competency Standards for Teachers), and they have established long term plans for their implementation. UNESCO has defined a teacher in the 21st century as one who is skilled in building diverse learning environments for enrichment and management of teaching with ICT (UNESCO, 2009). This teacher is seen as competent in developing innovative pedagogy encouraging active learning, interaction, and cooperation while emphasizing team work.

The current state of teacher preparation for ICT-based teaching, even in advanced countries, is yet insufficient to reach the above-mentioned goals (Voogt et al., 2017). For example, Blamire, Cassells, and Walsh (2017) conducted the literature review that was based on the analysis of 70 research studies from a variety of European countries over the years 2002 – 2017. According to the review, in most countries there is little evidence of follow-through from government policy to ICT implementation in initial teacher training; ICT is not integrated in subject curricula and is not compulsory in teacher training; the training of pre-service teachers in the pedagogical use of ICT develops due to enthusiastic teacher educators. Regarding Australia, Black and Smith (2009) reported "fundamental systemic flaws in the pre-service teacher education system in terms of developing teacher competence in embedding ICTs in pedagogy and practice": the weakness of curriculum, poor modeling of ICT-based teaching by faculty, insufficient field practices by student teachers, the inadequacy of the computer systems at partner field schools, and the absence of ICT-based teaching skills assessment in a formal accreditation of pre-service education graduates. Australian student teachers' scores in technological-pedagogical-content knowledge (TPACK) were found to increase from first to fourth year level, but their final scores were still low relative to the mid-point (Sweeney & Drummond, 2013). In the USA, the National Center for Education Statistics reported that almost all teacher education institutions included in their curriculum topics related to training pre-service teachers to teach with technology (Kleiner, Thomas, & Lewis, 2007). However, the National Association of State Boards of Education (2012) pointed out that only 60 percent of the USA educators who received certification in educational technology felt prepared to incorporate these skills into their pedagogical strategy. Similar problems in teacher training are mentioned in other countries (Granston, 2004; Meisalo, Lavonen, Sormunen, & Vesisenaho, 2010; P21, 2010; Tømte, Hovdhaugen, & Solum, 2010).

The case of Israeli teacher education colleges was studied during 2008-2009 by an intercollegiate research network (Goldstein et al., 2011) and found a similar picture: most of the pre-service teachers graduated with no practical experience in ICT integration in teaching. In most courses, pre-service teachers were exposed to basic forms of ICT integration in teaching while innovative models of ICT integration (e.g., collaborative learning, inquiry, web-based synchronous and asynchronous distance learning) were rare; collaboration between college faculty and school staff for the purposes of pre-service teacher training of ICT integration in teaching was quite weak. These findings were widely discussed by the professional community of teacher educators with administrators holding key positions in the Ministry of Education and served as the basis for data-driven decisions in designing the goals and strategies of the National Program for transforming the teacher education colleges to meet the demands of the 21st century. With the beginning of the National Program implementation in the colleges of education, the above-mentioned research network renewed an evaluation process of the impact of the program on pre-service teacher preparation for ICT integration in teaching.

The Conceptual Framework of the Study

The study aimed to compare the stages of pre-service teacher preparation for ICT integration in teaching in the first and in the final third year of the National Program implementation. It was important to design a conceptual framework and concrete measures allowing such a comparison. As a basis, we used the framework of the previous study (Goldstein et al., 2011) as well as the other studies (Agyei & Voogt, 2014; Black & Smith, 2009; Brun, 2012; Shah & Ulrich, 2017). Following the findings related to the first year of the study, we completed this framework by adding further issues. The final conceptual framework of the study is shown in Figure 1.

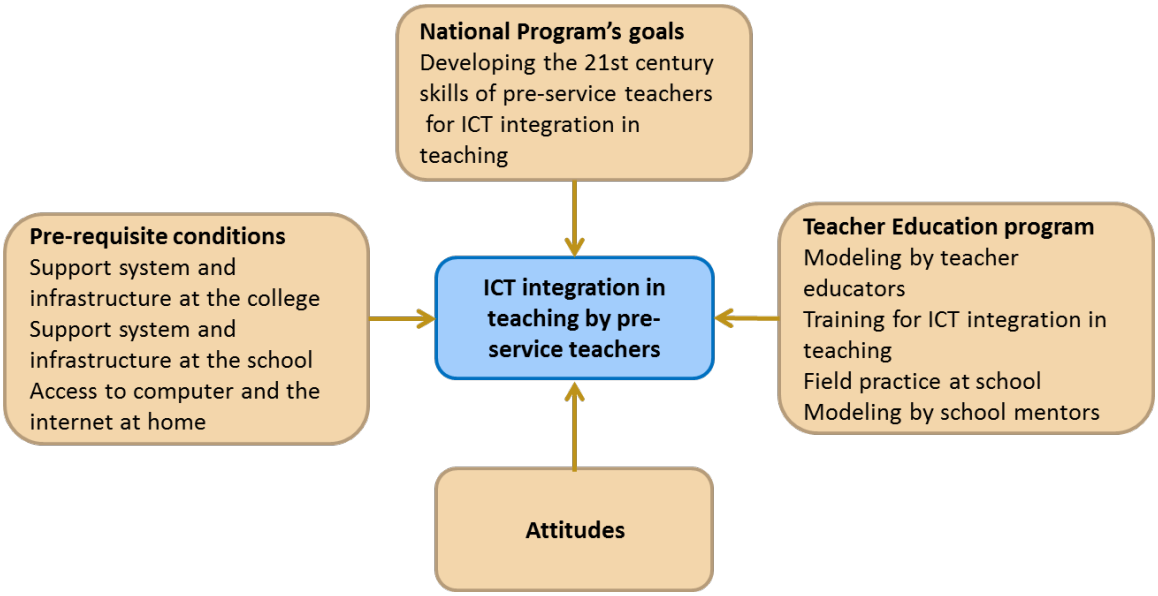

Figure 1. The conceptual framework of the study

There are four issues influencing pre-service teachers' preparation for ICT integration in teaching. The National Program defined the goal of teacher education as preparing pre-service teachers to be able to develop important 21st century skills of their school pupils. The practical content, pedagogical and technological knowledge of the pre-service teachers is formed by a combined influence of different factors: the curriculum, modelling by teacher educators, direct training to teach with technology, field practice at school, and modelling by school mentors. The willingness of the pre-service teachers towards ICT integration depends on personal attitudes toward the usefulness of ICT in education. There exist several conditions that can promote or hinder this willingness: a support system and infrastructure at colleges and schools, and computer and the Internet availability at home.

The study focuses on the following research questions:

1. What was the impact of the National Program on pre-service teacher training concerning the integration of ICT in their teaching?
2. What variables predict the extent of the pre-service teachers' practice and the ways in which they integrate ICT into teaching?

Methodology

The study was conducted using quantitative methods which give an overall picture of the phenomenon and allow for examining the interrelations between relevant variables as well as a comparison of the mean values of group indices based on large quantitative data. The study compares several indices of pre-service teacher training to teach with ICT collected by a questionnaire in two rounds two years apart: at the beginning of the National Program implementation in 2013, and towards its completion in 2015.

PARTICIPANTS

The participants were pre-service teachers studying in Israeli colleges of education in which the National Program was implemented. In the first round, 1402 pre-service teachers from seven colleges of education participated in the study while, in the second round, there were 922 respondents from eight colleges. The respondents belong to different programs and stages of study: bachelor degrees, academic retraining certification programs, and master's degrees. For different purposes, different sub-samples of the overall sample were used (Table 1).

Table 1. The samples and sub-samples of the participants

Samples and sub-samples	Goal	Round/s	Number of colleges	Number of participants
Total samples	Descriptive statistics	First	7	1402
		Second	8	922
Sub-samples in the advanced stages of undergraduate studies and academic retraining	Descriptive statistics and statistical inference about means for evaluating the changes between the two rounds	First	7	642
		Second	7	412
Sub-sample of the respondents whose mentor teachers used ICT in teaching	Predictive statistics for identifying factors influencing teaching practice	Second	8	239

To compare the changes between the two rounds of data collection, we chose pre-service teachers from seven colleges of education who were in the advanced stages of undergraduate studies (third and fourth years) and pre-service teachers in academic retraining certification program (a total of 642 in the first round and 412 in the second round). For the purposes of predictive statistics, we used the sub-sample of the second round, as the questionnaire used in the second round had additional meaningful indices about conditions in the field practice at schools. This sub-sample included 239 respondents who mentioned that their school mentor teachers integrated ICT in teaching.

INSTRUMENTS

The questionnaire used in the first round was based on a questionnaire developed by Goldstein et al. (2011) that focused on the following components: modeling by faculty members, training pre-service teachers to use ICT in teaching, personal characteristics of the respondents, and prerequisite conditions in the college and home required for ICT integration (infrastructure and technical support). It was adapted for the purposes of the current study to include references to new online learning environments (for example, social networks) as well as the new learning management system (Moodle) incorporated by the colleges. In addition, questions relating to the goals of the National Program (such as, being leaders in the process of innovative ICT integration in teaching and managing school life) were included in the questionnaire. We also added three open-ended questions where the pre-service teachers were asked to describe the best ICT-based lessons delivered by faculty members, school mentor teachers, and pre-service teachers themselves. The analysis of the responses on the open-ended questions in the first round revealed additional factors influencing pre-service teachers' practices in schools. Therefore, we added to the questionnaire in the second round three questions regarding modeling by school mentor teachers, pre-service teachers' teaching methods, and prerequisite conditions needed for integration of ICT at schools.

The second questionnaire included 25 questions of which six related to background information. The variables of the questionnaire were concerned with: components of pre-service teacher training for teaching with ICT, attitudes towards the contribution of educational technology to teaching and learning, access to computers, and existing technical support. The components of training included modeling by faculty members, modeling by school mentor teachers, pre-service teacher training to teach with ICT, and field practice in teaching with ICT.

Modeling by lecturers was measured as the number of courses (on a scale ranging from *1-in none of the courses* to *5-in 8 courses or more*) in which ICT-based assignments were integrated (for the purposes of inquiry, problem-solving, case-study analysis, project-based learning, use of learning management systems (LMS), synchronous meeting environments, social networks, and more). The average of these 15 items was used as a variable named "modeling by lecturers." Modeling by school mentor teachers was measured by requesting pre-service teachers to indicate if their mentors integrated ICT in teaching (with *1-no; 2-yes*). In the case of a positive response, the respondents were asked to choose the ways of ICT integration from a list of 10 options (ICT use for demonstration, exercising, gaming, searching for information, web-quest, problem-solving, online discussion, communicating, word-processing, and preparing power-point presentations). The average of these 10 items served to estimate the diversity of ICT integration in teaching by mentors and was used as a variable "modeling by mentors."

Data on pre-service teacher training to teach with ICT were collected using three items: the number of courses in which they were instructed to plan ICT-based lessons in schools, the number of courses devoted to instruction on how to teach such lessons, and use of LMS or a web-portal of the school. The average of these three items was used as the "training for ICT integration in teaching" variable. Field practice was measured using two variables: the number of ICT-based lessons the pre-service teachers taught in schools (on the scale of *1-I did not teach ICT-based lessons* to *5-I taught more than 8 lessons*), and the degree of diversity of ICT integration in teaching measured by items similar to the variable "modeling by mentors." The averages of the items regarding the diversity of pre-service teachers' teaching methods were used as the variable "methods of ICT integration in teaching by pre-service teachers." Questions about the diversity of ICT integration were examined in the second round only and served the purposes of predictive statistics.

The pre-service teachers' attitudes towards ICT integration in teaching and learning were examined using six items (based on a five-point Likert scale: of agreement from *1–strongly disagree* to *5-strongly agree*): the contribution of ICT to learning regarding the pre-service teachers themselves and the school pupils; the contribution of ICT to the teaching skills of the respondents; relevance of ICT integration in teaching their area of expertise; their opinions on the advantages and disadvantages inherent in ICT integration in teaching in schools. The average of these items served as the variable "attitudes."

Prerequisite conditions required for ICT integration in teaching in the colleges were measured using three items (on a scale ranging from *1-nonexistent* to *4-exist to a great extent*): access to computers, access to the internet in the college, and availability of technical support. The average of these items was used as a "conditions in the college" variable. The respondents were asked about access to computers and the internet in their homes (on the same scale), and the average of these two items was used as a "conditions at home" variable. Prerequisite conditions in the schools were measured by six items (on a scale of *1-strongly disagree* to *6-strongly agree*): the degree of encouragement from the mentor teacher; the degree of support from the staff; the availability of a computer; the availability of a projector; the availability of the internet; the availability of technical and pedagogical support. The average of these items was used as a "school conditions" variable. This variable was used in the second round only.

Quantitative data analysis was conducted using SPSS software. Reliability and validity of the first questionnaire were evaluated for content and construct validity and found satisfactory. The content validity was established by five ICT coordinators from five colleges of education and six research

experts in the fields of ICT integration in education. The clarity and accuracy of the formulation of the questions were examined by 22 pre-service teachers from the participating colleges. The reliability of the questionnaire was examined by measuring the internal consistency (Cronbach's alpha) of questions which included several statements. The convergent validity of the questionnaire was examined by a principal component factor analysis using varimax and oblimin rotations in questions containing several statements, and the calculation of correlations between the average values of statements included in these factors. These tests showed that the questionnaire used to collect data in the first round was valid and reliable (Oster, Goldstein, & Peled, 2015). Reliability and validity of the second questionnaire were evaluated in a similar manner in the current study and were also found satisfactory. The answers on the open-ended questions were analyzed through content analysis using the Grounded Theory Approach (Glaser, 1992).

RESULTS

The findings relate to two major issues: the impact of the National Program on pre-service teacher training concerning ICT integration in teaching, and the factors influencing the integration of ICT in the practice teaching of the pre-service teachers.

THE IMPACT OF THE NATIONAL PROGRAM ON PRE-SERVICE TEACHER TRAINING OF ICT INTEGRATION IN TEACHING

The findings show a meaningful impact of the National Program on pre-service teacher training concerning the integration of ICT in teaching. In all the variables, except for the variable "conditions at home," there was a statistically significant increase in mean values between the two rounds of data collection (Table 2). The greatest change was found in the number of lessons taught by respondents in teaching practice at their field schools. The effect size of the change in this variable ($\mathbf{d_{Cohen}}$= 0.49) indicates the considerable change: it reached almost half of the standard deviation of the variable. In the second round, 35% (compared to 20% in the first round) of the pre-service teachers taught more than eight ICT-based lessons, 30% (compared to 25% in the first round) taught between three and eight lessons, and 35% (compared to 55% in the first round) taught only one lesson or did not teach any lessons in ICT integration.

The increase of the mean value of the variable "modeling by lecturers" (the mean number of courses in which respondents were offered different ICT-based assignments) is statistically significant, but the size effect is small: that even in 2015, an average of the integration of the entire range of ICT-based assignments was in only one or two courses. Of the 15 types of ICT-based assignments examined, there were more common types and less common ones (Table 3). The most common assignment was submitting learning outcomes using electronic tools. Information processing, visualization and simulation, case studies, online discussions, and web-based inquiry were required on an average in 3-4 courses. The less common assignments were related to integration of project-based learning, creativity assignments (wiki, blog or site development), online synchronous activities, social networks, virtual worlds, and mobile learning.

A slight statistically significant increase was found in the means of other variables: training for ICT integration in teaching, pre-service teachers' attitudes towards the use of ICT in education, and conditions in the college required for ICT integration in teaching. Regarding the contribution of ICT to teaching and learning, the respondents expressed positive attitudes in the first round of data collection, and their attitudes improved slightly in the second round. As for the college conditions required for ICT integration, the respondents estimated them in both rounds as moderate with a slight increase of the mean of the variable in the second round. In contrast, the change in conditions in the home was not significant and, in both rounds, the conditions were assessed as having been largely fulfilled. It is important to note that the two-year period between the two rounds of data collection was too short to show all the systemic changes promoted by the National Program, and therefore the findings of this study can show only the trend of this change.

Table 2. Changes in the components of student training for ICT integration in teaching from 2013-2015

Variable and its scope	Round	Mean	St.Dev.	F	Sig.	Effect size d_{Cohen}
Modeling by lecturers (1-5)	2013	2.09	0.69	18.80	0.000	0.27
	2015	2.28	0.72			
Training in ICT integration in teaching (1-5)	2013	2.16	0.97	11.69	0.001	0.22
	2015	2.37	1.02			
Number of ICT-based lessons taught in school (1-5)	2013	2.10	1.81	59.30	0.000	0.49
	2015	2.99	1.82			
Attitudes (1-5)	2013	3.85	0.69	7.30	0.007	0.17
	2015	3.97	0.72			
Conditions in the college (1-4)	2013	3.40	0.70	5.09	0.024	0.14
	2015	3.49	0.58			
Conditions at home (1-4)	2013	3.78	0.57	2.08	0.150	0.09
	2015	3.83	0.50			

Table 3. The frequency of ICT-based assignments offered to pre-service teachers in the courses

Mean frequency	ICT-based assignments offered to pre-service teachers
5-6 courses	Submitting learning outcomes using electronic tools
2-3 courses	Information processing, visualization and simulation, case studies, online discussions, web-based inquiry
Less than 2 courses	Project-based learning, creativity assignments (wiki, blog or site development), online synchronous activities, social networks, virtual worlds, mobile learning

The qualitative analysis of the responses on the open-ended questions gathered in the first round allowed the identification of ten different methods of ICT integration by pre-service teachers and their school mentor teachers. Hence, we could expand the questionnaire in the second round to quantify data on methods of ICT integration in teaching by both pre-service teachers and their school mentor teachers and examine relationships between these variables. Of the 642 participants who responded in the second round, only 239 indicated that their instructor integrated ICT in teaching, meaning that only about one-third of the respondents had the opportunity to be exposed to modeling by their mentor teachers. In addition, these respondents noted which of the ten methods of ICT integration in teaching were used by their school mentors, and 412 respondents mentioned which of these ten methods were used by themselves in teaching in their field practice schools. The comparison of the methods of ICT integration in teaching by respondents and their school mentor teachers is represented in Table 4. As can be seen in Table 4, the most popular methods of ICT integration in teaching used by both pre-service teachers and mentors were for demonstration and illustration, and for preparing PPT presentations (used by 80% of respondents and mentors). The less popular methods included the use of educational games, information searching, word processing and

online peer communication, which were used by about two-thirds of pre-service teachers and mentors. Half of the pre-service teachers group as well as mentors integrated online drill and practice exercises, ICT-based inquiry and online discussions. The least popular methods were complex problem-solving, used by one third of the pre-service teachers and mentors.

Table 4. Methods of ICT integration in teaching by the school mentor teachers and pre-service teachers

Methods of ICT integration in teaching	**The percentage of pre-service teachers attesting that their school mentor teacher taught lessons using specific methods of ICT integration in teaching**	**The percentage of pre-service teachers attesting that they themselves taught lessons using specific methods of ICT integration in teaching**
	N=239	**N=412**
Demonstration and illustration	84.2	91.8
Online drill and practice exercises	47.2	54.2
Educational games	66.9	72.8
Searching for information	62.7	59.7
ICT-based inquiry	47.9	46.8
Complex problem solving	38.0	35.0
Online discussions	47.0	42.8
Preparing PowerPoint presentations	75.8	81.2
Word processing	64.1	63.8
Online communication with peers	57.3	46.9

An important finding is that there is a similarity in the distribution of ICT-based assignments used by mentors and pre-service teachers. This finding suggests that pre-service teachers tend to adopt the methods to integrate ICT in teaching used by their mentors while the most popular methods support traditional teaching approaches. The mean values of ten items describing the use of different methods of ICT integration in teaching by pre-service teachers and mentors were used as two variables named "pre-service teachers' methods of ICT integration" and "modeling by mentors" respectively. These variables reflect the degree of integration of various ICT-based teaching methods (traditional as well as more innovative). Their values range between 0 (no method used) and 1 (all methods used). We found a considerable correlation between the variables "modeling by mentor teachers" and "pre-service teachers' methods of ICT integration" ($r = 0.62$, $p<0.001$) that supports the conclusion about the role of the mentor teachers in forming teaching practices of pre-service teachers.

The analysis of the responses on the open questions in the first round allowed the identification of the main barriers encountered by respondents when trying to teach ICT-based lessons in their field practice at school. The barriers concerned six issues: support by mentor teachers, support by school stakeholders, access to computers, access to the internet, the possibility to equip pupils with computers or tablets during lessons, and pedagogical support by the school ICT coordinator. These issues were added to the questionnaire used in the second round of the data gathering. The data collected

from the sub-sample of 412 respondents who taught ICT-based lessons at school is presented in Table 5.

Table 5. Prerequisite conditions in schools needed to pre-service teachers for ICT integration in teaching

Conditions in school	Mean*	St.Dev.	Percentage of agreement**
My mentor teacher encourages me to integrate ICT in teaching.	4.54	1.51	78%
The school stakeholders encourage me to integrate ICT in teaching.	4.53	1.36	80%
The computer and projector are available for me at school.	4.50	1.69	76%
The school has a good wireless network.	4.03	1.68	65%
Pupils can be equipped with computers or tablets during lessons.	3.25	1.83	45%
I have pedagogical support in planning ICT integration in teaching (for example, by the school's ICT coordinator).	3.47	1.71	52%

* The scores ranged from 1–strongly disagree to 6–strongly agree.
**Total of different degrees of agreement: tend to agree, agree and strongly agree

About three-fourths of the respondents in the sub-sample agreed (with different degrees of agreement) that they were supported by their mentors and stakeholders, and computers and projectors were available at the school. Only about half of the sub-sample agreed their school had a good wireless network, could equip pupils with computers or tablets during lessons, and provided pedagogical support to respondents in planning ICT integration in teaching. Thus, the conditions in schools were more suited to integrating ICT in teaching in traditional ways using the teacher's computer and projector and less to actively involving pupils in learning using individual computers or tablets. The average of these six items served as a new variable named "conditions in school."

Factors Influencing ICT Integration in Teaching by Pre-service Teachers

To examine which factors predict ICT integration in teaching by pre-service teachers, a multiple linear regression test was conducted. The independent variables included the different components of pre-service teachers training in accordance with the conceptual framework of the study: modeling by lecturers, direct training of ICT integration in teaching (guided by the college lecturers or supervisors), modeling by mentors, pre-service teachers' attitudes towards ICT integration in education, conditions at home, college conditions, and conditions in the school. The first model focused on the extent of pre-service teachers' practice, taking the variable "number of ICT-based lessons that pre-service teachers taught in field practice in school" as the dependent. The second model focused on the pedagogical aspects of ICT integration, taking as the dependent variable "pre-service teachers' methods of ICT integration in teaching." We suggested that this variable is also dependent on the extent of teaching practice since the more pre-service teachers' practice teaching, the more they will be able to diversify their teaching methods. Hence, the second model includes the "number of ICT-

based lessons that pre-service teachers taught in field practice in school" as the independent variable. The results of the regression for these two models are presented in Table 6.

Table 6. Results of the multiple linear regression tests

Dependent variable, explained variance and the model's significance	Predictors	β	Sig.
Model 1 Dependent variable: The number of ICT-based lessons that pre-service teachers taught in field practice in school Explained variance 14.9% F (3, 193) =11.3, p<0.001	Constant		0.538
	Conditions in school	0.21	0.002
	Attitudes	0.24	0.000
	Training of ICT integration in teaching	0.16	0.020
Model 2 Dependent variable: pre-service teachers' methods of ICT integration in teaching Explained variance 37.1% F (4, 190) =28.0, p<0.001	Constant		0.000
	Modeling by mentors	0.39	0.000
	The number of ICT-based lessons that pre-service teachers taught in field practice in school	0.23	0.000
	Modeling by lecturers	0.25	0.000
	Conditions in school	0.14	0.015

* β - standardized coefficients
**Sig. – significance of the coefficient. Only significant variables are presented.

The factors that predict the extent of pre-service teachers' practice in ICT integration in teaching are the attitudes, the conditions in the school, and the direct training of ICT integration in teaching. The factors predicting the pre-service teachers' methods of ICT integration in teaching are the modeling by mentors, the number of ICT-based lessons that pre-service teachers taught, modeling by lecturers, and conditions in school. The conditions in colleges and at home were not found as significant predictors in either model. These variables are the least varying of all the components of pre-service teacher training for ICT integration (see Table 2). A possible explanation may be that these conditions were rather satisfactory for most of the respondents. The results of the second model emphasize how important the modeling by mentors and lecturers for forming pedagogical knowledge and practice of the pre-service teachers are.

DISCUSSION

In the colleges that participated in the study, we found a positive impact of the National Program on preparing pre-service teachers to integrate ICT in teaching. In the final year of its implementation, the pre-service teachers had more practice in ICT-based teaching; they gained more learning experience from the modeling of their college lecturers, and expressed more positive attitudes regarding ICT integration in education. At the same time, there is a need to increase pre-service teacher training of ICT integration in teaching, because there is still a third of the respondents who finish their studies without practical experience in teaching ICT-based lessons. It is extremely important that the colleges of education define field practice in ICT-based teaching as an obligatory component of teacher training programs for all pre-service teachers.

As for the diversity in methods of ICT integration, we found that college lecturers, school mentor teachers, and many pre-service teachers mostly used ICT in ways that strengthen traditional teaching methods while innovative ways aimed at active engagement in learning (for example, project-based learning, inquiry, problem-solving) were rare. Other studies revealed similar situations with the development and adoption of innovative ways of ICT integration in teaching (Agyei & Voogt, 2014; Bai & Ertmer, 2008; Shah & Ulrich, 2017). There may be two reasons: reluctance of teachers to change their pedagogical approach, and lack of necessary conditions in colleges and schools. The transition

from traditional to innovative teaching that promotes 21st century skills is not simple and can take a long time. At first, teachers use ICT to strengthen their practice, and only after gaining experience and being exposed to innovative uses that other teachers make use of, can they be able to take risks and adopt or invent new ways of ICT integration in teaching (Hwee & Koh, 2013). A second reason why teachers tend to stick to traditional teaching methods is that most schools and colleges do not have adequate individual equipment to support active learning, apart from a computer and a classroom projector. The recent trend in the use of end-point devices (laptops, tablets, and smartphones) can provide good solutions for equipping students with access to the network and enable active, personalized learning for each student and collaborative learning for groups of students. Recently, schools in Israel have begun to equip tablets to classrooms and, hopefully, this trend can promote more meaningful integration of ICT in teaching. If the colleges of education choose these schools for the teaching practice, the pre-service teachers will have more opportunities to watch ICT-based lessons of their mentors, and will be able to practice a variety of teaching methods in their classes.

Several factors were found as predictors of pre-service teachers' practice in ICT-based teaching. Pre-service teachers' attitudes, conditions in schools, and training of ICT integration in teaching had a statistically significant impact on the number of ICT-based lessons pre-service teachers taught in their field practice at school. The importance of positive attitudes towards the contribution of ICT to teaching and learning was pointed out by numerous studies that examined ICT integration by teachers (Agyei & Voogt, 2014; Brun, 2012). According to Ajzen's (1991) Theory of Planned Behavior, positive attitudes are a necessary condition for a person's decision to perform an action. However, positive attitudes are not enough. Two other factors influence behavioral action: social norms in the environment and the estimated degree of difficulty in performing the behavior. For example, a pre-service teacher who has positive attitudes toward the contribution of ICT to teaching and learning can avoid using ICT in teaching if the environment does not encourage him or if he expects many difficulties in doing so.

The organization of an ICT-based lesson in a school is a complex task: a pre-service teacher has to coordinate the lesson with the school system, make sure the equipment works properly, arrange the pupils' transition to a computer lab or equip them with tablets in the classroom. Managing classroom behavior also becomes more complex. Therefore, it is clear that the pre-requisite conditions in school served as a predictor of the extent to which the pre-service teachers integrated ICT into teaching. Schools that provide infrastructure, technical support, and encourage the integration of ICT in teaching enable pre-service teachers to develop knowledge and skills in teaching with ICT.

Regarding the pedagogical aspect of ICT integration, we found that the diversity of teaching methods pre-service teachers used was dependent mostly on modeling by their school mentor teachers. The mentor teacher plays an essential role in building pedagogical, technological, and content knowledge of pre-service teachers. Her/his pedagogical and practical knowledge shapes the professional development of novice teachers. The mentor's behavior reflects the environmental norms in school, and thus influences the extent to which the pre-service teachers intend to realize their attitudes towards the integration of ICT in teaching (Ajzen, 1991). It is, therefore, important that the mentors of the pre-service teachers be skilled in using innovative methods of ICT integration in teaching. Unfortunately, only a third of the sample in the second round of data gathering had the opportunity to learn from their mentors to teach using ICT. In order to overcome this obstacle, colleges should choose field practice schools in which teachers are experienced in ICT-based innovative teaching. The training of school mentor teachers towards meaningful mentoring can also lead towards a positive impact (Ambrosetti, 2014).

We found that modeling by college lecturers also influenced the diversity of teaching methods used by pre-service teachers, in accordance with other studies (for example, Admiraal et al., 2017; Tondeur et al., 2012). As teacher educators become more creative in integrating ICT in teaching, so will pre-service teachers adopt and implement more innovative teaching methods. Thus, the main challenge for colleges of education is to reconstruct teaching process towards innovative constructivist stu-

dent-centered teaching approaches with the use of ICT, such as problem and project-based learning, inquiry, simulations, gamification, location-based learning, peer-to-peer learning, personalized, and collaborative learning. The third factor affecting the diversity of teaching methods related to the extent of practice in ICT-based teaching. Teaching experience leads pre-service teachers to develop a sense of self-efficacy (Darling-Hammond, 2006) and enables them to apply the theoretical knowledge they have acquired in academia (Loughran, Mulhall, & Berry, 2008). Dorner and Kumar (2016) emphasized the importance of collaboration between college supervisors and school mentor teachers in promoting the effective practice of pre-service teachers in meaningful integration of ICT in teaching focused on innovative pedagogy. Even more effective strategies for pre-service teacher preparation for ICT-based teaching are related to the idea of college-school partnerships. Polly, Mims, Shepherd, and Inan (2010) analyzed numerous resources examining outcomes of the US National initiative "Preparing Tomorrow's Teachers to Use Technology" launched by the Department of Education in 2000. Within the framework of this initiative, more than 400 teacher education institutions received grants and developed various approaches to implement the goals of the initiative. The research of Polly et al. indicated that a college-school partnership was especially successful since it opened the way for developing collaboration between teacher educators responsible for field practice, school teachers, and pre-service teachers in planning and co-teaching ICT-based lessons. These efforts required additional workload of the staff which was funded by the budget of the grants. In addition, involvement of schools in such projects raised the level of their responsibility for providing the necessary infrastructure, administrative and technical support.

Conclusion

In conclusion, there is no doubt that the implementation of the National Program for transforming the colleges of education to meet the demands of the 21st century has contributed greatly to teacher training. The challenge facing the colleges at present is to advance innovative approaches to integrate ICT in education by college lecturers, school mentor teachers, and pre-service teachers as well as to provide proper equipment allowing for individual use during the lessons. Future studies should focus on evaluating strategies that promote pedagogical innovations as well as their implementation in teacher education.

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GOING BEHIND THE SCENES AT TEACHER COLLEGES: ONLINE STUDENT KNOWLEDGE SHARING THROUGH SOCIAL NETWORK TECHNOLOGIES

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ABSTRACT

Aim/Purpose	The present study aims to describe existing peer-to-peer, social network-based sharing practices among adult students in teacher colleges.
Background	Ubiquitous social network sites open up a wide array of possibilities for peer-to-peer information and knowledge sharing. College instructors are often unaware of such practices that happen behind the scenes.
Methodology	An interpretative, qualitative research methodology was used. Thirty-seven Israeli students at a teacher college in Israel participated in either focus group discussions of (N = 29) or in-depth interviews (N = 8).
Contribution	Whereas knowledge sharing has been a main focus of research in organizational and information sciences, its relevance to educational settings has thus far been underscored. Recent research shows that peer–to-peer knowledge sharing is widespread among teenage students. The current study extends that work to an adult student population.
Findings	The findings show that knowledge sharing of this type is a common and even central feature of students' college life and study behavior. It takes place through a variety of small and larger social network-based peer groups of different formations, including mostly college students but at time also practicing, experienced teachers. Sharing groups are formed on the spot for short term purposes or are stable, continuous over longer time periods. The contents shared are predominantly lesson summaries, material for exams, reading summaries, and lesson plans. They are used immediately or stored for future use, as

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	students have access to vast data bases of stored materials that have been compiled throughout the years by students of previous cohorts. Teacher students mentioned a range of reasons for sharing, and overall regard it very positive. However, some downsides were also acknowledged (i.e., superficial learning, exclusion, attentional overload, and interruptions).
Recommendations for Practitioners	College faculty and teaching staff should be cognizant and informed about these widespread peer-based knowledge sharing practices and consider whether perhaps changes in teaching formats and task assignments are required as a result.
Future Research	Future research should extend this work to other higher education settings, cultures and countries, and should map the perceptions of higher education teaching staff about peer-to-peer, online knowledge sharing.

Keywords social network technology, knowledge sharing, teacher training

INTRODUCTION

The omnipresence of ubiquitous social network technologies (SNTs), such as Facebook, Twitter, and WhatsApp, have redefined the way in which we share and communicate with our fellow colleages, friends, and family members on a daily basis. The ease and speed with which we can retrieve, share, and re-use knowledge and information with others is incomparable with the reality of only two decades ago. Recent research has started to explore how these technologies have been taken up by both teachers and students for study and learning-related pruposes. In the present work, we report on findings from a qualitative study that show how teacher college students have come to adopt SNT for study-related knowledge sharing. We aim to describe the main features of such practices and to discuss their potential affordances and limitations.

BACKGROUND

Although initially intended for leisure, friendship, and personal interaction, social network technologies (SNTs) have by now crossed over to other fields and are being used for a large variety of different purposes, among which are professional, commercial, and political. Recent research shows that ubiquitous SNTs are also used for study-related, pedagogical, and other educational purposes, both in secondary and post-secondary education (e.g., Asterhan & Bouton, 2017; Hughes, Ko, Lim, & Liu, 2015; Rosenberg & Asterhan, 2017; Waycott, Sheard, Thompson, & Clerehan, 2013; L. T. Yu, 2014). Given the pervasiveness of SNTs in virtually every aspect of everyday life and the fact that teenagers and young adults use ubiquitous SNTs such as Facebook, Twitter, and WhatsApp extensively (Prensky, 2005; Tawiah, Nondzor, & Alhaji, 2014), this should perhaps not be surprising. Much of existing work on educational SNT usage, however, has focused on student-teacher communication with SNT (e.g., Asterhan & Rosenberg, 2015; Bouhnik & Deshen, 2014; Hershkovitz & Forkosh-Baruch, 2013; Ophir, Rosenberg, Asterhan, & Schwarz, 2016; Rosenberg & Asterhan, 2017) and researcher- or instructor-initiated efforts to embed SNT in secondary and tertiary education teaching (e.g., Hrastinski, Edman, Andersson, Kawnine, & Soames, 2014; Keller & Koichu, 2017; Schwarz & Caduri, 2016; Tsovaltzi, Judele, Puhl, & Weinberger, 2015).

In a recent study, we documented a relatively underexposed aspect of SNT usage in education, namely student-initiated organization in SNT peer groups for study-related, academic purposes (Asterhan & Bouton, 2017). It was documented how teenagers have adopted ubiquitous SNTs such as WhatsApp and Facebook to share materials, lesson summaries, advice, and study-related information in school-based peer groups and on a large scale. In the present work, we aim to extend that research to adult students in teacher colleges.

LITERATURE REVIEW

KNOWLEDGE SHARING, SOCIAL NETWORKS TECHNOLOGY AND EDUCATION

Knowledge sharing refers to activities in which individuals share their own internally stored knowledge or external knowledge sources they have at their disposal by making it accessible to others (Asterhan & Bouton, 2017). There are countless examples of online knowledge sharing, such as contributing to an online Wikipedia entry, posting a response to a question on a thematic Q&A forum, uploading a tutorial video to YouTube on how to knit a hat, or posting reading summaries to one's personal blog, to name a few. In the vast majority of cases there is no direct monetary reward involved for making one's knowledge available. Moreover, in contrast to other forms of sharing, knowledge sharing is not a zero-sum game. It involves letting someone else have something that you have, without entailing any kind of material sacrifice on the part of the sharer (John, 2012). In other words, through sharing one's knowledge one does not become "less knowledgeable". Quite to the contrary, when a sufficient number of participants contribute, knowledge sharing leaves one with more (John, 2012, 2013).

Knowledge sharing has been a very popular topic of investigation in informational and in organizational sciences (e.g., Bock, Zmud, Kim, & Lee, 2005; Taylor & Todd, 2001; Wasko & Faraj, 2005; C. P. Yu & Chu, 2007). The vast majority of that research has focused on organizational contexts and sharing between employees (Kankanhalli, Tan, & Wei., 2005; C. P. Yu & Chu, 2007) or in online communities (Lin & Huang, 2013; Lin, Lin, & Huang, 2008). Knowledge sharing is an explicit goal and encouraged in such contexts, as it has substantive benefits for the organization. Findings show two main motivations for individuals to share knowledge in these contexts: Expectations of social rewards for the sharer and expectation to benefit from the many contributions of other participants (e.g., Bock et al., 2005; Davenport & Prusak, 1998; Herzberg, 2003).

In contrast, knowledge sharing is a term that is rarely used in the educational literature. In previous work, Asterhan and Bouton (2017) distinguished between knowledge sharing and other types of peer-led learning interactions more commonly studied in educational research, such as peer cooperation (coordinating work to create a collective product) and peer collaboration (exchanging and building on each other's ideas through shared thinking and discussion) (see also Dillenbourg, 1999). Educational research has almost solely focused on the latter two types and their benefits for learning: cooperation and collaboration in classroom group work activities, that have been initiated, supported and guided by expert teachers (e.g., Hmelo-Silver, Chinn, Chan, & O'Donnell, 2013; Webb, 2009).

Student peer-to-peer knowledge sharing for school-related purposes has, to the best of our knowledge, not received much empirical attention in the educational literature as a topic in and by itself. Existing studies on self-organized, SNT-based peer groups in higher education settings have predominantly focused on the social and psychological function of such communication, rather than on study-related knowledge sharing (e.g., Davis, Deil-Amen, Rios-Aguilar, & Canche, 2012; Hrastinski & Aghaee, 2012; Lotan, 2012; Roblyer, McDaniel, Webb, Herman, & Witty, 2010; Selwyn, 2009; Tess, 2013). Some studies in the organizational and informational sciences have been conducted on knowledge sharing among university students (e.g., Wei, Choy, Chew, & Yen, 2012; Yuen & Majid, 2007). However, these have addressed the topic from an informational science instead of an educational science viewpoint and conflated between knowledge sharing and other forms of peer learning interactions. Furthermore these did not specifically focus on SNT-based knowledge sharing.

In two recent studies, Asterhan and Bouton (Asterhan & Bouton. 2017; Bouton & Asterhan, 2017) explored SNT-based knowledge sharing among secondary school students and found that teenagers self-organize in SNT-based peer groups to share and use shared school-related knowledge materials extensively. Across two survey studies, it was found that the majority of teenagers participate in such online sharing and in general perceive that it helps them achieve better academic results. They then

distinguished between three different categories of SNT sharing for study purposes: 1) sharing teacher-created materials and administrative information, which require little personal investment but which helps the entire group (such as homework reminders, photographs of the whiteboard, and work sheets); 2) sharing learning derivatives and resources that involve considerable personal investment and skill (such as summaries of lectures or reading material summaries or homework solutions); and 3) asking for and providing advice and help through peer direct verbal communication within the social network itself. Sharing of the first and the third type proved to be most frequent, but even the least frequent type of sharing (cheating, i.e., copying individual, solved assignments) proved to be rather frequent, as more than a quarter of the participants admitted to using such materials very frequently.

In the present study, we seek to extend research into SNT-based, peer-to-peer knowledge sharing in formal educational settings to an adult student population, namely teacher trainees in teacher colleges. Our research questions center around the following aspects of knowledge sharing in teacher colleges:

1. How do students self-organize in SNT groups for study-related purposes and what are the characteristics of these groups?
2. What are the types of materials that students share in these SNT, when do they share these, and with whom?
3. What are their motivations for participation or non-participation in sharing through SNT groups?

To complement the existing survey-based findings and to deepen our understanding of the phenomenon, we adopt a qualitative method of investigation to document its dynamics and uncover the interpretations of reality as perceived by the students (Denzin & Lincoln, 2000).

METHOD

PARTICIPANTS

Thirty-seven teacher students from one large teacher training college in central Israel participated in this study. They participated in either semi-structured focus group (2 face–to-face groups of $N = 4$ each, 1 online group, $N = 21$) or one-on-one semi-structured interviews ($N = 8$). The study included students enrolled in a B.Ed. or teacher retraining program (i.e., studens who have a B.A in a non-Education related field and have worked in a different profession before).

Demographic information about the participants in the focus groups and the interviews is presented in Table 1. The focus group and interview participants were selected to represent a large variety of study programs, as well as personal backgrounds (e.g., gender, age, discipline), but all had experience with SNT-based sharing for study purposes. The online focus group consisted of 21 teacher students (2 males) in an online college course on online teaching and the role of teachers in online environments. Most of these ($N = 20$) were enrolled in programs for secondary school teacher training (6 in the humanities and English as a second language, 14 in math and science; 18 in B.Ed.). Forum participation was obligatory in this course and a part of the course assignments.

Participation in F2F focus groups and interviews was voluntarily without receiving material or other compensation. Participants in the F2F focus groups were recommended by the college's faculty members as active participants or leaders of social groups and personally invited to participate. The first F2F focus group consisted of 4 students (1 male), from the English as a second language teacher training program (3 B.Ed. program). The second F2F focus group consisted of 4 female students studying for their B.Ed in primary school teaching programs.

Participants for the personal interviews were recruited from respondents to an online survey on sharing (N = 487 in total) (Bar-Tal & Asterhan, 2017), who indicated that they were interested in participating in a subsequent interview and who provided contact details (N = 22). E-mails and e-mail reminders were sent to these 22 students to set a date and time for an interview. Eight teacher students responded to these mails and participated in interviews.

Table 1. Personal characteristics of participants in interviews

Alias	*Gender*	*Towards teaching degree*	*Discipline*	*Study program*
Shibolet	Female	Secondary	Humanities	Retrainee
Calanit	Female	Secondary	Science	Retrainee
Oren	Male	Secondary	English	Retrainee
Marva	Female	Primary	English	B.Ed.
Harduf	Male	Secondary	Mathematics	M.Ed.
Moran	Female	Preschool	Humanities	B.Ed.
Teana	Female	Preschool	Humanities	Retrainee
Ziporen	Female	Primary	Humanities	B.Ed.

TOOLS

A guide to interviews and focus group discussions was constructed (Appendix). Questions were formulated to first address teacher students' usage of SNTs in general. Questions on sharing for academic purposes focused on the following topics: (a) what is shared and when; (b) reasons behind sharing; (c) personal experiences with sharing and SNTs in college; and (d) who does and doesn't share?

PROCEDURE

All the data were collected during the 2015-2016 academic year. The face-to-face focus groups and the interviews (range 80-100 min) were conducted in private, closed rooms on college campus. The online focus group discussion was active for one week and was conducted on Moodle, at the end of an online course. Both the focus groups as well as the interviews were semi-structured. They were conducted as an open conversation with the first author, who probed participants from a list of pre-formulated questions and topics (see the Appendix). The discourse in each session took a different direction and the questions were introduced in different orders and with different emphases, according to the flow of the discussion. The F2F meetings were audiotaped and transcribed in full. The log files of the online discussion were saved. Personal logs were collected by the first author. Since there were no differences between students in the various programs, the data was holistically defined and calculated.

FINDINGS

Using Atlas.ti (7.1) for the thematic content analysis patterns, we analyzed through repeated readings and careful examination of the transcribed protocols (Neuendorf, 2002). Following, a comparison was made between the presence of unique, repeated units (categories) within the data set (Yin,

2008). This procedure yielded a total of 4 main themes, namely, (1) the formation of SNT-based study groups, (2) the type of materials shared, (3) the motivations for sharing, and (4) matters of time in sharing. We present each general theme separately, and provide detailed information and verbatim citations for each main theme below.

Theme 1: SNT group participants - "Tell me who your friend is and I will tell you who you are"

Teacher trainees self-organize in different types of SNT-based groups. These groups differ on a number of dimensions, such as the professional background of group participants and size. As for the first, most groups consisted of teacher trainees only. Some consisted of a mix of teacher students and field professionals from outside the college. The size of self-organized SNT groups also varied. We distinguished between small groups, which consist of two to ten participants, which most commonly "reside" on WhatsApp. Large groups can contain from tens to, in some cases, even thousands of participants, and most commonly reside on Facebook:

> *People open groups like flies.* (laughs) (Oren)

Groups containing only teacher students. The number of participants in small, student-only groups range between two to ten participants. The activity time is flexible and varies according to the aims and offline relationships between the group's participants. For example, some small groups are created for the specific goal of completing a particular assignment. During the course of the assignment the group is very active, but it will be closed upon task completion. In contrast, other small student-only groups are based on offline existing friendships and acquaintances. They are active throughout the semester, or even throughout the full course of study in college and beyond, and are characterized by high participant commitment to one other.

> *All three of us are friends and all three of us are going through the same teacher training, so we share a lot (…). We argue a lot about what we construct, and we have regular courses we study together.* (Shibolet)

> *Our group was set up at the beginning of the first year, and now we have all reached the end of the third year. The group has been active throughout the past three years, during the semesters, during the exams, and even during the vacations between the academic years.* (Nurit)

Larger groups include students studying in the same programme in the same year. It is not always clear who initiated the establishment of the group. It operates for a few years, with students joining and leaving at varying frequencies. These groups contain a tens of teacher students, sometimes even hundreds. They are active throughout the academic year, and in some exceptional cases continue to the following years.

> *First of all, it is very helpful. We have a group… of one hundred and fifty participants on Facebook, which is the entire year, and throughout the year people ask questions. Class cancellations. (…) People upload summaries. I personally upload summaries there to help the other girls. We upload questions before an exam. All kinds of things, the girls helping each other. There is good cooperation there.* (Moran)

The participants' commitment in these groups is low, and the group is constantly "stocked" with new material and information. In addition, they contain a lot of organizational and logistic information, but little personal communication. Interestingly, none of the participants mentioned SNT groups with participants from different teacher colleges.

Groups with in-service teacher participants. Teacher students are also participants of social network groups that include active, in-service teachers. As teacher trainees, they work with in-service teachers in assigned schools as part of their training. To facilitate on-going coordination and communication, trainees are then often temporarily included in existing teacher WhatsApp groups in that school and for the time of the training period.

A rather different type of social network groups that teacher students may be participants of are large, designated Facebook groups for active, in-service teachers. These groups have large numbers of participants, from a few tens to a few hundreds or even thousands and are active over many years. Teacher students can turn to them for professional advice, help, and tips in a range of areas. The students who join such groups feel "small" compared to the experienced teacher "giants" and mainly absorb information or ask for advice, but rarely contribute or share information.

> *I have often encountered a situation with students in the school where I do my teacher training, or I want to receive information about teaching first hand. In such cases, I post a question in Facebook groups dealing with teaching and receive several answers from different teachers, from various areas of the country, with different levels of experience, and different pedagogical and educational approaches. The range of opinions to which I was exposed allowed me to formulate the best position for me, relying on past cases and receiving legitimacy from those with more experience than me.* (Nurit)

Personal acquaintance in such groups is limited, but the group is constantly active. The initiator is often a teacher with experience and authority on the topic, and who usually acts as the group's administrative manager.

> *Then she, Sarit Meller, is the manager of the "Committed Teachers group"… She always responds to everyone… Her entire presence in the group clear, while she is still busy with… still in the area of teaching, I wonder how she finds the time? She is so helpful, finds time to really advise, direct, support, give ideas, she even sends you to all sorts of posts where people talked about the issue before, look here and look there, so she is someone that whenever she, whenever I see her name, I read it, I really appreciate her.* (Marva)

Theme 2: The type of materials shared

Students share study-related materials in all types of format: text in posts, textual documents, voice message, pictures, and videos Content-wise we discern between three type of learning and study materials that are shared: summaries, assignments for submission, and lesson plans.

Summaries. Making and obtaining summaries of learning materials are common activities among teacher students. Many students rely only on prepared summaries that are made and shared by others. Teacher students consider this pattern of sharing as useful for reducing the time devoted to studying. The students who created and shared the summaries may wish to brand themselves and enjoy helping others (see Theme 3).

Participating students mentioned two types of summaries that are commonly shared in SNT groups: lesson summaries and student-made summaries of textual learning materials (e.g., textbooks). Lesson summaries are used extensively, both by teacher students who are absent in class (e.g., for classes for which physical presence is not an official grade component), but also by students who were present in class. Teacher students who share their lesson summaries sometimes get the reputation of good, hardworking students, who write good summaries.

> *Students in the front rows bring laptops from home and type everything the lecturer said. You know in advance that you would want to ask them for their lesson summaries.* (Oren)

In many cases, they are also the initiators who open the groups. Paradoxically, the availability of these "good summaries" online may deter teacher students to attend classes for which attendance is not compulsory, as is shown in the next quote:

> *This makes learning too accessible. It is funny. I don't go to the lesson and I already have the summary before my eyes, I don't even have to go and photocopy it.* (Shibolet)

Sharing of student-made summaries of textual course syllabi items, on the other hand, usually peaks in the days prior to an exam. But in contrast to the lesson summaries, coordinating the obtainment

of all the necessary summaries does not always go smoothly, and the group has to coordinate finding missing contents to complete the puzzle and cover all the material for the exam.

> *We had someone in the group who found it and wrote to the group: girls, I'm the "savior", I have found the summaries… and that day she sent everyone all the summaries and for two days before the exam we sat with these summaries.* (Seora)

In this case, much of the activity is within the small groups, but the participants keep in touch with equivalent groups that might have obtained the missing material. They share with everyone, both the participants of the personal group and other groups of students taking the same course.

> *Here is Dr. Levy's exam. She wrote it on the board and I photographed it and sent it to the large group, not just to our group, I sent it directly to the large group.* (Shoshana)

In some cases, especially in smaller groups, the group participants distribute the materials amongst themselves and each participant is responsible for summarizing a particular part of the syllabus until a pre-set deadline. Each participant shares his/her summary on time and thus all participants obtain a complete set of summaries in the end. Anonymous sharing, where the identity of the original person who created the summary is unknown, is more common in large groups that accompany introductory or obligatory courses. Each syllabus item has one or more summaries which are uploaded to a repository and shared in both small, intimate or larger groups (see also Theme 4). In all the summary sharing patterns, the student who feels like the "responsible adult" usually provides the summaries and/or organizes the learners, and is the initiator of the group.

Assignments. Teacher students are required to prepare and submit individual assignments autonomously. Due to the ease with which teacher students can share each others' work through social network sites, however, they collect information from friends and share examples of similar assignments.

> *For personal assignments, I ask people to get an impression of how much they have written. If there is someone whose writing, I appreciate… I ask to see what he did because it helps me formulate the idea, not necessarily at the copying level, it just helps you get the overall order, and get the direction.* (Harduf)

In another pattern of sharing, students prepare the individual assignment independently, but before submitting it to the lecturer, ask friends to read it and comment:

> *In our group, two people asked me for an opinion and I gave an opinion. Just girls who ask.* (Zufit)

In the case of group assignments, teacher students make extensive use of SNT groups and tools, both for coordinating task distribution as well as for completing the task itself. This can be achieved in a an egalitarian matter, according to which each student equally contributes, has an equal say, and group members are collaboratively in charge of the final, assembled assignment in its entirety.

> *We discuss on WhatsApp who will do each part, what we write in each part, and we also talk over Skype conference calls, and one of us writes it down, someone types in Google Docs. Each of us puts her part into Google Docs.* (Shibolet)

In other cases, the group appoints a temporary or permanent leader for such assignments. The leader is responsible for planning, schedule, receiving materials, and sharing them among the participants, and editing all the materials to create the complete assignment.

> *She organizes things and if she sees an update she says: girls, there is such and such work, let's get organized and do it. She is the thinking head of our group.* (Seora)

Students share a lot of materials, but there is actually only one student who reads and edits the entire assignment before it is submitted.. The rest of the teacher students in the group only know the particular piece of information each of them prepared individually. This process of sharing, places them in a position of minor participation in a larger assignment. The protocols showed that this structure of distributed and fragmented group work is more frequent.

> *In advance, I don't go over the parts of the others, only if I don't trust them, but there is the dominant person who checks all the parts.* (Shibolet)

The initiative to open a group for one assignment usually comes from one active student who enjoys organizing and planning everything in advance. In contrast, groups that are active over time are usually initiated naturally as a result of the friendship between teacher students, and serve for a wide range of issues, contents, and types of sharing.

Preparing Lesson Plans. Trainees spend one day a week in practical training in a school or kindergarten. They observe classes and participate in teaching. For this purpose, they are required to prepare written lesson plans that are submitted to their pedagogical mentor a few days prior. Lesson plan development usually entails a back and forth of dialogue and exchange of improved drafts with the mentor. With the help of SNT, however, there are several shortcuts:

> *We have a folder of lesson plans. Whenever someone teaches a lesson she shares the plan to the folder. This is excellent, because we do not always have time to construct a lesson plan and a detailed presentation, so we use each other's materials. But nothing compares to writing the lesson plan and preparing the presentation yourself, because that way you understand things much better… But the learning is not so deep when we have the material available.* (Havazelet)

Teacher students who are participants of larger Facebook groups with active teachers gather full or partial lesson plans from these groups, or they collect a few and create their own lesson plan. Based on the interview and focus group data, it appears then that the pedagogical mentor, who used to closely monitor, supervise, and support students ' lesson plans construction, has now become the last person in the chain, receiving finalized lesson plans that do not necessarily reflect the student's individual ability to create a lesson plan. Furthermore, teacher students sometimes receive support and advice from other practicing teachers who they meet online and who share their material and professional knowledge as "tribe elders".

> *It is very efficient and helpful for building lesson plans. There is no limit to the ideas and suggestions people give. We are exposed to very creative things that we would probably not have thought of ourselves (…) and we can learn from the experience of others.* (Rakefet)

Theme 3: Motivations for sharing and not sharing

We distinguish between motivations in favor and against sharing, and present them in separate subsections.

Motivations in favor of sharing.

Three main motivation categories in favor of participation in peer-to-peer sharing were detected in the data corpus: social gains, academic gains, and logistic gains.

Social gains. Social gains refer to actual and expected gains that improve the social standing and/or the social relationships of the sharer or the receiver of the shared information. One type of social gain that was mentioned by the participants in this study is self-branding, that is, the sharer brands himself as knowledgeable, as an object of admiration, and as a person whose company is desirable. Frequent sharers report an increase in their self-image and their social status in their online groups and their real-life friends.

> *We had a very, very big annual exam in… I shared summaries… and one very large summary with all… Many people said thank you, thank you, this was very helpful in the exam. I felt a great sense of satisfaction.* (Moran)

The atmosphere in teacher training colleges in Israel is generally collaborative and void of competition for external rewards (such as, scholarships based on academic merit, awards of excellence). Teacher students perceived that helping others does not detract from the helper's chances of succeeding.

> *People share and are not pressured because we don't have a Dean's Excellence Scholarship here, as we did in my bachelor degree studies at University, where only one out of the entire group wins.* (Calanit)

Some also mentioned the expectation that the act of sharing in the present will lead to future benefits, when the act will be reciprocated by the persons who benefitted from it (quid pro quo).

Academic gains. The act of sharing and making the materials accessible to others requires the learner to organize his thinking, summarize, and organize the study material and knowledge, so that it will be accessible and clear to others. The recipient of the material and knowledge receives organized, tidy products that they feel help them in achieving better results.

> *I saved everything from all the years, I have actual folders from the first year.* (Marva)

The student's ability to prepare a paper, to write fluently, or to solve a mathematical problem is sometimes limited, but with the help of colleagues, each one contributes a part and together, as a group, they are able to produce a better end product than if each learner would have handled the issue or solution alone.

> *My grades… are very high, and I have to note that a large proportion of this positive result should be attributed to the people in my WhatsApp group.* (Lilach)

Finally, some mentioned that it opens up opportunities for learning new materials that are not part of any particular course. This was mentioned only with regard to large online groups that include experienced, in-service teachers. In such groups, the students are exposed to a range of topics, fields, and information sources.

Logistic gains. Sharing saves time, which is one of the most valuable resources in the 21st century. Teacher students do not need to think, prepare, plan, know, learn, photocopy, and write on their own. Sharing frees them from some of these tasks and frees up valuable time for other things.

> *Instead of searching for the answer on the Internet and studying the subject, I get the answer right away and use it immediately.* (Havazelet)

The down-sides of SNT-based sharing.
Teacher students also mentioned reasons to refuse participation in sharing practices and negative side effects of sharing.

Reasons for refusing to share or to partake in sharing. Some teacher students mentioned that whereas they contribute to sharing (either of their own initiative or at the group's request), they abstain from using materials shared by others. They then choose to not benefit from the "crop" of materials and information of joint sharing.

> *I like to rely only on myself. I have no problem providing an opinion to others.* (Bosmat)

Some mentioned that they or others choose not to share materials with specific students. Several reasons were mentioned: Fear of cheating and copying, unwillingness to share a complete solution to those who were not involved throughout the process, feelings of exploitation (especially with larger assignments that require more effort), lack of personal acquaintance with the person who requested the materials, and a personal disliking of a particular individual.

> *I made my effort to get it, so that's your problem… I don't have to make their lives easier… This sense of exploitation.* (Seora)

Finally, participants also mentioned instances of punishing defunct group participants, especially the ones who only lurkand do not "contributing sufficiently". The common way to deal with this issue is to open a new group without that person and without his/her knowing.

> *There was someone I had to chase and by the time the day of the exam arrived I was lacking some part for the exam, so we opened a new group without her.* (Zufit)

The ostracized student may notice that the group has gone quiet, but may not be aware that his/her peers continue their activities elsewhere without him/her, as no one has officially left the first group. He or she may then not know, at least for some time, of his/her ostracized status and loss of all the sharing benefits.

Sharing pains: Negative side effects of sharing. Sharing may sometimes come at a price. First, the incessant stream of messages can cause pressure and anxiety for certain students as a results of social exclusion or of social comparison.

> *In one of the assignments the girls talked a lot on WhatsApp and a situation arose where you and I were not in the conversation and we felt like outsiders, which caused us misunderstanding, confusion, and pressure that everyone knew the course material… and we didn't.* (Sigalit)

Oversharing and an overload of messages can also create interference with ongoing study tasks and concentration. Some students mentioned this as a reason for leaving a group, especially when the message were mainly off-topic.

> *It [the phone] is sometimes a burden. There was a day when I just silenced the group. Once every hour I went in to check, but every minute was too much.* (Calanit)

The opportunity to divide group task into smaller tasks that are distributed among group participants may also have potential negative effects for individual intellectual progress. When each individual only prepares one particular subset of the total task or reading and relies on others to do the remainder for him/her, important learning and development opportunities are missed. The same is true for finding ready-made solutions available on one's social network, as is clear from the next two quotes:

> *The fact that it's all so accessible causes our imagination and our thinking about difficult subjects to atrophy, because we just run to the quick answers on various networks.* (Rakefet)

> *It sometimes limits imagination and creativity: (…) we instantly see someone else's answer before answering ourselves, and this may dictate our own thought pattern.* (Nurit)

Theme 4: Matters of time in sharing

Continuity and immediacy. Most participants reported ongoing, continuous activity in the WhatsApp groups, throughout the day.

> *From the early morning, there is talk and talk and talk and talk.* (Yearit)

However, they also mention going offline regularly and/or regulate the reception of postings in ways that allow them to function without constant interruptions:

> *The groups themselves are all on silent for me (…). When I am free and want to, I look at the telephone and see how many messages I have. I choose which messages to respond to and which not.* (Oren)

Group activity peaks in breaks and around deadlines. The materials may be gathered continuously throughout the semester, but toward the end of the semester, as the exam or course assignment due date approaches, sharing frequency becomes very intensive, with people sharing many lesson summaries, photographed material, article summaries, and so on.

> *Like now, at the end of the semester (…). Not everyone reads the articles. Someone reads and shares with us on WhatsApp what the article is about (…) and it happens in every assignment, it's not some special event.* (Erez)

Based on the student reports, response to requests for sharing are quite fast, particularly in WhatsApp groups. When there is a problem, a difficulty, or a question, an immediate response is usually posted by at least one of the participants, with either a picture, a written reply, or a summary.

Building data bases for future use. Some feel responsible to contribute to the construction of a communal online learning material database, which is passed on to the next generation of teacher

students in the year or semester following. Usually one particularly involved student initiates and leads such an effort, while others follow suit. Regarding themselves as senior supporters of incoming teacher students, they collect the suitable course-related materials in a dedicated folder, usually situated on Google Drive.

> *There are girls who took a certain course now and others will take it in the second semester… We pass materials and essays.* (Dikla)

> *Assignments and pages in these groups without the lecturers, anything I think could help other girls, I just send, whether it's the material I summarize, articles I think, anything that could help. For example, summaries I made, I send them so if they have the course now in the second semester they will already know and have the materials.* (Avivit)

Exam item databases are built as well. The preparation, management, organization of the sharers, and the schedule are conducted with military precision, as is evident in the next quote:

> *We now have a procedure, as soon as an exam is over everyone writes the questions she remembers from the exam… and we give this to those who have not yet taken the course.* (Bosmat)

A few highly motivated students also construct databases for their own future use. This is particularly true for lesson plan and other teaching materials that may come in handy when being an active teacher in the future. Teacher materials, lesson plans, and such are collected and stored in the communal cloud on Google Drive.

> *We share with each other the lesson plans that teachers in the school prepared, and then I have a place on my phone with cool ideas for lesson plans, for example, of the teacher I'm observing, or in private lessons, or I do something cool, or I have index cards… I photograph the cards… then I tell the group right away and they save this for themselves.* (Shoshana)

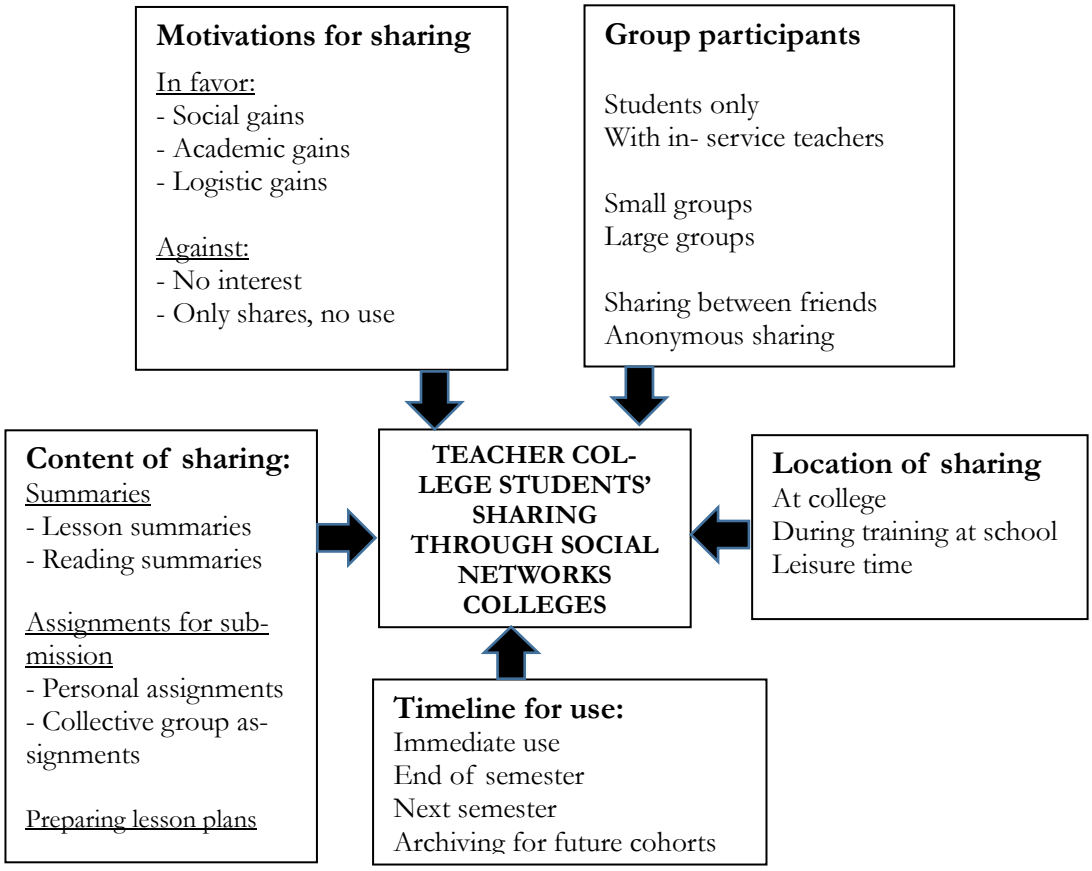
DISCUSSION

In the present study, we explored and described the phenomenon of SNT-based, peer-directed knowledge sharing for study purposes among adult teacher college students. In alignment with recent findings from teenage, secondary school populations (Asterhan & Bouton, 2017), we found that knowledge sharing of this type is a common and even central feature of college life and study behavior. The main features of these sharing practices are summarized in Figure 1. Our findings show that study-related, online knowledge sharing among teacher trainees takes place in (1) small groups of intimate study friends, (2) small-scale, temporary collaborations on a particular class assignment (usually on WhatsApp), or (3) in very large Facebook groups that span a whole cohort, several cohorts or even practicing teachers. The main contents shared are lesson summaries, material for exams, compulsory reading summaries, and lesson plans. They are used immediately, at the end of the semester, and/or stored for future use (i.e., professional use in future or for the next cohort of college students). SNT-based knowledge and material sharing is overall regarded very positively by teacher college students, but they also recognized some of its downsides (i.e., more superficial learning, exclusion, attentional overload, and interruptions). Teacher students mentioned a range of reasons for sharing that are personal, study-related, and logistic-organizational.

Our data indicate that the prominence of knowledge sharing in everyday study behavior, the motivations behind sharing and the contents of sharing materials among students align to a large extent with previous studies (Asterhan & Bouton, 2017; Hrastinski & Aghaee, 2012; Hughes et al., 2015). We found sharing categories somewhat similar to the ones in Hrastinski and Aghaee's higher education sample (2012), but, in contrast, found that knowledge sharing is pervasive rather than sporadic. Moreover, the qualitative, in-depth approach we adopted here also uncovered several new insights that may be more particular to higher education and/or to teacher colleges.

The characteristic of higher education students' sharing practices documented here may have several implications for the field. College faculty and teaching staff should at the very least be cognizant about this widespread peer-based knowledge sharing and consider whether changes in teaching formats and task assignments are perhaps required in light of it. For example, the easy availability and the sheer volume of study materials and lesson summaries on SNTs may render class attendance unnecessary in the eyes of students, since they receive lesson summaries before the lesson (in courses that are similar every year), at the end of the lesson, or at the end of the semester. This pattern requires policy makers to reconsider and decide whether to continue the policy of non-compulsory attendance or, alternatively, to change the character, type, and managing of face-to-face classes.

Figure 1. Main features of SNT-based knowledge sharing for study purposes among teacher trainees at a teacher college



The findings about the changing role of the pedagogical mentor reported here are particularly relevant to teacher colleges. Traditionally, the pedagogical mentor is to provide support for the progress and construction of lesson plans and functions as the mediator between theory and practice (e.g., Anderson & Shanon, 1988; De Jong, Korthagen, & Wubbels, 1996; Rodgers, 2002). However, our findings show that the pedagogical mentor is now often the last person in the chain and receives a complete lesson plan instead of playing an active role in the process of lesson plan building. It seems that this work has been replaced by copying existing lesson plans that are available online, in the worst case, and/or by the guidance of practicing teachers who share their materials and professional knowledge as "tribe elders", at best. The finding that -at least some- students consult with practicing expert teachers and online teacher communities should be considered in a positive light. However, we note that we could not discern the frequency and prevalence of such expert consultation and whether this concerns in-depth interactions or, instead, merely the copying of materials that are made available through the online Facebook community of teachers. It has become much easier, and

thus perhaps more frequent, to directly approach them online or to "lurk" as noncontributing, observing novices when the experts converse among themselves in Facebook groups, for example. Future research should further explore these interactions.

Knowledge about these pervasive knowledge sharing practices amongst students may also elicit a rethinking about individual and group task assignments during or at the end of a course. Based on our conversations with students reported here, students rarely read the primary original sources in the syllabus, but instead rely on (several) student-prepared summaries and other secondary sources. As for task assignments that are to be submitted to instructors during or at the end of a course, even excelling teacher students were found to consult and examine other people's work before performing the task by themselves. At least in some cases, students reported sharing their work with peers for feedback and review. Others may compile a mix of excerpts from different completed assignments available with minimal cognitive investment. Some of these aspects are expected to promote learning and development (such as peer review and peer consultation), whereas others are contradictory to the goals and intent of the instructors (such as copying). As for the group assignments, according to the students who participated in this study, there is often no brainstorming or "genuine" peer collaboration of high quality (e.g., Dillenbourg, 1999; Hmelo-Silver et al., 2013; Webb, 2009). Instead, each person prepares a small part of the assignment and only the group leader reads the entire assignment, takes responsibility, does quality control and (presumably) enriches his/her knowledge. Therefore, teacher students should consider whether they really benefit from SNTs in their learning process and outcome.

CONCLUSION

Even though ubiquitous SNTs were originally designed for social purposes, the present findings add to recent research showing that students have domesticated these tools for self-organized school- and study-related purposes as well, in particular to share learning and study materials. These sharing practices appear to be very pervasive and common, both in high school and in college settings, and have therefore accumulated in a substantive change in study practices over the last years. It becomes increasingly important that teaching staff become aware of these changes so that they reflect upon and adapt their teaching routines accordingly, should they deem this necessary. As a follow-up to this research, we have conducted several interviews with college instructors to understand what they know about online peer sharing in SNTs. It was very difficult to find interviewees, as most candidates claimed that they had no knowledge of this phenomenon at all. This difficulty underscores the importance and contribution of the present study that aimed to portray and describe existing practices and shifts in students' study practices. Social media research should dedicate more attention to the non-social puproses for which users use social network technology, such as study.

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APPENDIX

1. Which social networks are participants of?
2. Why are you part of social networks?
3. What do you share there?
4. Why do you share?
5. What do you expect others to share with you?
6. Who are the people who share the most?
7. How are they different from one another?
8. Who are the most active participants and who the least active participants. Why?
9. How much time is allocated to the social aspect and how much to the academic aspect?
10. How do you use the social network for learning?
11. Tell me of an experience which is related to social networks, that you had in college.
12. Is there a difference in the scholarly use of the social networks?
13. What is the difference in your scholarly us of the social networks?
14. Does every course have its own group in a social network or do you have one group in a social network for all (the subject matters or courses?
15. Is the entire class or all the interns in one group? Which is more common?
16. Is the lecture or the pedagogical instructor also part of the group in the social network?
17. Who are the participants? Everyone who enrolls the course?
18. Who are the silent participants, why?
19. Who doesn't share and why?
20. Who was left out and does not share or have friends in social networks?
21. Who are the ones who quit?
22. Who is admired and who isn't?
23. Is the membership in the networks according to some criteria (Jew, Arabs Russians, and the age of the Teacher students)?
24. When you applying for a large group and small group? When it was part of a large group there and what are you doing differently?
25. Are there times that more or less all network activities and unique network in particular?
26. What bothers you the social networks on the subject of learning?
27. Does it hurt or bother getting five lesson plans and you don't know what to do?
28. Are you using social networks or processes try looking for solutions that are ready, ready to work, lesson plans ready?
29. Have you ever whose applications have not been answered? What this has done to you?

BIOGRAPHIES

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THE VOICE OF TEACHERS IN A PAPERLESS CLASSROOM

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ABSTRACT

Aim/Purpose	This study took place in a school with a "paperless classroom" policy. In this school, handwriting and reading on paper were restricted. The purpose of this study was to gain insights from the teachers teaching in a paperless classroom and to learn about the benefits and challenges of teaching and learning in such an environment.
Background	In recent years, many schools are moving towards a "paperless classroom" policy, in which teachers and students use computers (or other devices such as tablet PCs) as an alternative to notebooks and textbooks to exchange information and assignments electronically both in and out of class. This study took place in a school with a "paperless classroom" policy. In this school, handwriting and reading on paper were uncommon.
Methodology	This qualitative study involved semi-structured interviews with 12 teachers teaching in a paperless school. The research questions dealt with the instructional model developed, the various ways in which the teachers incorporated the technology in their classrooms, and the challenges and difficulties they encountered.
Contribution	This study provides important advice to the way teachers have to work in paperless classrooms.
Findings	It pointed out the contribution to students in three ways: preparing students for the future; efficiency of learning; empowerment of students. The teachers presented a variety of innovative methods of using the laptops in class and described a very similar structure of the lesson. The teachers described the difficulties involved in conducting a paperless classroom instruction and emphasized that despite the efficiency of the computer and its ability to support the teaching process, they used technology critically. The findings also indicate that

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	some teachers were concerned that the transition from the regular classroom to a paperless one may negatively impact students' reading and writing skills.
Recommendations for Practitioners	Teaching in a paperless school is challenging. On the one hand, going paperless contributes to active and adaptive learning, efficiency, and the acquisition of 21st-century skills or, as they described their main goal, to prepare students for the future. On the other hand, computers in class cause problems such as distraction and disciplinary issues, information overload, and disorganized information as well as technological concerns.
Impact on Society	Teachers in the paperless school develop a solid rationale relying on ideas for teaching and learning in a paperless environment, and use varied technologies and develop innovative pedagogies. They are aware of the challenges of this environment and concerned about the disadvantages of using the technology. Thus they develop a realistic and critical view of the paperless classroom.
Future Research	Future studies investigating the teachers' voice as well as the pupils' aspect could help guide schools in preparing teachers for the paperless classroom.
Keywords	paperless classroom, teachers, K-12, BYOD, laptops

INTRODUCTION

In recent years, many schools are moving towards a "paperless classroom" policy, in which teachers and students use computers (or other devices such as tablet PCs) as an alternative to notebooks and textbooks to exchange information and assignments electronically both in and out of class. This approach is based on the concept that each student brings a personal laptop or iPad to school (BYOD: bring your own device) and uses it throughout the day as part of his/her personal equipment (Arney, Jones, & Wolf, 2012; Duncan, 2012; Ferguson, 2017; Shepherd, & Reeves, 2011; Wang, 2010).

This study took place in a school with a "paperless classroom" policy, which means that each student used a laptop as a replacement for books and notebooks and managed his or her learning assignments via a laptop, which was part of their personal school equipment. In this school, handwriting and reading from paper were rare. The purpose of this study was to hear from the teachers teaching in a paperless classroom and to learn about the benefits and challenges of teaching and learning in such an environment.

The following sections will describe the literature review for learning in a paperless environment, the methodology, findings regarding the contribution to the students, methods used by teachers and the challenges of the paperless classroom. It will conclude with discussion about the pros and the cons of such a classroom.

THE PAPERLESS CLASSROOM

The primary rationale for the paperless classroom is to promote a more efficient and organized classroom while preparing students for the practical world outside school walls (De Bonis & De Bonis, 2011; Slowinski, 2000; Wang, 2010). It is apparent that over the last ten years, the internet and ICT tools have changed the amount of accessible information, the ease of communication, and the learning methods using digital devices. The workplace becomes paperless and more schools include virtual classes (Capek & Hola, 2015). It is not just a new tool or a method of teaching and learning but a new paradigm of learning (Yuniarti, 2014). Paperless pedagogy aims to improve the learning experience and help students develop electronic skills and competencies (De Bonis & De Bonis, 2011; Suhr, Hernandez, Grimes, & Warschauer, 2010). Studies have also found that the paperless classroom improves the students' engagement and motivation (Ferguson, 2017; Teeter, Madsen, Hughes, & Eagar, 2007) as well as higher order thinking skills and collaboration (Kashtan, Ram, Forkosh & Ran,

2016). It can also enhance the instructor's ability to solicit active participation from all students during class, conduct immediate and meaningful assessment of student learning, and provide needed real-time feedback and assistance to maximize student learning and enhance performance (Enriquez, 2010; Watfa, & Audi, 2017). According to Hetzroni and Shrieber (2004), students with disabilities, especially dysgraphia, benefit even more from a paperless classroom policy. They can type instead of handwrite, and this tends to improve their academic performance.

Researchers have shown that in general students respond positively to the paperless classroom (Ferguson, 2017). They express a high level of satisfaction and have no desire to return to a paper system (Arney et al., 2012). Several researchers (Bebell, & O'Dwyer, 2010; Hofstein et al., 2013; Lei &Zhao, 2008; Suhr et. al, 2010) reported that students experienced the paperless classroom as a more personalized, interactive, effective, and enjoyable learning environment. On the other hand, students also expressed some frustration in regard to specific issues such as delivering online testing and writing formulas with text and numbers digitally (Shepherd & Reeves, 2011). Studies conducted in paperless classrooms have reported that the level of satisfaction was not equal among students. According to Ferguson (2017) and Keane, Lang, and Pilgrim (2012), younger students were significantly more positive about using iPads than older students in the same school. Gender differences were also found, with boys being more positive in their attitudes towards using iPads and laptops than girls (Ferguson, 2017; Shonfeld & Meishar-Tal, 2016). It was also found that the satisfaction of students with learning in a paperless classroom decreases somewhat over time (Berger-Tikotsky, Zion, & Spektor-Levy, 2016; Shonfeld & Meishar-Tal, 2016).

From the teachers' point of view, a paperless policy suggests a change in teaching methods, from a teacher-centered approach to a learning environment in which students explore and structure their knowledge through interaction with other students. Teaching in a paperless classroom can employ constructivist pedagogies that place students and learning at the center (Anderson, Mitchell, Thompson, & Trefz, 2014). Similarly, Harasim (2012) claimed that changes in the way we acquire knowledge, in particular through the Internet, will lead to teachers developing a different epistemology about knowledge. It is not only about the access to different techniques and instruments, but also the need for the competence to deal with technology and make appropriate decisions about technological instruction that can have significant impact on students (Grigoryan, & Babayan, 2015). Part of the rationale for our study was to explore whether teachers in our school indeed changed their views of knowledge or simply used the same pedagogy as before, enhanced by digital technology.

Previous research has focused mainly on learning processes and students learning in a paperless classroom (Berger-Tikotzky et al., 2016) and less on teachers and the challenges they face in moving towards a paperless classroom. This study aims to illuminate the perspective of the teachers by presenting the voices of those who taught in a school where a paperless classroom approach had been implemented.

Context

This study took place in a school in Israel with a "paperless classroom" policy. It was a new "growing" school in which each year a new grade was added. The study was conducted during the third year of the school's existence. The junior students were in 7th grade and had been at the school for one year, while the senior students were in 9th grade and had three years' experience in the school. The students and teachers brought their own laptops to school. Instead of notebooks, they used the OneNote application. They did not carry printed books but used digital books and other digital materials that made the school's Learning Management System (LMS) accessible to them. The classrooms were equipped with smartboards or projectors to project digital materials in the classroom. The entire school had broadband Wi-Fi, and students as well as teachers could access the Internet at any time and from any location in the school.

METHODOLOGY

The research was conducted using qualitative methods. The main questions were the following: What methods do teachers in a paperless classroom use? What is their attitude toward the paperless classroom policy? What are the challenges they encounter? The open-ended questionnaire was administered by the researchers only after it was discussed with the school pedagogical advisor, an external school advisor, and the educational consultant. This team of the research advisors helped the researchers to formulate the questions for the research and choosing the teachers for the interviews. Twelve teachers were interviewed using a semi-structured interview approach. The teachers were from different disciplines, and one was an educational advisor. Most were young (30-40 years of age) with only 1-5 years teaching experience. Most had masters' degrees.

The semi-structured questionnaire included 16 open-ended questions in four areas: personal details, attitudes to technology in education, attitudes to the paperless classroom policy, and the application of this policy in class. The interviews were transcribed and then analyzed based on grounded theory. Bottom-up content analysis was conducted to identify themes. Narralizer software was used to create the categories and the themes (Shkedi, 2014).

FINDINGS

The analysis of the interviews produced the categories and themes. These results are the answer to the research questions. The results are presented schematically in Table 1 and in a broader form with citations in the following section.

Table 1. Numbers of teachers related to each of the categories and themes

Category	No. of teachers related to the category	Theme	No. of teachers related to the category
1.The rationale of learning in a paperless classroom	11	Preparing students for the future	7
		Efficiency of learning	4
		Empowerment of students	4
2. Methods used by teachers to implement a paperless classroom	10	Similar model of a lesson	8
		Media-enriched learning	4
		Adaptive Learning	3
		Group learning	7
		Flipped Classroom	3
		Varied technological environments	6
3. Challenges related to teaching and learning in a paperless classroom	12	Distraction and discipline problems	7
		Information overload	4
		Technological problems	6
		Underdeveloped skills:	
		Social skills	4
		Reading skills	5
		Writing on paper	5

As can be seen from Table 1, all 12 interviewees related to the third category of the challenges of the paperless classroom. However, not all of them mentioned the rationale of the paperless classroom

(11) and only 10 of them spoke about their lesson methods. The majority of teachers (7) emphasized the importance of preparing their students for the future, the unified structure of the lesson on one hand (8) and the variety of technological tools they used on the other. Seven of them mentioned the group work they do in their classes. They emphasized distraction and discipline problems (7) as well as technological problems (6) as their main challenges. Underdeveloped skills were also emphasized but were divided to subthemes (14 altogether).

As shown in Table 1, categories were derived from the interviews dealing with the teachers' perspectives in the following areas:

a. The rationale of learning in a paperless classroom
b. Methods used by teachers to implement a paperless classroom
c. Challenges related to teaching and learning in a paperless classroom

A. The Rationale of Learning in a Paperless Classroom

It was found that learning in a paperless school contributed to students in three ways:

1. **Preparing students for the future** - Learning in a paperless classroom is perceived by the teachers as a means of preparing students for the future world and for the job market. The digital skills that the students acquire during classes are part of training them to develop real-life skills such as self-learning, information gathering, and collaboration. This view was reflected by one of the teachers in the following statement*: "It's not a choice, it's a reality of our lives.*"

2. **Efficiency of learning** - Teachers said that learning in the paperless classroom was more efficient in two ways. First, it was more efficient in terms of time and accessibility to and organization of information. As one of the teacher stated, "*As far as I'm concerned, what is really optimal here is that they have everything here. I can send them a message. If there is a test, I can put the material for the test here. There is no, 'I can't find it.'"* Second, the technology improved communication among students and teachers. The online environment offered new means of interaction between them, contributing to the transparency of the learning process and the effectiveness of assessment. As one of the teachers noted, "*It is possible to track who entered, who did what, and the student receives the grade immediately."* Nevertheless, it should be noted that the teachers did not view technology as the main issue; one commented, "*I do not have enough experience to tell you if the computer makes them better students. But I think the computer is a very simple tool, very convenient and suitable for this time and age. If my lesson is not good ... then the computer will not help make it better."*

3. **Empowerment of students** - The pedagogical rationale that emerged from the teachers reflected the perception that students' needs must be put at the center. According to the teachers, the technology enabled them to design lessons that focused on active and meaningful learning and contributed to the enjoyment of learning, as expressed in the following statement: "*The Internet came to our advantage, in reading real materials, learning English by actual activity, communicating with the world .... Create the activities, let them create things in general, give them challenges."* Some teachers emphasized the experience of self-regulated and personal learning as central to the learning experience in a paperless classroom. As one said, "*The materials are available on the computer, and the student has a responsibility to learn, to progress, and to fulfill the tasks."* In the case of students with special needs, the special-education teacher emphasized the advantages of the paperless classroom in enabling "*everyone to connect and work on his assignment and in his own pace*."

B. Methods used by Teachers to Implement a Paperless Classroom

During the interview, teachers were asked how the vision of the paperless classroom was reflected in their teaching. Despite differences among teachers in terms of seniority, disciplines, teaching experience in schools, and educational philosophies, they described a similar model of a lesson. An ordinary lesson had the following structure:

1. Opening the lesson with presenting the material for 10-15 minutes. During this stage, computers were closed and the students' full attention was on the teacher.
2. Students were given a task and began to work independently, in pairs, or in groups.
3. Subsequently, the students were brought together for discussion and lesson closure.

Teachers described diverse teaching methods and strategies such as media-enriched, independent, collaborative, individual, remedial, and adaptive learning, and the flipped classroom.

Media-enriched learning: Some teachers described how they integrated online video and prepared recorded lessons for their lessons. As one of the teachers said, "I *can prepare a lesson while I sit at home and record a YouTube video. I already have more than a hundred videos...."*

Adaptive Learning: One way to use technology in teaching is through personalized learning and individual learning, especially for students with special needs. As the Special Education Teacher explained, "*The advantages are reading with a reading software…. The computer allows us to give customized instructions, everyone can connect and work on his/her assignment ....*"

Group learning: The teachers employed collaborative learning as well as individual learning in their classes. In their opinion, collaboration enabled higher-order thinking and gave students a sense of knowledge of the material. Collaborative learning encouraged students to explore multiple aspects in situations, develop social skills, and foster leadership. As one of the teachers noted, "*This is the most fun. You go around the groups .... It's as if you look at how they've advanced."*

Flipped Classroom: Use of videos by teachers and students is not only taking place in class but also at home. It promotes the flipped classroom approach (Flipped Learning Network, 2014), in which students learn about a subject at home and use the face-to-face lesson to clarify questions and delve into the material with the teacher. One of the teachers noted, "*There can be a lesson in which I sit at home and record a YouTube video related to an assignment…. I solve only the question one and two in the video... and then they come to class, I say, 'You've seen the video, great, here are exercises, start working.'"*

Varied technological environments: The teachers' best-practice lesson descriptions show a variety of technology environments used during the year. The environments mentioned in the interview were simulations, games, smart board, work pages, videos, digital books, 3D, Google Maps, and OneNote. The diversity of tools and techniques is part of a wider understanding of the schools' role: "*I think we here at school try to implement a lot of things that do enhance the optimal experience, which breaks the limits of a classroom with four walls, just to get out of this space, getting into other learning spaces.*"

C. Challenges related to teaching and learning in a paperless classroom

Alongside the benefits the teachers recognized in teaching in a paperless classroom, they also pointed to some difficulties and disadvantages. The disadvantages can be divided into four primary categories: distraction and discipline problems, information overload and disorganized information, technological problems, and underdeveloped skills.

Distraction and discipline problems: Most teachers claimed that the computer distracted many children by popup messages, online communication with friends, and distracting games, all of which

required the teachers to supervise the students when they were working on their computers. Teacher *M* noted, "*You see students sitting with an open computer and playing solitaire and on Facebook ….*" One of the methods teachers found useful in reducing distraction was to limit the use of the computer at the beginning and the end of the lesson, during classroom discussions, or in cases of whole-class teaching. As this teacher said, "*When I teach, I teach. While having a discussion, while there is brainstorming, the computer is closed.*"

Information Overload: One of the perceived advantages of the paperless classroom is that the online environment in general and the digital notebook in particular invite new possibilities for accessing and handling information. However, some teachers perceived this as a challenge. Maintaining order and managing information in the digital environment was not so easy for the students, as one of the teachers explained: "*The truth is that when working with a portable computer one must teach a child how to organize his information …. There is this difficulty of knowing to manage information because it is a lot of information.*"

Technological Problems: Although teachers and students had appropriate training, there were still problems in operating and managing the technology. The problems related to maintenance of infrastructure and personal devices, operation of applications and internet sites, and the need for further technological training. Teacher *M* said, "*There are technical problems, you know, which you do not have with paper. It's annoying.... I go into a site, it just crashed.…There are PC problems.…They don't recharge the computer at home and there aren't enough outlets. There are web crashes, and it is difficult to activate the task.*" Some teachers said that it took them a long time to train the student to make proper use of the technology and "*even after a long period of intensive learning of new tools, gaps still exist.*" According to the teachers, there were problems with the students' keyboarding competence; one noted that there were "*students' typing problems. They need to improve their typing; some students have problems with computer control.…Students do not have enough...computer skills.*"

Underdeveloped Skills: The teachers noted three types of skills that the paperless classroom policy may damage and expressed their concern regarding them:

1. **Social skills:** Teachers were concerned that the students' social skills were in retreat. As online space becomes a more significant place for interaction, social skills are reduced accordingly and social anxiety rises. As one teacher put it: "*What we hear from a lot of parents, also a lot from children, they go home to play with their friends through the net. That is to say, they meet much less....*" The same concern was also expressed by another teacher: "*Today we need to make an effort to cut off the children from the computer. Students who do not have friends ... find refuge on the computer.*" *Teacher D* also commented on social issues. She claimed that the lack of social skills was very clear in the classroom dynamics and added, "*I would not want to lose the social skills required in face-to-face meetings.*"
2. **Reading Skills:** Some teachers believed there was a problem with the reading of texts, mostly long texts. In their opinion, reading for a long time from a computer screen, mobile phone, or tablet is more difficult than reading from printed materials. Teacher Y claimed, *"It's hard to do much reading of long texts. I think long texts should be read on paper.*" Some teachers felt that reading on the computer adversely affected reading comprehension, compared to reading on paper, so they preferred to print the text.
3. **Writing on Paper:** Some teachers believed that word processing affected writing skills. In teacher Y's opinion, writing skills such as summarizing were absent: "*[H]ere another big part falls through: first of all summarizing skills, the skill of writing a summary.*" Teacher T thought that in situations where empirical and experiential methods are required, the notebook was missed: "*[T]hose who learn biology at least, should have a notebook. I feel that they suffer from not writing, don't draw things, no longer do things through other senses.*" Another issue of concern to the teachers was that in the national matriculation exams handwriting is required, and students in this school did not use handwriting, which could harm their performance. As teacher D com-

mented, "*The strategies of reading a text and labeling and highlighting and writing next to the text, that we don't have on the computer, I mean, we do but it ... it's different. The writing is disappearing, and then on the exam [matriculation] suddenly they are asked to write, so where's the daily use compared to the exam?"* Teacher D continued, "*The Ministry of Education still requires the students who learn in a digital environment to take the written matriculation examinations and not digitally."* In other words, there is a gap between national requirements and what takes place in the school.

Some teachers did not use only a digital environment but gave their students tasks to perform on paper. Some believed that it was important to maintain the skill of writing on paper. Teacher I said, "*Paper is not a dirty word. I want to see them express themselves, I want to see them writing ... from start to finish. With a sketch, I do use paper. I often encourage the children during the lesson as well, to scribble a sketch in a notebook. It's okay*." The use of paper from time to time does not express opposition to the idea of a paperless school or to the integration of technology in teaching, but it stems from specific pedagogical needs. Teacher L summed up her personal philosophy and the importance of using paper in the classroom: "*There are activities that go better with paper and one should use them. There are activities that are better on the computer....I think a lot of things go into your head, through physical writing."*

The challenges as described in Table 1 were important and mentioned by all interviewees. The themes derived from this category were more detailed concerning learning, writing and reading in class. Table 2 presents these aspects schematically.

Table 2. Paperless Classroom Challenges

Long Texts	**Writing**	**Pleasure**
• Long text- Uncomfortable to read • Harms understanding	• Typing problems • Disparity between pupils • Disparity between pupils and teachers	• Missing the sense of touching the book • Digital books vs. printed books
Distractions	**Information Overload**	**Technology Problems**
• Popups • Chats with friends • Enticing games • Computer supervision	• File organization • Retrieving information • Managing information	• Laptop problems • Infrastructure – Sockets, Charging, Internet • Sites and apps – installation and setup

The challenges presented in Table 2 emphasize issues around the absence of paper and the difficulties of managing the new tool, i.e., the computer. It is important to mention that all these categories were derived from the teachers' interviews.

The results pointed out that that the teachers rationalized the reality of the paperless classroom by claiming that it prepared the children for the future, added to efficiency of learning, and empowered their pupils. They used a similar structured lesson but employed different technology and pedagogy for their classes. They were aware of the challenges such as distraction and discipline problems, technological problems and underdeveloped skills, especially reading and writing skills.

DISCUSSION

In recent years, many schools have moved towards a "paperless classroom" policy, in which teachers and students use computers (or other devices such as tablet PCs) as an alternative to notebooks and textbooks and exchange information and assignments in and out of class electronically. This is be-

cause the internet and ICT tools have changed the amount of information accessible, the ease of communication and the learning methods using digital devices (Capek, & Hola, 2015). This research aimed to discover the rationale of learning in a paperless classroom, the methods used by teachers to implement it and the challenges related to teaching and learning in a paperless classroom.

From the interviews with the teachers, it is clear that teaching in a paperless school is challenging. On the one hand, going paperless contributes to active and adaptive learning, efficiency, and the acquisition of 21st-century skills or, as they described their main goal, to prepare students for the future. This is in line with other research that points out that paperless pedagogy improves the efficiency of the learning experience and contributes to developing electronic skills and competencies (De Bonis & De Bonis, 2011). In addition, technology improves learning-process transparency and engagement in learning; order and organization also improve, helping to assess student learning. These advantages were also mentioned by Enriquez (2010) and the Edudemic staff (2014) as being important in preparing students for the real world. On the other hand, computers in class cause problems such as distraction and disciplinary issues, information overload, and disorganized information as well as technological concerns. These might change according to age and gender differences (Ferguson, 2017; Keane et al., 2012; Shonfeld & Meishar-Tal, 2016).

The teachers used the computers in class mostly as a digital notebook and for access to the school's online learning environment. In addition, new and innovative possibilities and pedagogies were observed, such as the Flipped classroom approach and group work that rendered the class more active, making the work meaningful and contributing to the enjoyment of learning. It seems that the results of this research support the view that teachers who work in a paperless classroom school are more likely to use innovative pedagogy and employ constructivist epistemology and theory (Anderson et al., 2014; Harasim, 2012). Studies have also found that the paperless classroom improves the engagement and motivation of students (Ferguson, 2017; Teeter et al., 2007) as well as higher order thinking skills and collaboration (Kashtan et al., 2016).

Most previous studies (Enriquez, 2010; Watfa & Audi, 2017) emphasized the benefits of learning and teaching in a paper less classroom, stressing the contribution of the paperless classroom to the enhancement of the instructor's ability to solicit active participation from all students during class, conduct immediate and meaningful assessment of student learning, and provide needed real-time feedback and assistance to maximize student learning and enhance performance. The teachers interviewed in this research acknowledged these benefits, however, they also were critical and aware of the challenges that the paperless classroom brings about. The teachers expressed their concern about distraction and discipline issues (Fried, 2008) that the paperless classroom may cause, as well as information overload (Roda & Thomas, 2006) and technical problems that are inherent in the teaching and learning digital environment. They were also concerned about the social skills as online space becomes a more significant place for interaction, probably at the expense of face to face interactions.

The issue of reading and writing was stressed. Some teachers claim that the fact that students don't read and write on paper adversely affects those skills. They believe that there is a problem with the reading and understanding of texts, particularly long texts. These findings add to Liu's (2005) claims that students tend to develop strategies of skimming and not intensive reading and that writing requires keyboarding skills that are not natural and easy to achieve (Barkaoui, 2014). It also strengthens previous studies reporting that students are reluctant to read long texts from screens and preferred handwriting (Shonfeld & Meishar-Tal, 2016). However, pen-based computers might change these attitudes (Koile & Singer, 2006). It is also important to look at differences between the teachers prospective on distractions. Teachers were complaining on popups screens, games and chats, while pupils were not aware of those distractions (Shonfeld & Meishar-Tal, 2016). It seems that there is more research to be done on the benefits and the challenges and to find the best way to teach and employ reading and writing in a paperless classroom.

CONCLUSION

In conclusion, this study shows that teachers in the paperless school develop a solid rationale relying on ideas for teaching and learning in a paperless environment, and use varied technologies and develop innovative pedagogies. They are aware of the challenges of this environment and concerned about the disadvantages of using the technology. Thus they develop a realistic and critical view of the paperless classroom.

This study is relevant to the growing number of schools developing paperless classes (Capek & Hola, 2015). However, it relies on the results of one school in a specific area and on 12 teachers' interviews. Thus the results cannot be generalized. Other future studies investigating the teachers' voice as well as the pupils' aspect could help guide schools in preparing teachers for the paperless classroom.

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UNDERGRADUATE HAREDI STUDENTS STUDYING COMPUTER SCIENCE: IS THEIR PRIOR EDUCATION MERELY A BARRIER?

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ABSTRACT

Aim/Purpose	Our research goal was to examine whether the prior, Talmud-based education of ultraorthodox Jewish men is merely a barrier to their academic studies or whether it can be recruited to leverage academic learning.
Background	This work is in line with the growing interest in extending the diversity of students studying in higher-education institutes and studying computer science (CS) in particular.
Methodology	We employed a mixed-methods approach. We compared the scores in CS courses of two groups of students who started their studies in the same college in 2015: 58 ultraorthodox men and 139 men with a conventional background of Israeli K-12 schooling. We also traced the solution processes of ultraorthodox men in tasks involving Logic, in which their group scored significantly better than the other group.
Contribution	The main contribution of this work lies in challenging the idea that the knowledge of unique cultures is merely a barrier and in illustrating the importance of further mapping such knowledge.
Findings	The ultraorthodox group's grades in the courses never fell below the grades of the other group for the duration of the five semesters. Due to their intensive Talmud studies (which embeds Logic), we hypothesized they would have leverage in subjects relating to Logic; however this hypothesis was refuted. Nevertheless, we found that the ultraorthodox stu-

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	dents tended to recruit conceptual knowledge rather than merely recalling a procedure to solve the task, as novices often do.
Recommendations for Practitioners	We concluded that these students' unique knowledge should not be viewed merely as a barrier. Rather, it can and should be considered in terms of what and how it can anchor and leverage learning; this could facilitate the education of this unique population.
Impact on Society	This conclusion has an important implication, given the growing interest in diversifying higher education and CS in particular, to include representatives of groups in society that come from different, unique cultures.
Future Research	Students' unique previous knowledge can and should be mapped, not only to foresee weaknesses that are an outcome of "fragile knowledge" , but also in terms of possible strengths, knowledge, values, and practices that can be used to anchor and expand the new knowledge.
Keywords	computer science, diversity, prior education, Talmud, Logic

INTRODUCTION

There is a growing interest in extending the diversity of students studying in higher-education institutes in general, and studying computer science (CS) in particular. Postsecondary education confers numerous benefits both to the individual and to society, including higher incomes and lower rates of unemployment and government dependency. Studying CS as a major domain can be a springboard for successfully entering the labor market and, in turn, for increasing social mobility. Graduates can pursue a career in CS and in other relevant areas. However, the lack of diversity in computing has existed for decades (McGill, Decker, & Settle, 2015) at all levels.

There are many barriers to college access and success. One such barrier is affordability. Another potential barrier is a lack of preparation for higher education. In this work we focus on adults who did not undergo core studies (e.g., math, sciences, and English) education during their childhood and youth, and who would like to study CS in order to get a high-paying job that would enable them to provide for themselves and their family. Can they succeed in higher education studies?

More specifically, this work concerns the integration of Israeli ultraorthodox Jewish men into CS academic studies, in particular the role that their unique, previous education plays. The ultraorthodox Jewish community (*Haredi*) has radical and stringent religious demands. These men lack a conventional high-school education and, hence, they underwent little if any core studies (math, sciences, information-communication technology, English, and so forth). Their education is based mostly on studying the Talmud, which we explain later.

As in the case of other minorities, the unique education and upbringing of ultraorthodox Jewish men is often perceived as a *barrier*, preventing them from studying CS as well as the domains of science, technology, engineering, and Mathematics (STEM), which in turn, prevents them from getting high-wage jobs. However, little is known about this issue empirically. In this work we examine this assumption and present our results. Employing a mixed-methods methodological approach, we compared the scores of Israeli ultraorthodox men who studied CS with a group of men with conventional K-12 schooling, and who had studied the same program. We also traced the solution processes of ultraorthodox men in tasks involving Logic, in which their group scored significantly better than the other group.

LITERATURE REVIEW

As mentioned above, the ultraorthodox Jewish community (*Haredi*) has radical and stringent religious demands. This group is divided into many subgroups that differ from one another in their specific

ideologies and lifestyles. In 2014 the ultraorthodox Jews comprised about 11% of the Israeli population.

Many of the Haredi men do not participate in the Israeli labor force. Instead, they devote most of their time to studying in a *yeshiva* (Talmudic academia, discussed later). Specifically, according to the Israeli Central Bureau of Statistics (2015), 56% of Haredi men were employed (in comparison with 89% of the general population of men in Israel, ages 25-64). As a result of the low employment rate and their low personal income, most ultraorthodox households are below the poverty line. In fact, 52% of the Haredi population is below the poverty line in comparison with 19% of the general population. This tendency has been stable since 2006. The percentage of ultraorthodox children in poverty is very high (67%) and their per capita income is 47% lower than that of the general population.

In recent years the government of Israel has invested substantial efforts in integrating Haredi people, both men and women, into the labor force, in ways that would improve their economic situation, yet allow them to maintain their unique life style (Gal, 2015). One such endeavor is to enable and facilitate this population to pursue academic education, which in turn would enhance their chances to work in high-paying jobs. However, this is not trivial when it concerns ultraorthodox men, given their unique prior education, which we will now explain.

Ultraorthodox Jewish men lack conventional, formal education including science, mathematics, technology, and English. In fact, in 2013 only 2% of Haredi boys earned matriculation certificates (in contrast to 17% of Haredi girls) (Malach, Choshen, & Cahaner, 2016).

As Davidman and Greil (2007) put it, "Haredi (including Hasidic) Jews, like other highly encapsulated groups, provide environments that are insulated from secular life in a variety of ways" (p. 205), including their unique education system. The K-12 education of Haredi men is based almost exclusively on sacred texts, mostly the books of the Talmud (sometimes they study for 10 hours a day). Talmudic texts commonly take the form of a written transcript of an ever lively, usually agonistic, and occasionally vituperative oral discussion. The most common contemporary framework for the Talmudic study process within the study hall is the *Havruta*—(lit. company, friendship, from *Haver*: friend)—paired study. The students of the *yeshiva* have pages of the Talmud before them and they collaboratively engage in debating the meaning of any given section while intellectually juggling a host of other interpretations given for the same section, whether recorded on a given page or not (Blum-Kulka, Blondheim, & Hacohen, 2002).

These studies differ from academic studies not only due to the different contents studied, but also in the learning values advocated. Academic studies are goal oriented (tests, degrees, and so forth), whereas the ultraorthodox religious values encourage engagement with the sacred texts as a worthwhile activity on its own. Torah li-shma (Torah is the first part of the Hebrew bible), namely, study as an end in itself, is a central ideal in this lifestyle (Blum-Kulka et al., 2002), which might be expressed in the development of certain habits of mind, such as critical reading, paying attention to nuances, and being explorative and inquisitive (Dembo, Levin, & Siegler, 1997).

However, there are also overlaps between Talmudic studies and other fields. A prominent overlap is Logic. The Talmud is a body of arguments and discussions about all aspects of human life: social, legal, and religious. This canonical text was completed over 1500 years ago, and its argumentation and debates contain many logical principles and examples (Abraham, Gabbay, & Schild, 2011b). Applying appropriate strategies is at the core of Talmudic learning. General and possibly conflicting tasks are often involved in Talmudic learning, in which the learner must apply Logic and make decisions in an unknown new situation (Abraham, Gabbay, & Schild, 2009, 2011a, 2011b; Abraham, Gabbay, Schild, Hazut, & Maruvka, 2011).

Abraham et al. (2009, 2011a, 2011b) show how forms of basic rules in Talmudic Logic can be transformed into general frameworks that are very much relevant to today's research in Logic, artificial

intelligence, law, and argumentation. They use mathematical formulations of problems in the Talmud, creating loops, matrices, and equations.

However, significant differences exist between Talmudic and mathematical Logic. One is that the Talmudic texts do not include any logical or mathematical symbols and formulations (Dembo et al., 1997). Another prominent difference is the ways in which a statement is determined as "true". In mathematics and in many scientific disciplines, two opposing propositions cannot be simultaneously declared as "true". The "truth" of a statement is based on its coherence (or agreement) with all narratives that have been endorsed up to that point. Talmudic justification, on the other hand, involves reasoning between several, often equally plausible alternatives. Consequently, one's Talmudic interpretation must be supported by evidence, but it does not necessarily refute other interpretations (Segal, 2011), as mathematical or scientific counter-examples do.

Computer education has many advantages with respect to this population. It has potential to offer jobs with higher wages. The field of computing does not conflict with faith and ideology. One can work from home and use a 'kosher Internet program', namely have access to the Internet, which is restricted according to different Haredi requirements (Campbell & Golan, 2011). In a survey conducted in 2008 by the Ministry of Economy, 49% of ultraorthodox men were interested in academic education, and of these, 23% were interested in computer education of some sort (Malachi, Cohen, & Kaufman, 2008).

There is vast work on how to get students from the underrepresented groups to enroll in CS programs and how to make it more approachable to those students from underrepresented groups who have enrolled in CS classes. The former is challenging due to the image of CS as an asocial, tedious and boring profession, for geeks (Porter, Guzdial, McDowell, & Somon, 2013).

The latter is challenging as well. There is a high dropout rate (Bennedsen, & Caspersen, 2007; Kinnunen & Malmi, 2006), especially from those groups in CS. Varma (2006) and others (e.g., Goode, 2008; Guzdial & Forte, 2005) contend that CS courses can and should be made more minority-friendly and focus on the importance of building on students' capital and their prior, unique knowledge. Often, attempts to build on students' capital have focused on increasing their motivation and their sense of the relevance of CS, as well as making sense of concepts through examples from their own cultural world.

These challenges, although important on their own, are less relevant to our work, since building on students' capital means not only building on the unique parts of this capital, but also on students' acquaintance with the contents, norms, and practices of conventional schooling, which is not the case when considering ultraorthodox men, as we explained.

The unique prior education of ultraorthodox men, though rich in knowledge of Talmud, is often perceived as a barrier, "a lack of general studies, matriculation certificates, and professional qualifications" (Malach et al., 2016, p.8). Their intensive studies are viewed as adding low if any value to their academic studies (Cohen, 2005; Gal, 2015). However, we found two empirical works, both in mathematics, which suggest that their unique ultraorthodox upbringing may leverage academic learning. Dembo et al. (1997) compared the performances of two groups of Israeli male students, those attending mainstream, secular schools, and those in ultraorthodox systems (age groups of 12-14, 16-18) in solving geometric misconception problems. Interestingly, the ultraorthodox 12 to 14-year-olds performed better than their secular peers, although they had not previously received instruction in geometry. Among the 16 to 18-year-olds, the secular students did somewhat better, but this advantage was limited to those secular students who had studied the most advanced mathematics curriculum. Ultraorthodox and secular students both benefited, to equal degrees, from training aimed at improving their understanding of geometry. Dembo et al. (1997) ascribe the advantages of the ultraorthodox lifestyle to the characteristics of their education, especially the values of in-depth understanding and the tendency to read critically.

The work by Ehrenfeld (2016) further reinforces the hypothesis that a Talmudic background can leverage academic studies. Ehrenfeld (2016) examined the discourse of ultraorthodox men who had studied mathematics in a preparatory course and found that students set goals and utilized practices of exploration and discussion with peers, which enabled them to delve into problems, gain a conceptual understanding, and solve them (see also Ehrenfeld, Heyd-Metzuyanim, & Onn, 2015). However, we found no other empirical work about Haredi students learning of STEM education in higher education or at any other level.

Is the unique Haredi background merely a hindrance to their CS academic studies or could this unique background positively affect their learning? CS is a discipline that relies both on mathematics (especially Logic) and on engineering. The ultraorthodox men lack a body of knowledge, gained throughout a formal school education as well as experiencing life in a modern world, which could bring about difficulties when studying CS. On the other hand, these students bring to class their positive, unique learning habits from the yeshiva. Specifically, their pursuit for truth might transfer to an in-depth exploration for a conceptual understanding, as reported by Dembo et al. (1997) and Ehrenfeld (2016). Additionally, their Talmudic learning involves an intensive use of Logic, since it involves logical arguments. Hence, they might possess a general conceptual framework of logic that they could apply to a new context.

METHODOLOGY

RESEARCH OBJECTIVES AND HYPOTHESES

We considered three objectives. The first objective was to examine whether the prior education of ultraorthodox male students is merely a barrier to their CS studies. To this end, we compared the achievements of ultraorthodox and non-ultraorthodox men who had studied the same CS program. If indeed their prior education was merely a barrier, it would be expressed in lower performance and higher dropout rates. We will refer to this hypothesis as H1. The opposite hypothesis was that the performance of the ultraorthodox would be no less than that of the second group due to certain strengths, which we also sought to explore and describe.

To this end, we posed the second and the third objectives. Our second objective was to examine the assumption that the ultraorthodox students' acquaintance with Logic during their Talmudic studies would facilitate their learning of Logic in the context of CS studies. Therefore, we compared the performances of ultraorthodox and non-ultraorthodox men in the course on digital systems, the first course in which they were introduced to concepts in Logic in their academic studies. Again, two contrasting hypotheses were examined. One, that the acquaintance of the ultraorthodox group with Logic would be transferred to the new context, CS, which would be manifested in a higher performance in the course than that of the second group, who had not engaged in Talmud studies to this extent. We will refer to this hypothesis as H2. On the other hand, the Logic studied in Talmud studies is different (e.g., the notion of truth) and the context of CS greatly differs from that of Talmud studies. Therefore, the ultraorthodox students might not find this knowledge useful, or may use it inadequately; hence, they would not perform better than the other group.

Finally, we considered an exploratory objective of monitoring ultraorthodox men as they solved tasks in topics in which they had performed better than the other group, in order to gain insights into their academic strengths.

RESEARCH METHOD

We employed a mixed-methods methodological approach and, more specifically, a quantitatively driven mixed-methods approach. In such an approach, the research study is, at its core, a quantitative study. The qualitative method is added to supplement and improve the quantitative study by providing an added value or more complex answers to research questions (Creswell, 2013).

In our case, the first two objectives were addressed quantitatively. In order to address the first objective, we compared the grades of the ultraorthodox male students with other male students in compulsory courses in the CS program over 5 consecutive semesters. The second objective was addressed by comparing the two groups' performance in a test consisting of tasks in Digital Logic. The third objective was addressed qualitatively. We used talk-aloud protocols in order to explore the strengths of the ultraorthodox students as they solved tasks in Digital Logic.

Participants

The participants were undergraduate students at a college of technology in Jerusalem, Israel. Most of the students at this college are religious Jews, although from different social groups. Women also study at this college but at a separate campus.

We focused on two groups of men. One group consisted of ultraorthodox men whose prior education lacked almost any general high-school education, and, instead, they had studied religious subjects for at least 4 years, sometimes studying more than 10 hours a day, specifically Talmudic studies. Before starting their academic studies, they are obligated to participate in a one-year preparatory program that includes a basic high-school education. We will refer to this group of students as the Talmudic group (TG). Their ages ranged from 23 to 28.

We compared the performances of TG in CS courses with a second group, male students who underwent a conventional Israeli high-school education. We will refer to this group as the conventional group (CG). We chose to refer only to the male students in order to eliminate issues related to gender differences. Their ages ranged from 19 to 25.

Most of the CG members were religious. Their high-school education included religious studies, which also included Talmudic studies, but they were not as broad and deep as in the TG. These men had earned a full matriculation certificate with an advanced program in Mathematics. In Israel, this sector (Dati Leumi, or national religious Jews) has better academic achievements in comparison with other sectors in Israel. For example, Feniger, Mcdossi, and Ayalon (2015) found that this sector performed better in reading comprehension tests conducted by the Programme for International Student Assessment (PISA) than did the secular Jews.

Our participants started their academic studies in 2015. Specifically, in 2015, TG consisted of 58 students and CG consisted of 139 students.

Research Tools

Grades

We compared the achievements of students in the TG and CG in compulsory courses in the CS program over 5 consecutive semesters. These courses involve mathematics, computer programming, and theoretical computation.

Dropout rates

We calculated the dropout rates of the participants in CG and TG.

The test

In order to assess students' understanding in four main topics of digital Logic (State and sequential circuits, Number representations, MSI components, and Boolean Logic), we used questions from the Digital Logic Concept Inventory (DLCI) (Herman, 2011; Herman & Handzik, 2010; Herman, Kaczmarcczk, Loui, & Zilles, 2008, 2012; Herman, Loui & Zilles, 2009, 2010, 2014; Herman, Zilles & Loui, 2011). A concept inventory (CI) is a standardized assessment tool designed to measure stu-

dents' understanding of the core concepts of a topic (Goldman et al., 2010), i.e., the extent to which it matches the accepted conceptual framework of a discipline.

We used the latest version of the Digital Logic Concept Inventory (DLCI), DLCI β1. This version was administered at six institutions in the United States and provided a representative sampling of 688 students from across the country.

Specifically, we selected six items from the DLCI β1(Herman, 2011) and included them as part of the final examination of the course Digital Systems. The entire examination included 16 items. We will refer to the six items as *the test*. The test is presented in the Appendix. Table 1 describes the concepts examined. For each concept, we listed the items used for its examination: their original DLCI β1 numbering and their numbering in the test)

Table 1. The items in the test

Concept	DLCI β1	Test
• State and sequential circuits, especially the ▪ Relationship between states and flip-flops	6,17	1,4
• Number representations ▪ Two's complement representation, overflow	14	2
▪ Number bases	16	3
• Functionality of MSI components ▪ Decoders and multiplexers	24	5
• Boolean logic ▪ Underspecified Boolean functions ▪ Boolean operators (the Don't Cares)	21	6

We compared the performances of the different groups, namely, the TG and CG. First, we examined whether the difference in the groups' performances for the entire test was statistically significant (assessed by the average scores and calculating the p-value), and, additionally, we compared the performance of each item (also, assessed by the average scores and by calculating the p-values).

Talk-Aloud Protocols

Shortly after the test, we interviewed four students from TG. We selected those students who had earned grades of 40-80% on the test. Each student was asked to answer the same four open-ended questions, while expressing his thoughts. The questions spanned the topic of number representation. We chose this topic because TG performed significantly better on this topic than CG did. In order to trace students' thought process, we needed questions that they did not see before; therefore, we used questions previously used in the early stages of constructing the DLCI. In the analysis of the transcriptions, we traced students' solution processes and reasoning, the strategies used, the knowledge expressed (correct and incorrect), verification methods, and so forth, in order to gain insights on how they dealt with the tasks. To this end, we relied on relevant codes constructed by the administrators of DLCI (Herman, 2011; Herman, Kaczmarcczk, Loui, & Zilles, 2008; Herman, Zilles, & Loui, 2011).

Data Collection Process

The test was conducted in the first semester of the school year of 2015-2016, as part of the examination in the course on digital systems, the first course in which students were introduced to con-

cepts in Logic in their CS studies. This course is a 3.5 credit course, given in the first semester of the first year. In total, 326 students took the final examination of the course (including women). Of these, 58 students belonged to TG and 139 to CG.

The comparison revealed an advantage for TG in comparison with CG, but in only two items. This led us to pose the third objective and develop the talk-aloud protocol, which were conducted shortly after the test.

Finally, in 2017, the grades of those students who began their studies in 2015 (and were still enrolled in college) were compared. In each course we compared two groups of course participants—ultraorthodox students (i.e., TG) and non-ultraorthodox students (i.e., CG). We noted that there was a certain dropout rate in both groups and, therefore, in order to examine the role it played, we calculated the dropout rates as well.

Reliability and Validity

The Test

We based our method of analyzing the test's reliability and validity on the methods used in DLCI for the same purposes (Herman, 2011; Herman & Handzik, 2010, Herman, Loui, & Zilles, 2010; Herman, Zilles & Loui, 2014).

We calculated Cronbach's α for the full examination (16 items) and for the test (6 items). Both were calculated for the entire population that participated in the examination, 326 students (comprising TG, CG, and women). Cronbach's α for the full examination (16 items) is 0.68. Cronbach's α for the test is 0.416.

Apparently, Cronbach's α for the test is a poor value (a Cronbach's α of 0.60 or above is generally considered acceptable for typical classroom assessments (Jorion, James, Schroeder, & DiBello, 2013)). However, it resembles Cronbach's α values for DLCI β1 for a population of 377 students (0.54) as well as the values of Cronbach's α values conducted for each subtopic of DLCI β1, which included 5-7 items each (0.45-0.57).

Construct validity evaluates whether the items actually test the concepts that they were intended to test (Streveler et al., 2011). The construct validity of DLCI was established by having the Delphi experts rate the quality of each item and suggest improvements. The distractors were constructed and verified (to ensure that students select a particular distractor for the reasons predicted) using personal interviews with students (Herman, 2011). In our work we relied solely on these measures of validity.

The Talk-Aloud Protocols

In order to achieve reliability, we worked as follows. First, each of us analyzed two transcripts separately. Then, we compared and discussed the analyses and resolved any disagreements. In the consecutive iteration, we analyzed all four transcripts separately, and discussed and resolved the few disagreements that we had.

Results

TG's Achievements

Table 2 presents the comparison between the achievements of students in TG and CG who took the obligatory CS courses for five consecutive semesters. The courses are classified into three categories: mathematics, programming, and theoretical computing.

The results show a slight advantage for TG. In three courses TG performed better than CG, by a statistically significant difference: Infinitesimal Calculus 1 ($t(136) = 2.339$, $p = 0.021$), Infinitesimal Calculus 2($t(132) = 2.035$, $p = 0.044$), and Differential Equations($t(100) = 1.985$, $p = 0.049$). In all

other courses there was no statistically significant difference. Except for one course, TG's course average was slightly better than that of CG.

Table 2. Scores of the TG and CG

COURSE	SEMESTER	TG			CG			STATISTICS		
		N	MEAN	STDV	N	MEAN	STDV	t	df	p
Mathematics										
Infinitesimal Calculus 1	1	46	86	10	92	79	19	2.339	136	0.021*
Infinitesimal Calculus 2	2	46	86	12	88	80	18	2.035	132	0.044*
Linear Algebra 1	1	45	79	10	93	76	16	1.152	136	0.251
Linear Algebra 2	2	44	80	11	84	78	17	0.706	126	0.481
Differential Equations[2]	2-4	34	88	11	68	81	19	1.985	100	0.049*
Computer programming										
Introduction to Computer Programming	1	41	80	11	91	77	17	1.035	130	0.303
Programming in C++	2	36	83	10	81	76	23	1.751	115	0.082
Programming in windows	3	29	87	9	56	87	8	0	83	1
Digital Systems	1	48	73	12	91	71	28	0.472	137	0.638
Digital Logic	3	30	80	13	60	78	16	0.593	88	0.555
Theoretical computing										
Data Structures and Program Design 1	2	30	76	9	60	77	16	-0.318	88	0.751
Data Structures and Program Design 2	3	30	80	13	60	78	16	0.593	88	0.555
Automata & Formal Languages	4	15	76	13	34	68	23	1.257	47	0.215
Computer Algorithms	5	19	80	11	23	79	12	0.279	40	0.782

* denotes a statistically significant difference between the groups (p-value <0.05).

STUDENTS' DROPOUT RATES

It is noteworthy that the number of course participants decreased from the first to the fifth semester (Table 2). We therefore examined the dropout rates of the two groups and found that they were similar. Specifically, of TG that started their studies in 2015, 20% dropped out in the first year and 16% in the second year, in comparison with 16% and 19% of CG, respectively. Hence, hypothesis H1 was refuted.

The Test

Hypothesis H2---that TG will do better in the Digital logic tasks than CG did--- was refuted as well. On the test, CG performed slightly better (Mean = 3.64, SD = 1.49) than TG (Mean = 3.44, SD = 1.67), yet the difference between the groups was not statistically significant $t(195) = 0.790$, $p = 0.430$.

The results of the comparison between TG and CG in each item of the test are presented in Table 3. TG performed better than CG regarding the topic of number representations (items 2 and 3). These differences are statistically significant ($p<0.05$, Table 3). In the remaining four tasks, there were no statistically significant difference between TG and CG.

Table 3. Comparison of performance on the test items for TG and CG

ITEM	TG		CG		STATISTICS	
	N	CORRECT RESPONSES(%)	N	CORRECT RESPONSES(%)	Z	P
1	58	48	139	53	-0.640	0.522
2	58	73	139	57	2.227	0.026
3	58	78	139	64	2.060	0.039
4	58	53	139	61	-1.032	0.303
5	58	58	139	58	0	1
6	58	51	139	57	-0.770	0.441

Talk-Aloud Protocols

For each question, we present the goal of the question, as formulated by Herman (2011) and Herman et al. (2011). We describe the approaches employed by the students in our study.

Question 1 - Comparing numbers

Question 1: Which number is greater?

I. $(11010)_2$ or $(32)_{10}$?

II. $(2B)_{16}$ or $(31)_{10}$?

Herman et al. (2011) found that students prefer to solve this question (and similar ones) by converting the numbers to decimal base. Moreover, they reported that with hexadecimal base, students prefer first to convert it to binary base and often then to decimal base. According to Herman et al. (2011), the over-reliance on converting to binary first, though not a misconception, is indicative of novice behavior, since it concerns *using procedural knowledge* not necessarily derived by *conceptual understanding*.

In our study, only one student applied the "conversion" procedure in question 1.I. The remaining three students did not convert the numbers at all. Rather, they used an approach derived from conceptual understanding. Specifically, they indicated that $(11010)_2$ is less than $(32)_{10}$ by noting that $(11010)_2$ does not extend into 32's place in binary base.

The same conceptual understanding was evident in one student's responses to question 1.II; the student explained that $(2B)_{16}$ is more than $(31)_{10}$ by noting that the weight of digit 2 in the number $(2B)_{16}$, by itself is 32, which is greater than 31. He correctly calculated only the value of the significant digit (digit 2 of the number $(2B)_{16}$) according to its place (32), and since 32 already is larger than 31, he did not need to complete the conversion.

Question 2 - Subtraction in binary base

Question 2: Subtract the following numbers, which are in binary base:

1110011 – 0011110=

In order to solve this equation, students had to perform the borrowing operation. Most of them (three out of four) solved this question incorrectly. When subtracting the third digit from the right, students had to borrow $(100)_2$. Instead, they borrowed $(1)_2$. A similar mistake was reported by Herman (2011) and Herman et al. (2011). Similarly to Herman's reports, these students recalled (incorrectly) procedural knowledge. Apparently, they did not employ any checking procedure, which would have informed them they were wrong.

Question 3 - Two's complement representation

Question 3: The number 0100101 is represented in 7-bit two's complement.

I. What is the number?

II. What is the advantage of two's complement representation?

In response to part I of this question, only one student represented the number as $(1011011)_2$, a common mistake (Herman, 2011; Herman et al., 2011), whereas the others responded correctly, $(37)_{10}$. According to Herman et al. (2011), this mistake is due to students' confusion between "two's complement representation" and "two's complement operation"; thus, they interpreted the number 0100101 in 7-bit two's complement as $(1011011)_2$ or $(91)_{10}$.

In response to part II, three reasons were provided by the four TG students. Similarly to the students in Herman's (2011) work, all four of them mentioned that (a) two's complement representation has only one representation for zero, and that (b) it can represent more numbers than any other representation. However, there is a third reason: (c) it simplifies the hardware implementation of subtraction, as well as the addition of positive and negative numbers. The last reason was rarely mentioned by Herman's students, although it is the primary advantage of using the two's complement representations. This could imply a lack of understanding the relationship between the topic of number representation and the structure of the computer, and a misunderstanding of its significance (Herman, 2011). In this study, all of the students mentioned the third reason, which reinforces our argument that they employed a conceptual understanding, and took into account the relationship between hardware and number representation.

Question 4 - Overflow

Question 4:

I. Give an example of overflow.

II. Which of the following 2's complement additions result in overflow?

1. 0110+ 1010 2. 0110+0101

This question was designed to reveal students' understanding of the implications of the fixed length of a register in a computer, as well as their understanding of one of its implications, the concept of overflow. Understanding the implications of the fixed lengths of registers in a computer is perceived as one of the most counter-intuitive concepts related to the interpretation of numbers (Herman, 2011). It is therefore common that students have difficulties when they need to deal with operations that involve numbers of a fixed length. Furthermore, they often struggle to understand the concept of overflow. Since a conceptual understanding of overflow requires an underlying conceptual under-

standing of the structure of a register in a computer, many students fail to solve overflow problems correctly. In their solution attempts, they often rely on operational/situational definitions of overflow, such as "overflow happens when the addition of two positive numbers results in a negative number" (Herman et al., 2011, p. 84). Namely, they recall, rather than exhibit a conceptual understanding.

In our study, all the students answered this question correctly. All of them correctly demonstrated a case of overflow, entailing a correct explanation that overflow occurs because of the fixed length of the registers. The tendency to utilize conceptual knowledge was prominent in one student's approach. He converted the numbers to decimal representations, 5 and 6, and concluded that the addition, 11, is larger than the largest number that can be represented (7); hence, the addition will result in an overflow.

The results of the talk-loud protocols revealed that although students had fragile knowledge, they tended to employ a conceptual understanding rather than solely recalling procedures to technically solve the problems.

DISCUSSION

Our main research goal was to examine whether the prior knowledge of Haredi students is merely a barrier to CS academic studies, as is often viewed in public discourse. To this end, we compared the achievements of TG and CG in compulsory courses in CS for five consecutive semesters. Interestingly, TG consistently scored no lower and even scored higher than did CG. The dropout rates in both groups were similar. We thus refuted hypothesis H1, that students' previous education (and life experience) is merely a barrier. Apparently, the ultraorthodox male students have the ability to study CS successfully.

This ability is impressive, given that their knowledge of mathematics, English, and sciences—deemed important for CS— relies almost exclusively on the one-year preparatory course. Was their unique education a source of strength? Hypothesis H2, that TG will do better in the Digital logic tasks than CG did, was refuted. Logic is inherent in Talmudic studies (Abraham et al., 2009a, 2011b); hence, it was reasonable to assume that students' acquaintance with Logic would be transferred to their CS studies, especially in courses that involve direct instruction of Logic concepts, which was our second research objective. However, the results were mixed. Namely, TG did not perform better than CG in all the test questions. Specifically, they performed significantly better in items concerning number representations, whereas in other items there were no significant differences. We thus concluded that although Logic is inherent in Talmudic studies, its transfer to a CS context is not straightforward.

Rather, these results pinpoint the need to further understand the links between the unique knowledge of these students and the new knowledge with which they deal. The in-depth investigation of students' solutions of tasks concerning number representation, our third research objective, revealed that, as in the case of typical novices, their conceptual knowledge relevant to the topic was fragile. However, often they pursued conceptual understanding, in comparison with the typical novice-like tendency to solve a problem by merely recalling a procedure, without necessarily understanding the underlying concepts and their interrelation (Herman, 2011, Herman et al., 2011). This tendency is in line with the work of Dembo et al. (1997) and Erenfeld (2016), who found that students with a Talmudic background employed learning practices and habits of mind derived from a tendency and commitment to in-depth explorations in order to gain a conceptual understanding. Dembo et al. (1997) and Erenfeld (2016) attributed this tendency to the unique educational experience of the students. For example, Erenfeld (2016), who investigated the learning processes of ultraorthodox men during the preparatory course in mathematics, found that the Talmud learning experience, such as the ideal of getting to the truth (rather than accepting an authoritative voice), was expressed in students' questioning of any possible solution.

One may argue that these students have certain attributes, such as curiosity, resourcefulness, and intelligence, and that is what underlies their tendency to engage in in-depth explorations, as well as their success in this new and alien area. Future work is required to examine and elucidate this possibility. If indeed, this is the case, the difference must be rooted in their previous, unique knowledge, either gained throughout their unique schooling experience or their life experience in the unique culture in which they were raised.

In addition, it can be argued that the one-year preparatory makes the difference. However, if this was the case per se, it would be reasonable to assume that in other high-education institutions those students who participated in the preparatory course would achieve no less or even better than those who underwent conventional k-12 education. This is not the case, usually, for various reasons, such as low esteem, low intrinsic motivation, insufficient academic background, and the intensity of the preparatory program (Gero & Abraham, 2016; Zoabi, 2012). This again, invites an exploration of the unique knowledge and life-experience of this group.

CONCLUSIONS

The performance of the ultraorthodox group was no less and even slightly better than that of the non-ultraorthodox despite their lack of core studies. We can conclude that these students' unique prior knowledge was not merely a source of their weaknesses—it could also be a source of their strength. This conclusion has an important implication, given the growing interest in diversifying higher education in general, and CS in particular, to include representatives of groups in society that come from different, unique cultures.

Obviously, the present study has several limitations. First, we examined only one group of students who studied in one institution. The findings suggest that groups with a unique previous education could study in higher-education institutes despite their lack of core studies; however, many questions are raised. Are the results dependent on the institute? Is this success unique to the ultraorthodox society, or can we assume that the knowledge deduced from this study can be applied to other groups with a unique education (or perhaps only to groups with certain attributes that the ultraorthodox also have)? Can these groups succeed in other domains or only in CS? A future research study is required to address these questions, by examining the performances of samples of students from the same social group who study in different institutes, students from other groups with a unique education, students who study other domains, and so forth.

Second, the methods used in this work were insufficient to determine the strengths that the students' previous, unique experience and knowledge provided them in their academic studies (e.g., unique characteristics, certain habits of mind, contents, and so forth). However, this work is valuable in highlighting the potential of this unique knowledge and the need to explore it further. Students' unique previous knowledge can and should be mapped, not only to foresee misconceptions, namely, faulty extensions of previous knowledge, and weaknesses that are the result of "fragile knowledge" or the absence of a certain body of knowledge (e.g., Herman's DLCI), but also in terms of possible strengths, knowledge, values, and practices that can be used to anchor and expand the new knowledge.

Mapping would be beneficial, for example, to address questions raised in this study, such as why number representations were better understood than other topics, and what previous knowledge could have enhanced the understanding of the other topics if they were properly introduced.

Much empirical work exists in the CS literature reporting successful attempts to build on students' capital (e.g., Eglash, Bennet, O'donnell, Jennings, & Cintorino, 2006; Guzdial & Tew, 2006). However, we do not aim at increasing students' motivation or their sense of the relevance of the topic studied in their day-to-day life as in the abovementioned studies, but rather, the approach we suggest is concerned with mapping or assessing students' existing knowledge while looking for strengths, i.e., the

possible productive and nonproductive extensions of existing knowledge and practices in order to cope with and assimilate the new knowledge studied.

Such a pedagogical approach might be beneficial in terms of reducing the drop-out rates because it might aid the teaching/learning process by allocating more or less time according to the knowledge mapped, thus devoting more time to deal with to fragile or absent pieces of knowledge, and tackling unforeseen misconceptions.

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APPENDIX

THE ITEMS OF THE EXAMINATION

Question 1: (Question 6 of DLCI β1.0 Form A (Herman, 2011, p. 242))

Which statement best defines the word *state* when used to describe a sequential circuit?
1. State is the current value of all flip-flops in the circuit.
2. State is the current value of all inputs in the circuit.
3. State is the current value of all outputs in the circuit.
4. State is the current value of all flip-flops, and inputs and outputs in the circuit.

Question 2: (Question 14 of DLCI β1.0 Form A (Herman, 2011, p. 250))

Which of the following 4-bit **two's complement** additions could result in an overflow? Each variable (a, b, c or d) is either 0 or 1 independent of the values of the other variables.

I. 00ab+1101
II. 00cd+0110
1. II only
2. I only
3. I and II
4. None

Question 3: (Question 16 of DLCI β1.0 Form A (Herman, 2011, p. 254))

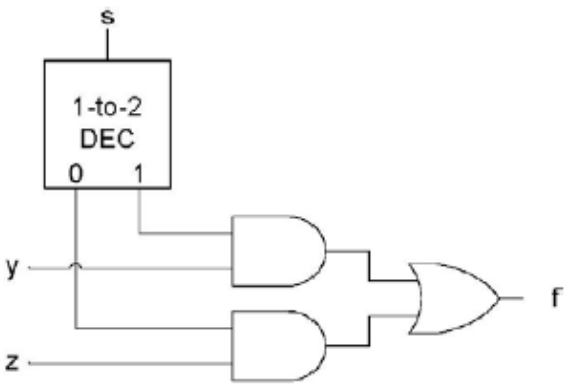
Which statement is true about the two sets of numbers?
1. $(2.7)_{10} > (2.7)_{16}$ and $(1.3)_{10} > (1.3)_{16}$
2. $(2.7)_{10} < (2.7)_{16}$ and $(1.3)_{10} < (1.3)_{16}$
3. $(2.7)_{10} = (2.7)_{16}$ and $(1.3)_{10} = (1.3)_{16}$
4. $(2.7)_{10} > (2.7)_{16}$ and $(1.3)_{10} < (1.3)_{16}$
5. $(2.7)_{10} < (2.7)_{16}$ and $(1.3)_{10} > (1.3)_{16}$

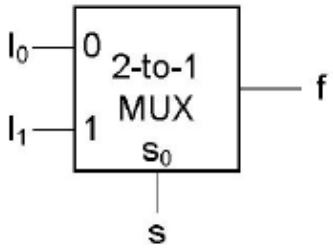
Question 4: (Question 17 of DLCI β1.0 Form A (Herman, 2011, p. 254))
What is the maximum number of distinct states of a sequential circuit that has 0 inputs, 3 flip-flops, and 2 outputs, which can potentially be over time?

1. 8
2. 1
3. 3
4. 0
5. None of the answers.

Question 5: (Question 24 of DLCI β1.0 Form A (Herman, 2011, p. 260))

Question 24. Below and to the left is a proposed implementation of a 2-to-1 multiplexer (MUX). The proposed circuit is constructed from a 1-to-2 decoder (DEC) and three additional gates. Which bit assignment should be used to make the two circuits have the same behavior (i.e., both implement the same function f)?





2-to-1 Multiplexer

s	f
0	I_0
1	I_1

Proposed implementation of a 2-to-1 MUX

1) The proposed circuit does not implement the 2-to-1 MUX.
2) The proposed circuit implements the 2-to-1 MUX only when $\langle y, z\rangle = \langle I_0, I_1\rangle$.
3) The proposed circuit implements the 2-to-1 MUX only when $\langle y, z\rangle = \langle I_1, I_0\rangle$.
4) The proposed circuit implements the 2-to-1 MUX when either $\langle y, z\rangle = \langle I_0, I_1\rangle$ or $\langle y, z\rangle = \langle I_1, I_0\rangle$.

Question 6: (Question 21 of DLCI β1.0 Form A (Herman, 2011, p .256))

Question 21. A combinational circuit is specified by the truth table below. For three input combinations, the output of the circuit does not matter ("don't-care"). The specification is implemented as a circuit using the following Boolean expression: $f = \bar{a}\bar{c} + b$. What will the circuit output when it receives the input combination <a,b,c> = <1,1,0>?

1) 0
2) 1
3) X (don't care)
4) Unknown

a b c	*output*
0 0 0	1
0 0 1	0
0 1 0	1
0 1 1	1
1 0 0	0
1 0 1	X (don't-care)
1 1 0	X (don't-care)
1 1 1	X (don't-care)

BIOGRAPHIES

Dr. Sara Genut is currently the Academic Head of the Machon Tal Campus at the Lev Academic Center in Jerusalem. Dr. Geniu overseas multiple departments which include Engineering, Computer Science, Nursing, Accounting, and Business Administration. She has served as an adviser to the Israeli Ministry of Education. She led the effort in adopting reforms in Science and Technology Educational Systems. Her research focuses on Science in Education. Dr. Genut holds a Ph.D. in Science Education from the Hebrew University of Jerusalem, Israel, received in 2001.

Yifat Ben-David Kolikant is a Senior lecturer in the School of Education at the Hebrew University of Jerusalem. Dr. Ben-David Kolikant's research focuses on examining the tripartite relationship of students, school learning, and technology in the information era. Mainly, her research revolves around two inter-related questions: (1) How does students' knowledge of subjects outside of school impact on their school learning? And, (2) what pedagogies are suited to the information age and the needs of students and what role does technology play? Dr. Ben-David Kolikant holds a Ph.D. degree in science teaching from the Weizmann Institute of Science, received in 2002.

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A LEARNING ANALYTICS APPROACH FOR EVALUATING THE IMPACT OF INTERACTIVITY IN ONLINE VIDEO LECTURES ON THE ATTENTION SPAN OF STUDENTS

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ABSTRACT

Aim/Purpose	As online video lectures rapidly gain popularity in formal and informal learning environments, one of their main challenges is student retention. This study investigates the influence of adding interactivity to online video lectures on students' attention span.
Background	Interactivity is perceived as increasing the attention span of learners and improving the quality of learning. However, interactivity may be regarded as an interruption, which distracts students. Furthermore, adding interactive elements to online video lectures requires additional investment of various resources. Therefore, it is important to investigate the impact of adding interactivity to online video lectures on the attention span of learners.
Methodology	This study employed a learning analytics approach, obtained data from Google Analytics, and analyzed data of two Massive Open Online Courses (MOOCs) that were developed by the Open University of Israel in order to make English for academic purposes (EAP) courses freely accessible.
Contribution	The paper provides important insights, based on quantitative empirical research, on the following: integrating interactive elements in online videos; the impact of video length; and differences between two groups of advanced and basic learners. Furthermore, it demonstrates how learning analytics may be used for improving instructional design.

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Findings	The findings suggest that interactivity may increase the attention span of learners, as measured by the average online video lecture viewing completion percentage, before and after the addition of interactivity. The impact is significantly stronger for the more advanced course. However, when the lecture is longer than about 15 minutes, the completion percentages decrease, even after adding interactive elements.
Recommendations for Practitioners	Adding interactivity to online video lectures and controlling their length is expected to increase the attention span of learners.
Recommendation for Researchers	Learning analytics is a powerful quantitative methodology for identifying ways to improve learning processes.
Impact on Society	Providing practical insights on mechanisms for increasing the attention span of learners is expected to improve social inclusion.
Future Research	Discovering further best practices to improve the effectiveness of online video lectures for diverse learners.
Keywords	online video lectures, interactive video, Massive Open Online Courses (MOOCs), distance learning, students' attention span, learning analytics, attention economy

INTRODUCTION

Online video lectures are becoming a main component of online learning within formal courses and informal learning environments, such as Massive Open Online Courses (MOOCs) (Daniel, 2012; Kalman, 2014; Raffaghelli, Cucchiara, & Persico, 2015; Siemens, Gašević, & Dawson, 2015). Online video lectures have been successfully used for supporting face-to-face learning (Boton & Gregory, 2015; Brecht, 2012; Kinash, Knight, & McLean, 2015; Whatley & Ahmad, 2007; Wieling & Hofman, 2010), as well as in-class learning, e.g., when there is a need to show students visual elements (Ostashewski, Reid, & Ostashewski, 2016). However, online video lectures are not a silver bullet solution for solving the challenges of online learning (Geri, 2011; Guri-Rosenblit, 2009; Lee, 2017).

One of the main drawbacks of online video lectures is that their availability may lead to procrastination, which eventually would cause student dropout (Diver & Martinez, 2015; Geri, 2012; Geri, Gafni, & Winer, 2014; You, 2015). Nevertheless, considering student procrastination tendency during the instructional design stage and adding elements such as mandatory viewing of the online videos throughout the semester was found effective in encouraging timely viewing (Costley, Hughes, & Lange, 2017). Another challenge is the short attention span of the viewers. According to a comprehensive study of MOOC learners, which involved analysis of nearly seven million MOOC video viewing episodes, the engagement time in viewing video lectures was six minutes at most (Guo, Kim, & Rubin, 2014; Kim, Guo, Seaton, Mitros, Gajos, & Miller, 2014; Lagerstrom, Johanes, & Ponsukcharoen, 2015).

Interactivity is a crucial element for improving the quality of online learning (Guri-Rosenblit, 2009; Siemens et al., 2015). Furthermore, empirical studies demonstrated the effectiveness of interactivity in extending the attention span of learners and enhancing their achievements (Cherrett, Wills, Price, Maynard, & Dror, 2009; Dror, Schmidt, & O'connor, 2011). Conversely, interactivity may be regarded as an interruption, which distracts students' attention (Davenport & Beck, 2001; Geri & Gefen, 2007; Pearce, Ainley, & Howard, 2005). On top of that, adding interactive elements to online video lectures requires additional investment of various resources, pedagogical, as well as technological. Therefore, it is important to investigate the impact of adding interactivity to online video lectures on the attention span of learners. Moreover, few studies concentrated on technological tools suitable for MOOCs, and there is a need for more research of tools, such as audio and video broadcasting, which are able to support instruction on a large scale (Raffaghelli et al., 2015).

The purpose of this study is to investigate the influence of adding interactivity to online video lectures on students' attention span. We employed a learning analytics approach (Long & Siemens,

2011) and analyzed data of two MOOCS of English for Academic Purposes (EAP) courses that were developed by the Open University of Israel. We analyzed over 200,000 episodes of online video lectures viewings and compared the viewing completion percentage, before and after the addition of interactivity. Furthermore, we investigated the impact of the video lecture length, as well as differences between the two groups of advanced and basic learners. This empirical paper contributes to understanding how to effectively integrate interactive elements in online video lectures. It also demonstrates the usefulness of evaluations that are based on learning analytics for improving instructional design.

THEORETICAL BACKGROUND AND THE RESEARCH QUESTIONS

LITERATURE REVIEW

This interdisciplinary study is based on concepts from the domains of: cognitive fit theory (Vessey, 1991), student retention in online learning (Ferguson & Clow, 2015; Geri, 2012; Guo et al., 2014; Kim et al., 2014; Lagerstrom et al, 2015), and attention economy (Davenport & Beck, 2001; Geri & Gefen, 2007), and applies them to student viewing patterns of online video lectures.

According to cognitive fit theory (Vessey, 1991), compatibility between task and information presentation format would improve task performance. There are differences among individual students in their abilities to learn independently. Hence, offering them diverse tools from which they can choose those that fit their learning preferences is expected to increase their academic motivation and performance (Chandler & Teckchandani, 2015; Keller & Karau, 2013). Terras and Ramsay (2015) emphasize the importance of considering the diverse psychosocial and cognitive profiles of learners during the design, development, and delivery of MOOCs. Moreover, different types of video lectures have dissimilar effects on the sustained attention and cognitive load of verbalizers and visualizers (Chen & Wu, 2015).

In the context of viewing online video lectures, adding interactive elements is expected to increase student engagement and performance (Cherrett et al, 2009; Dror et al., 2011). Furthermore, in a survey of 246 Chinese students, interactivity was found as positively influencing students' intention to revisit MOOCs (Huang, Zhang, & Liu, 2017). However, adding interactive elements to a video may interrupt the viewing experience (Pearce et al, 2005), and, as the students stop watching the video, they may be distracted and use the break for checking email, answering messages on social applications, or tending to other external requests for their limited attention resources (Davenport & Beck, 2001; Geri et al., 2014; Ramsay & Terras, 2015).

The study of Geri and Gefen (2007) about MBA students' perceptions of the usefulness of various online tools did not examine online video lectures, but its findings revealed that students appreciated mostly summaries of class meeting and presentations, sample exams, as well as task solutions. Students were less interested in interactivity on discussion boards or collaborative tasks. In the same vein, students may not be interested in completing tasks while watching videos, although it is supposedly helpful.

Another aspect that should be considered is procrastination (Steel, 2007). Students tend to delay their studies until the last minute (Gafni & Geri, 2010). When the video lectures are available online, students may wait until the end of the semester (Geri et al., 2014). At that point of time students may skip the interactive activities, due to their limited time.

Another way to address the attention challenge is to offer students mechanisms that would encourage them to complete viewing the course videos in a timely manner. Wandler and Imbriale (2017) propose that online instructors should promote the use of self-regulated learning strategies by students, including scaffolding time expectations, by dividing large assignments to sub assignments with several due dates. Romero, Cerezo, Espino, and Bermudez (2016) suggest using smartwatches for students to decrease procrastination behaviors in MOOCs. Specifically, Romero et al. (2016) developed an An-

droid wear-based application, which receives notifications from MOOCs and reminds students to complete their missions, in a similar manner to the tactics used for encouraging people to exercise. However, this study focuses on instructional design elements that may increase the attention span of learners who are already watching the online video lectures. Therefore, external mechanisms such as those suggested by Wandler and Imbriale (2017) and Romero et al, (2016), are beyond the scope of the current study.

Research Questions

Several factors may affect the effectiveness of interactivity in online video lectures. This primary study is conducted at the course level and explores whether the knowledge level of the students may affect the way they react to addition of interactive elements to online video lectures. On the one hand, advanced students have been found to gain more benefits from learning technologies (e.g., Warschauer, 2004; Wood, 2015). On the other hand, weaker or beginner students may benefit from the addition of interaction, as it is expected to improve their learning experience (Cherrett et al, 2009; Dror et al., 2011). Thus, it is important to inform diverse students in a manner that effectively conveys the message (Cohen, 2009), and it may imply delivering content in more than one format.

Since MOOCs research is still emerging (Raffaghelli et al., 2015), we shall present research questions, and would not propose specific hypotheses. Our first research question is:

- How does adding interactivity to online video lectures affect the attention span of students?

There are several ways to add interactivity to online video lectures. This study refers to asynchronous viewing of the lectures. The interactive activities involve only the individual student, i.e., there is neither collaboration nor interaction with other students, and no communication with the instructor or teaching assistants. The interaction involves answering short closed questions while viewing the online video lectures. Answering the questions is not compulsory, so the student may skip a question, or all questions, and continue watching the video. The second related research question is:

- Are there differences in the influence of interactivity in online video lectures on learners' attention span, between students who study a higher-level course and students who study the same sort of subject matter at a lower level?

As to the short attention span of MOOCs learners (Guo et al., 2014; Kim et al., 2014; Lagerstrom et al., 2015), we propose that the general reported findings of maximal six minutes of engagement time in viewing video lectures may not be applicable to MOOCs from the sort examined in this study, or other forms of online video lectures, which are part of formal courses. MOOCs learners have different motivations for learning, which affect their perseverance. When viewing an online video lecture as part of a formal course, especially if the viewing is compulsory, it is expected that learners would be more inclined to perform the task. Likewise, if viewing the videos would increase the chance to obtain a formal benefit, such as helping the students pass an exemption test, their inclination to watch the videos would be higher (Geri, Winer, & Zaks, 2017). While interactivity may expand the attention span of learners, as the videos become longer the chances of attrition increase. Since sometimes short videos of about five minutes, or less, are not applicable, the third research question that we examine is:

- What is the practical appropriate maximal length of an online video lecture that would still be short enough to retain learners?

Methodology

This study adopts a learning analytics approach (Long & Siemens, 2011) that is a common methodology is the study of MOOCs (Raffaghelli et al., 2015). Learning analytics evolved from the general trend of data analytics research and practical applications (LaValle, Lesser, Shockley, Hopkins,

& Kruschwitz, 2011) particularly its use in learning environments (e.g., Hershkovitz & Nachmias, 2009; Levy & Ramim, 2012; Romero & Ventura, 2013; Romero, Ventura, & Garcia, 2008).

We investigated how adding interactivity to online video lectures affects students' attention span by analyzing usage data of two MOOCs, which were developed by the Open University of Israel (OUI) in order to make English for Academic Purposes courses freely available. All undergraduate Israeli students must take a series of exams in EAP until they reach an exemption level. The initial EAP level is determined by a national exam. Typically, the academic institution offers a series of courses to prepare the students for the following internal exams and charges additional tuition fees for each course.

The Israeli Council for Higher Education asked the OUI, in 2015, to develop four MOOCs, two pre-basic EAP courses, a basic level course, and an advanced one. The most advanced level of EAP course was not included in the project. During the first stage of the project (from January 1, 2016 until August 6, 2016), the MOOCs were based on online video lectures and basic exercises. On the second stage of the project, which started on August 7, 2016, the online video lectures provided interactive assessment and feedback via advanced technological tools. The two phases of the project created a natural "before and after intervention" testing environment.

Before the intervention, the videos included 'rhetorical' questions, which the instructor answered. Hence, the viewers may have thought about the answer, but did not do anything. The interactive elements that were added to the videos included short "closed" questions, such as multiple choice questions, pairing items from two lists, and ordering items. The students could select whether to pause viewing the video and answer the question online or ignore it and continue viewing. It was not mandatory to answer the questions at any time. Those who chose to answer a specific question received an immediate feedback, as well as an opportunity to correct their answer if they were wrong. The short videos included sporadic interventions, as deemed appropriate by the pedagogical staff who prepared the contents of the courses. As this was a new paradigm, the instructional design team did not suggest any guidelines regarding the sort of questions or the intervals between the interactions. The videos usually included one to three interactions, with an interval of a few minutes between them. The lengths of the videos also varied, as further detailed in the results section.

In order to examine the effect of interactivity on the attention span of learners, as measured by their viewing completion percentage, we analyzed aggregate viewing data of the online video lectures that were the main instructional method of these MOOCs. The actual aggregate viewing data of each one of the online video lectures was obtained via Google Analytics (GA) (Clifton, 2012; Geri et al., 2014, 2017).

The two higher levels of EAP MOOCs, the basic and the advanced courses, were selected for this study in order to decrease a possible influence of dropout due to students' inability to cope with academic requirements. The sample included 67 video lectures, which comprised all the online video lectures of both courses.

The analyzed data comprised all the actual viewing data of the 67 video lectures during the examined period, as recorded by GA. During the first examined period, the access to the videos did not require registration. Therefore, there are no further details on the students who watched the videos. The rationale of the decision was to make the courses highly accessible and remove any constraints, even the nuisance of registration, in order to increase the motivation to try the new medium. During the second stage (beginning on August 7, 2016), users were required to register, but their details were not verified (i.e., the registration was on an individual basis and did not require affiliation or verification by a college or a university that the user was indeed a student). Since the purpose of the study was to identify ways to increase the attention span of learners, regardless of their background, no attempts were made to obtain more information about the demographics of the students.

During the initial analysis, which was performed shortly after the intervention and referred to a shorter period (51 days), few outlier videos were excluded because their aggregate viewing patterns suggested that they included a relatively high proportion of viewers who only sampled the videos, but were not engaged in learning (Ferguson & Clow, 2015). The excluded lectures were mainly the first videos of each study unit within the two MOOCs. Moreover, due to the novelty of the EAP courses, both average and median results were calculated. The medians were calculated in order to avoid a possible bias due to atypical behavior of some users of these MOOCs. There might have been instructors who would like to explore the videos, and their viewing patterns were different from those of learners. Furthermore, the intervention occurred before the beginning of the academic year, and the period afterwards was relatively short, hence the viewing patterns might not be have been representative. However, our analysis showed that the average and median results were similar. Moreover, the data analyzed in the current study referred to a longer "after" period (270 days). Therefore, the analyses reported in this study related only to the average results.

RESULTS

Table 1 illustrates a descriptive comparison of the two MOOCs before and after the addition of interactive questions to the videos (i.e., the intervention). The same videos were used in the English for Academic Purposes basic and advanced courses before and after the intervention. Since the videos varied in their length, the relevant measurement that was used for evaluating the change was the average completion percentage.

Table 1. Descriptive comparison of video lecture viewing (n=67)

	Before (no interaction)	**After (interaction)**
Period	Jan. 1, 2016 - Aug. 6, 2016	Aug. 7, 2016 – May 3, 2017
Days	218	270
Total views	112,846	115,087
Total time viewed	616,122 minutes	835,695 minutes
Average views per calendar day	565	426
Average video view duration (standard deviation)	6.85 minutes (2.86)	8.49 minutes (3.36)
Average completion percentage; (standard deviation)	61.10% (7.63)	77.08% (9.14)

Table 2 and Figure 1 present online video lecture viewing completion percentage by course level with and without interaction. The intervention significantly increased the average completion percentage of video lecture viewing for both courses: by 22.91% for the basic course (from 59.07% to 72.60%), and by 28.76% for the advanced course (from 62.86% to 80.94%). The paired samples two-tailed t-test results for the basic course were t=-17.43, 30 degrees of freedom (df), p<.0001, and for the advanced course t= -22.44, 35 df, p<.0001.

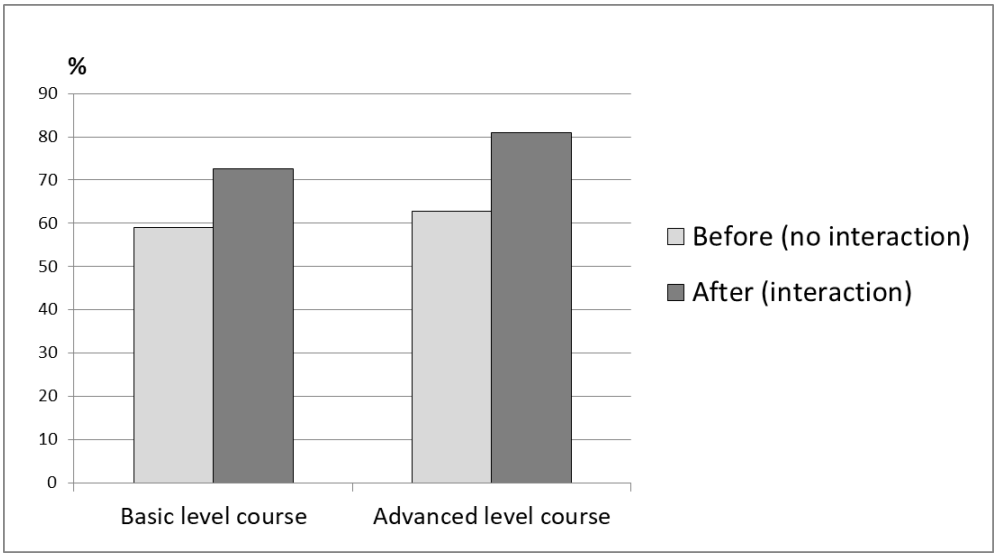

Figure 1. Average completion percentage of online video lecture viewing by course level with (after) and without interaction (before)

Table 2. Descriptive comparison of video lecture viewing by course level with (after) and without interaction (before)

Course Level	**Basic**		**Advanced**	
Number of videos (n)	**31**		**36**	
Total video length (for the whole course)	440 minutes*		331 minutes*	
Average video length (standard deviation)	14.18 minutes* (5.46)		9.19 minutes* (4.53)	
Interactivity	**Before (no interaction)**	**After (interaction)**	**Before (no interaction)**	**After (interaction)**
Period (duration)	Jan. 1, 2016 – Aug. 6, 2016 (218 days)	Aug. 7, 2016 – May 3, 2017 (270 days)	Jan. 1, 2016 – Aug. 6, 2016 (218 days)	Aug. 7, 2016 – May 3, 2017 (270 days)
Total views	49,965	51,648	62,881	63,439
Total time viewed	355,797 minutes	450,907 minutes	260,325 minutes	384,788 minutes
Average views per calendar day	229	191	288	235
Average video length* (standard deviation)	14.18 minutes (5.46)	14.01 minutes (5.18)	9.19 minutes (4.53)	9.18 minutes (4.49)
Average video view duration (standard deviation)	8.04 minutes (2.43)	9.73 minutes (2.80)	5.83 minutes (2.84)	7.42 minutes (3.47)
Average completion percentage (standard deviation)	59.07% (8.81)	72.60% (10.47)	62.86% (6.05)	80.94% (5.51)

* The same videos were used before and after the intervention. However, minor changes were made in the lengths of four video lectures.

Regarding differences between the two courses, before the intervention, there was a significant difference with a medium effect size between the completion percentage of the basic (59.07%) and the advanced (62.86%) courses (t=-2.073, p=.042, 65 df, equal variances assumed, Levene's test for equality of variances: F=3.174, p=.079, Cohen's d=-0.502). After the intervention, the differences between the courses increased (72.60% for the basic and 80.94% for the advanced) and were significant with a large effect size (t=-3.986<.0001, 43.911 df, equal variances not assumed, Levene's test for equality of variances: F=5.536, p=.022, Cohen's d=-0.997).

In order to examine the third research question, regarding the practical appropriate maximal length of an online video lecture that would still be short enough to retain learners, we split the sample of 67 videos to quartiles. Table 3 includes the completion percentage and other descriptive information of the four quartiles. We conducted an analysis of variance (ANOVA) of the completion percentage before and after the intervention, as well as Scheffe tests to identify the quartiles that significantly differ in their completion percentage. Both before and after the intervention, the ANOVA tests were significant (before: F=5.594, p=.001; after: F=15.033, p<.0001), with the fourth quartile significantly different from the first and second quartiles before the intervention, and from the other three quartiles after the intervention, according to the Scheffe tests.

Table 3. Online video lecture viewing completion percentage by quartiles with (after) and without interaction (before)

Quartile	N	Mean	Standard Deviation	Minimum	Maximum
			Video length (minutes)		
First	17	5.13	2.60	1.04	8.44
Second	17	9.62	0.46	8.59	10.25
Third	16	12.18	1.10	10.49	14.19
Fourth	17	19.09	3.19	14.26	25.04
Total	67	11.50	5.54	1.04	25.04
			Before: Average Completion Percentage (%)		
First	17	64.34	5.68	54.56	71.75
Second	17	63.63	6.21	55.26	74.83
Third	16	61.10	7.29	44.10	70.94
Fourth	17	55.35	8.16	30.42	63.50
Total	67	61.10	7.63	30.42	74.83
			After: Average Completion Percentage (%)		
First	17	83.80	6.38	72.38	96.79
Second	17	79.01	3.67	70.32	84.81
Third	16	77.74	5.61	62.97	83.24
Fourth	17	67.81	10.82	32.68	79.74
Total	67	77.08	9.14	32.68	96.79

The results presented in Table 3 are demonstrated in Figure 2, which shows that as the video length becomes longer, the average viewing completion percentages gradually decreases, both before and after adding interactivity. However, the differences between the first, second, and third quartiles are small (and mostly not significant, as reported above). Contrarily, the completion rate of the videos in the fourth quartiles, with average length of 19.09 minutes and 3.09 minutes standard deviation (SD), is significantly lower, even after adding interactive elements. Hence, with regard to the third research question about the practical appropriate maximal length of an online video lecture that would still be short enough to retain learners, our findings suggest that the range of the third quartile, 11-14 minutes may be the maximal effective video length range. However, this range may be affected by other factors, and should be corroborated by further research.

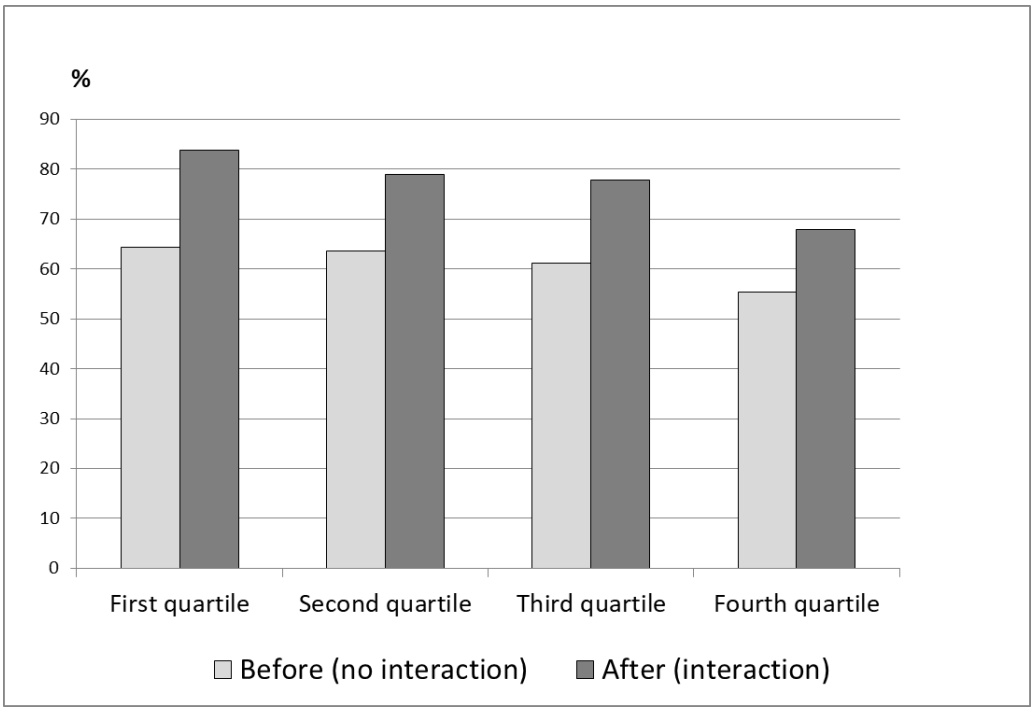

Figure 2. Average completion percentage of online video lecture viewing by quartiles of length with (after) and without interaction (before)

DISCUSSION

THEORETICAL IMPLICATIONS

Our findings suggest that interactivity may increase the attention span of learners, as measured by the average online video lecture viewing completion percentage, before and after the addition of interactivity, for both the basic and advanced English for Academic Purposes courses. The impact is significantly stronger for the more advanced course. However, when the lecture is longer than about 15 minutes (i.e., the fourth quartile in the analysis presented in Table 3), the completion percentages decrease relatively to the completion percentage of shorter videos, even after adding interactive elements.

The positive impact of interactivity on the average online video lecture viewing completion percentage is in line with the findings of Cherrett et al. (2009) and Dror et al. (2011). However, even after adding interactivity to the shorter videos (The first quartile, average video duration 5.19 minutes, SD=2.6, range 1.04-8.44 minutes) the completion percentage rate did not achieve 100%. This finding demonstrates the challenge of retaining attention (Davenport & Beck, 2001).

Thus, this research contributes to theory by both examining the impact of the interaction between video length and interactivity on the attention span of learners, and by providing a tool for quantifying the effective length of online video lectures.

Limitations

Nevertheless, further study is required for substantiating the findings. The MOOCs examined in this paper were intended to prepare the students for formal exemption tests and to save them tuition fee on a face-to-face course. Therefore, the students had a strong extrinsic motivation to complete them. The findings may not be applicable to other sorts of MOOCs, or to other types of learners.

Furthermore, since the examined MOOCs are open to all, it is possible that some people watched the videos for other purposes (e.g., to improve their knowledge of English), and their behavior might have been different than that of the students who took these MOOCs in order to prepare for the exemption exam.

Future Research

While MOOCs and other online learning opportunities serve "the needs of the already educationally confident" (Tuckett, 2017), those that do not have the necessary literacy skills require further assistance so they would not be left behind. Future research should seek further best practices to improve the effectiveness of online video lectures for diverse learners, and increase social inclusion.

Other promising research directions for increasing the attention span of learners who watch online video lectures include the use of badges (Gibson, Ostashewski, Flintoff, Grant & Knight, 2015) and elements of gamification (De Castell & Jenson, 2004).

While this study examined a seemingly linear learning, which is supposedly based on serial viewing of online video lectures, nowadays, much learning occurs ad-hoc, as people encounter a problem they want to solve and search for the solution or relevant information online. However, currently searching audio and video content is limited (Silber-Varod, Winer, & Geri, 2017). Nevertheless, if the relevant video lecture is located, and given the high motivation of the viewers, it would be interesting to examine if interactivity would be helpful or destructive in such situations, which are inherent in lifelong learning.

Practical Implications

Adding interactivity to online video lectures and controlling their length is expected to increase the attention span of learners. From a pedagogical point of view, we have shown that the interactive layer, which was added to video lectures, allowed learners to significantly extend their attention span. However, interactivity involves additional costs and adds complexity to the production process. This study demonstrated the potential of learning analytics to identify ways to improve learning processes and to provide important insights to decision makers. The ability to track and analyze behavior of learners who are presented with new features and capabilities is paramount for improving the effectiveness of learning environments, as well as supporting productive allocation of resources.

Conclusions

This study examined several aspects of how adding interactivity to online video lectures affects the attention span of students. Our findings, which are based on sample of 200,000 episodes of online video lectures viewings and are measured by the average online video lecture viewing completion percentage, indicate that interactivity may increase the attention span of learners. The second aspect that was examined concerned the course level. The results showed a significant difference between the basic English for Academic Purposes course and the advanced course, implying that the added interactivity was more helpful for stronger advanced students. Finally, we investigated the practical

appropriate maximal length of an online video lecture that would still be short enough to retain learners. The results revealed that for lectures longer than about 15 minutes, the completion percentages decreased, both before and after the addition of interactive elements.

Providing practical insights on adding interactivity to online video lectures and controlling their length is expected to increase the attention span of learners. As we move forward, we would like to improve the understanding whether interactive online video lectures might narrow the gap between weak and strong learners and allow better social inclusion.

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YOURS VIRTUALLY: ADVANCED MATHEMATICS AND PHYSICS IN THE ISRAELI VIRTUAL HIGH SCHOOL

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ABSTRACT

Aim/Purpose	The increasingly growing number of virtual high schools around the world has engendered new modes for teaching and learning and a promising area of research. While research in this emerging field has mostly taken a comparative lens that highlights differences between traditional modes of teaching and online teaching, research on high school students' and teachers' perspectives has remained dearth.
Background	This study identifies students' and teachers' perceptions of their learning and teaching advanced level mathematics and/or physics in the first Israeli virtual high school (VHS), which was launched five years ago.
Methodology	A survey of 41 questions was disseminated to the first graduating cohort of 86 Grade-12 students as well as to 22 VHS teachers. Additional data sources include students' essays on what it means to be a student in a VHS and field notes from a pedagogical development day.
Contribution	The purpose of this study is to highlight the workings of the Israeli VHS and in particular its important building blocks that include a teacher-tutor model, an ongoing gauging of students' work through a Learning Management System (LMS), and a continual teacher-developer interaction for the purpose of developing cutting-edge, technology-based course content.
Findings	Given the unique features of the Israeli VHS, both teachers and students report on feelings of unit pride, motivation, and investment in teaching and learning in the VHS.

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Recommendation for Practitioners	The Israeli VHS uses a combination of a teacher-tutor format, together with tools for gauging students' work and ongoing interaction between the teachers and the course content designers. Such a context creates new, fertile ground for technology-based, fully online teaching and learning of school mathematics and physics that may contribute to alleviating the problem of decreasing numbers of learners who are interested in taking advanced-level courses.
Recommendation for Researchers	Further exploration of aspects for improvement in the teaching model of the VHS, its design, and its support system and for finding out factors that impact attrition lay down important research trajectories that have not yet been trodden.
Impact on Society	Issues of equity and the democratization of learning of advanced STEM subjects are now possible to be seriously considered in a principled manner within the context of the VHS.
Future Research	Future research may focus on the affordances, possibilities, and limitations of learning within a VHS to ensure a more robust process that will allow more students to learn advanced mathematics and physics.
Keywords	virtual high school, teachers' perspectives, students' perspectives, mathematics, physics

INTRODUCTION

VIRTUAL LEARNING

The term virtual learning environment has been used interchangeably with terms such as distance education, e-learning, and web-based instruction (Rice, 2006). For the purposes of this paper and to reflect a current perception of what virtual learning environment is, we draw on the definitions of Crean Davis, Gaines, Paul, and Rukobo (2014), Rice (2006), and Schlosser and Simonson (2002) to define a virtual learning environment as a system that *provides* technology-mediated information spaces; *facilitates* synchronous and asynchronous teacher-student and student-student interaction that is independent of geographical proximity; *harnesses* pedagogically rich teaching approaches; and *promotes* state-wide or district-wide curricula through ongoing tests, homework, and evaluation and assessment of students' progress. Given the multifarious aspects of this definition, we use the term *virtual learning environment* as a referent of more recently developed technological learning systems rather than as a reflection of how online programs looked like a quarter of a century ago. Looking back, it is important to note that the first online programs were launched about twenty-five years ago in the United States (Watson, Murin, Vashaw, Gemin, & Rapp, 2011) and in Canada (Barbour, 2011). To date, there are about 200,000 students in Canada (Murphy, Rodríguez-Manzanares, & Barbour, 2011) and 700,000 students in the US who learn in different virtual environments (Picciano, Seaman, Shea, & Swan, 2012).

Research that focuses on online programs highlights several possibilities and limitations that are experienced in virtual learning environments. For example, it was found that learners in virtual environments have higher levels of motivation (Barbour, 2011; Tunison & Noonan, 2001), and that such environments generate wider accessibility for learning (Hughes, McLeod, Brown, Maeda, & Choi, 2007), provide quality-learning environments, improve learning skills (Clark & Berge, 2003), and enable interaction with other students and teachers who are located in distant geographical areas (Barbour, 2008). Some of the limitations identified in the literature concern the overwhelming amount of work required from the students, limited interaction with other students (Blau & Barak, 2009), and technical problems (Barbour, 2008). In comparative research that looked into students' perspectives in traditional versus virtual environments, it was found that students who learn in virtual environments are more satisfied with their learning experience (Summers, Waigandt & Wittaker, 2005), obtain higher academic achievements, and receive higher teacher support (Hughes et al., 2007). However, other research found opposite results indicating that there are no significant differences in learn-

ers' satisfaction between students who learn in virtual environments versus students who learn in traditional settings (Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004; Rivera & Rice, 2002; Ungerleider & Burns, 2003) thus indicating inconclusive findings. Given these findings and with the exponentially increasing numbers of virtual learning programs worldwide, the extent of research that focuses on learning in virtual K-12 environments remains dearth (Barbour, 2010). It is not surprising then that there are repeated calls for continued research in virtual K-12 learning programs in general (Barbour, Siko & Simuel-Everage, 2013) and in high school programs in particular (Barbour, 2017; Rice, 2006). The purpose of this paper is to contribute to the field of virtual learning by providing a snapshot of students' as well as teachers' perceptions of their experience in the first Israeli virtual high school that offers features which include the teacher-tutor format that, as far as we know, is unique to the Israeli VHS; the LMS, which is required in light of the fact that the courses are fully on line, and a continual interaction between developers and course teachers to identify technological and pedagogical tools that can be introduced into the environment to more efficiently and effectively teach and learn mathematical and/or physics concepts.

Israel's First Virtual High School

In September 2012, the Center for Educational Technology (CET) together with the Trump Foundation and the Israeli Ministry of Education launched the first VHS in Israel. The purpose of the VHS was to address the problem of alarmingly decreasing numbers of students who opt for advanced level mathematics and physics classes. The VHS was set to make advanced courses in mathematics and physics available to students in peripheral areas where schools could not provide these classes because of shortage of qualified teachers. In addition, the VHS was set up to make these courses available to students in schools that could not form a large enough class to justify opening advanced courses at school. To date, the Israeli VHS offers advanced courses in mathematics, physics, and civic studies. The unique model of the VHS is that of a fully online platform, which essentially means that there are no face-to-face meetings and that all communication modes between the teachers and the students are situated within the virtual environment. The fully online program is free of space-related constraints—as such, students can access the course content anytime, anywhere. This paper focuses on the Israeli VHS teachers' and students' perceptions of their experience. Specifically, the research questions, discussed in later sections, are aimed at shedding light on how students and teachers experience the unique teacher-tutor format, the LMS, and the technological tools available through the VHS to the teachers and students.

The first cohort of the Israeli VHS graduated in the summer of 2015. The graphs in Figures 1 to 3 reflect the growth and development of the VHS. Figure 1 shows the number of participating home schools that had students enrolled in the VHS. (In this paper, this term *home schools* refers to the high schools where the students attend regular classes) Figure 2 reflects the number of classes in the VHS in the first four years of its operation. Figure 3 points to the number of students who studied in the VHS.

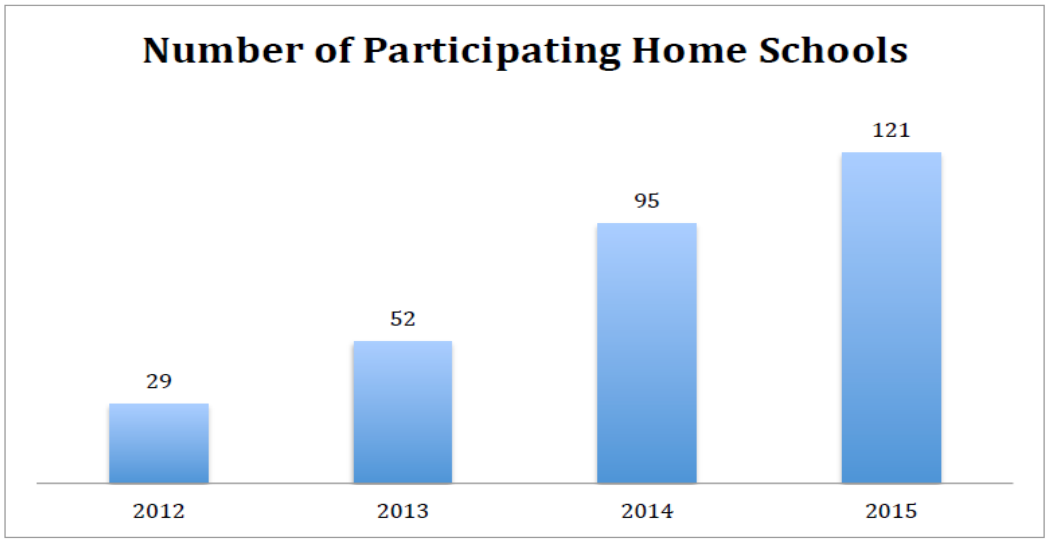

Figure 1: Number of participating home schools

Figure 1 indicates the growing number of participating home schools starting at 29 in 2012 when the VHS was launched and reaching 129 within the first four years of the school's operation.

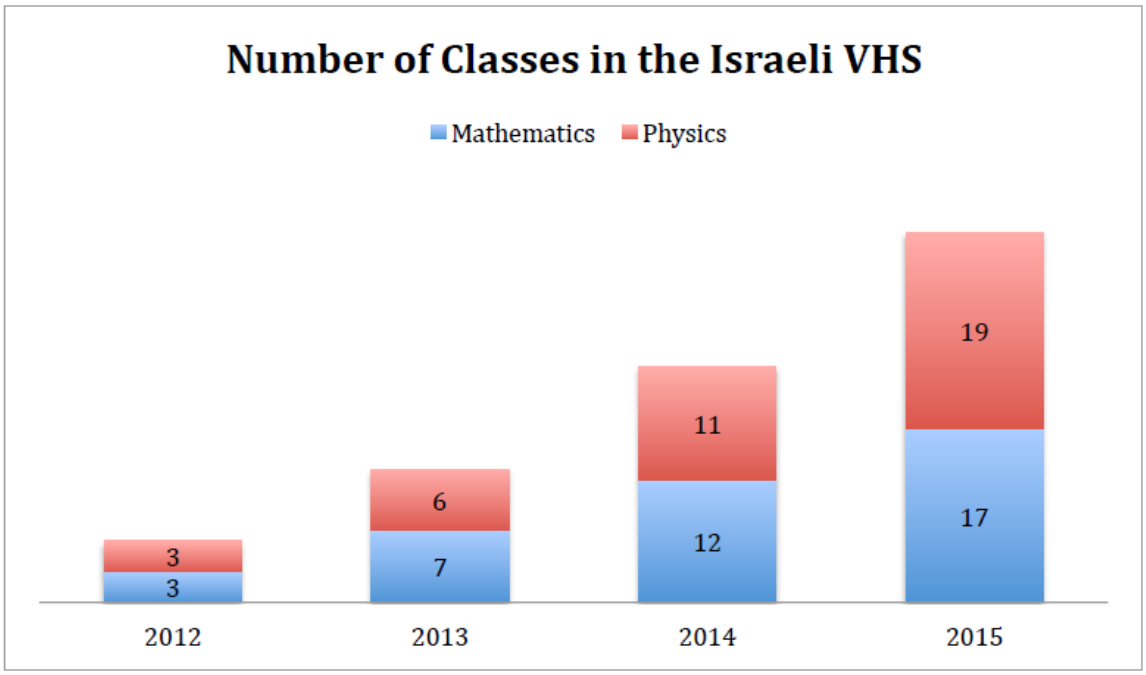

Figure 2: Number of classes in the Israeli VHS

Figure 2 demonstrates the number of classes that started off with six in 2012 and got to 36 within the school's first four years of operation.

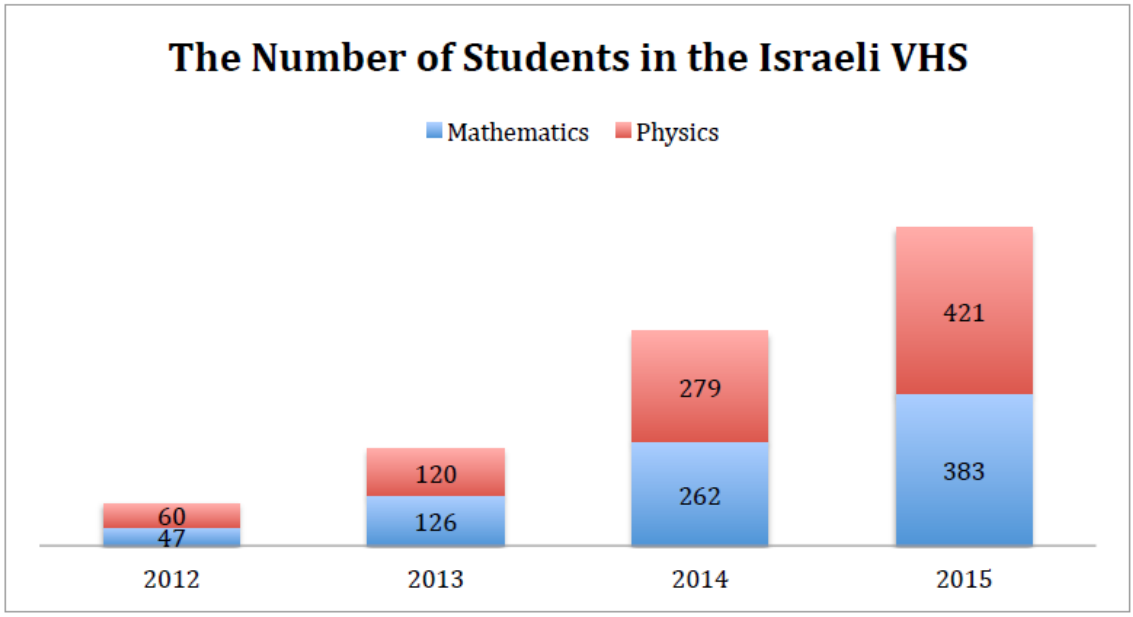

Figure 3: Number of students in the Israeli VHS

Figure 3 illustrates the increasing number of students enrolled in the VHS starting off with about 100 students in its first year and reaching about 800 students in its fourth year.

In order to better understand how the VHS courses are incorporated in the students' high school schedule, we will next describe its structure and design. In mathematics, for example, the model employed in the Israeli VHS is comprised of five to six synchronous lessons with a teacher of a class that has about 27 students from different schools across Israel. In addition to these weekly six hours of synchronous lessons, each student also logs on for two to three hours of virtual tutoring that takes place in groups of up to four students. Each tutoring group works with a university student who majors in a STEM-related field. Each student is also expected to electronically submit homework assignments, quizzes, and tests. The learning environment in the Israeli VHS provides content that is highly interactive and rich with media. Feedback is almost always instantaneous and ongoing support to ensure accommodation to emerging needs is always available.

During the synchronous classes, the students sit in their respective home school, in front of computers. Other students in the same school who are also enrolled to the VHS may also be present in the room sitting at their own computer. During the online class, the teacher uses videos, PowerPoint presentations, and other digital tools and applications such as a white screen (see Figure 4)—an interactive tool where the students and the teacher write on a writing pad that translates the content onto the screen.

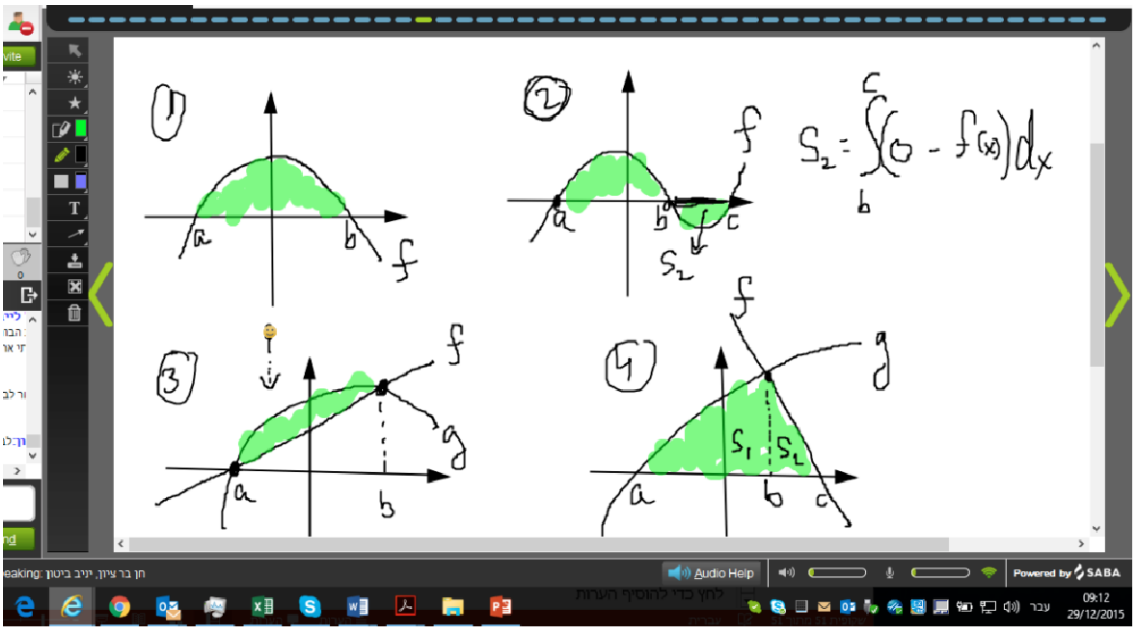

Figure 4: White screen

Figure 4. The students and the teacher use the white screen to share ideas and discuss them.

The use of dynamic software and simulation tools allows for interactive construction and visualization of concepts in mathematics and physics. This includes tools that allow for a manipulation of geometric shapes as is seen in Figure 5. Both the teacher and the students continually use the available software, features, and applications as they engage in dynamic and visual representations of concepts and configurations in mathematics and physics. In addition to the above-mentioned tools, the VHS platform also includes features that are oriented toward the facilitation of teacher-student, and student-student interaction. The polling feature and the chat feature, for example, provide a sense of democratization in the learning process, as they yield an opportunity for all participating students to interact, thus eliminating issues related to turn-taking as well as allowing all students to initiate and respond to emerging queries. Specifically, the use of these features disrupts the Initiation, Response, Evaluation model of interaction and classroom discourse (Cazden, 2001) that is prevalent in traditional classrooms where the teacher initiates the question, the student responds, and the teacher evaluates the response. Furthermore, unlike traditional settings, where teacher-student interaction is visible and audible for all, the VHS chat feature allows student-teacher interaction that is private. Alternatively, this same feature allows students to interact with others in the class without interrupting the lesson. This may take place when a student consults with other students during the lesson. In a similar vein, the polling feature allows for a quick gathering of students' input. This feature can provide an indication to the teacher of how well the students understood material presented and taught previously.

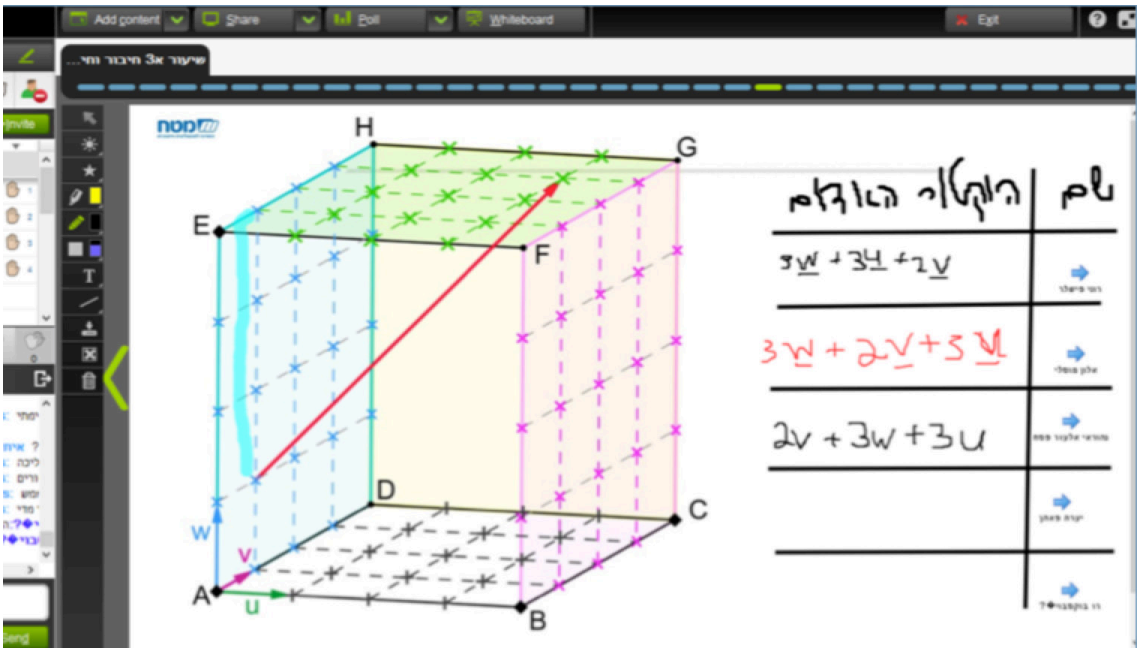

Figure 5: Dynamic software

Figure 5. The use of animated software that makes it possible to provide accurate construction and manipulation of geometric shapes

In addition to the above-mentioned tools and features that the VHS platform provides, there is also an integrated camera that allows the teacher and the students to see each other in a small frame in the corner of the screen. The student has a microphone that remains mute during the lesson unless the student speaks, asks or answers a question, takes part in a discussion, and so on. Importantly, one of the most distinguished aspects of the Israeli VHS is its transparency in teaching as all the classes are recorded and kept in an online repository. This online repository is open for all teachers, students, and tutors to listen to and view previously recorded lessons. Over and above, this transparency encourages a culture of collaboration and teamwork among and between teachers and tutors. In addition to the affordances embedded in the online repository of recorded lessons, teachers and tutors keep an online journal where they add their insights, queries, dilemmas, and teaching and pedagogical tips after each lesson thus creating and fostering a community of practice (Wenger, 1998).

METHODOLOGY

PARTICIPANTS

Eighty-six Grade-12 students who took advanced level mathematics and/or physics in the VHS in 2015 participated in the research. Forty-one were females; forty-five were males. Among the 86 students, 50 began their studies at the VHS in September 2012, which means they attended the VHS for three full school years. The rest had one or two years of learning experience within the VHS. The study also included 22 teachers (ten mathematics teachers and 12 physics teachers) that teach advanced-level mathematics or physics in the VHS.

In regard to the demographics, the VHS services a population of students that comes from diverse cultural and ethnic backgrounds. The student population comprised of 79% Jewish students, 8% Arab students, 3% Druze students, and 10% Bedouin students. Figure 6 reflects the students' home schools, which in Israel are arranged according to ethnic and religious sectors.

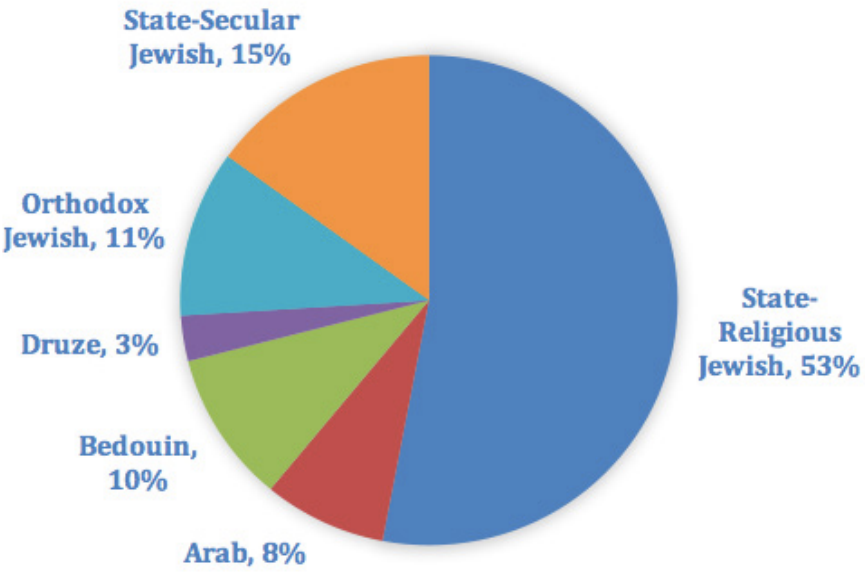

Figure 6: The VHS students according to sector

In regard to the different educational sectors that are highly diverse and disparate in Israel, Figure 6 reveals that whereas 53% of the students come from state-religious Jewish schools, 15% from State-Secular Jewish schools, and 11% from Orthodox Jewish schools, 21% of the students come from the different Arab sectors.

In addition, students enrolled in the VHS come from diverse geographical areas as shown in Figure 7.

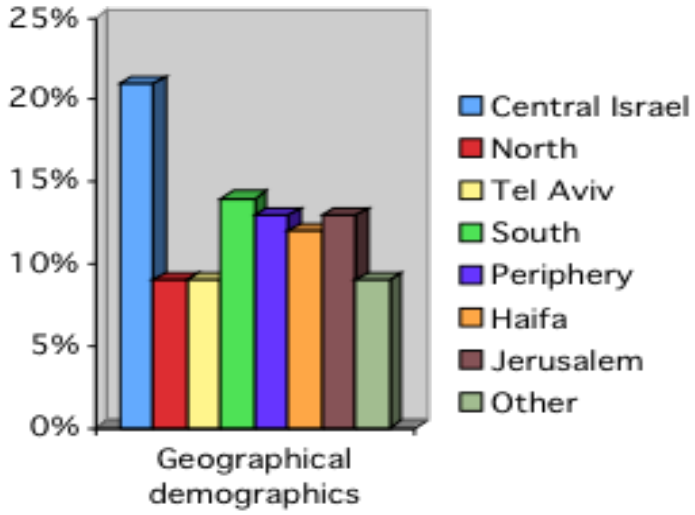

Figure 7: Geographical demographics

Figure 7: The VHS has students from all over Israel. Notably, about 50% of the student population comes from the north, south, periphery, and other areas in Israel.

In regard to the diversified socioeconomic background of the VHS students, it is important to note that the VHS has maintained a balanced distribution of high, middle, and low socioeconomic status (SES) levels that reflected the distribution in the general public as shown in Figure 8.

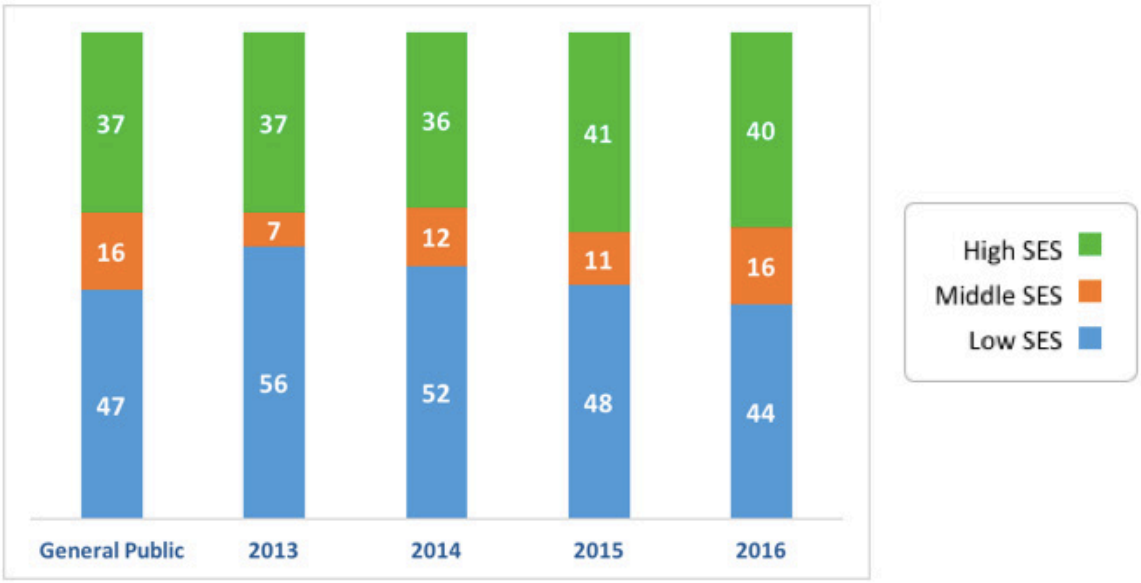

Figure 8: VHS students according to their family's socioeconomic status (SES)

We now turn to the research questions attended to for the purpose of this paper.

Research Questions

This paper brings forth an extensive and ongoing research that is conducted on the teaching and learning in the Israeli VHS. Specifically, it focuses on several research questions pertaining to students' and teachers' perceptions of the VHS and describes the tools that were used to collect the data. The following questions were formulated:

1) What are the students' perceptions about virtual learning in general and the virtual high school in particular?
2) What context-specific aspects do students highlight in their experience of the VHS and traditional learning environments?
3) What are the teachers' perceptions of their experiences in the VHS?
4) What are the teachers' perceptions of the affordances and challenges occasioned in the VHS?

Research Tools and Data Analysis

Students' perspectives data collection

A variety of tools were used to collect data that will reflect the students' perception of their experiences of the VHS. Data were collected through a questionnaire, student essays, and SWOT (explained in a later section). The survey questions were developed by the Research and Analysis Unit in the CET. The questions were formulated to collect students' and teachers' perceptions of the teacher-tutor format, the features of the LMS, and the teaching and learning tools available through the platform used by the VHS. The questionnaire was posted in Google Docs. It had 41 questions. Thirty-eight of the items in the survey were 5-point Likert-scale questions (1 indicating Strongly Disagree, 5 indicating Strongly Agree); three were open-ended questions. The Likert-scale questions focused on a wide range of aspects related to learning in a virtual environment in general and in the VHS in particular. Questions included reference to the year the student began his or her studies in

the VHS, the class they took, the experience of learning in the VHS, aspects of the different available tools and modes of teaching, and their contribution to learning.

The three open-ended questions were the following:

1) Looking back at your school years in the VHS, please note what things you were most pleased with.
2) Please note the things you would like to see changed in the VHS. These can be recommendations to the VHS team as to the general treatment of students, the virtual meetings with the teacher, the tutoring, the homework, or any other aspect that you think is relevant.
3) Some think that face-to-face learning is preferable to virtual learning in preparing students for the future. Others believe that virtual learning is necessary to prepare students for the job market. What is your opinion?

The combination of Likert-type questions and open-ended questions was aimed to garner deeper insights about learning in the VHS from the students' perspectives. As is acceptable in studies that rely on qualitative and quantitative analyses of data, the students' responses to the Likert-type questions were analyzed with descriptive statistics. The responses to the open-ended questions were analyzed using inductive analysis in order to identify key themes (Patton, 2002) and typical patterns (Bogdan & Biklen, 1982).

Students' essays on what it means to be a virtual student in a VHS were another data source. Students were encouraged to share their experience of learning in the VHS and their thoughts of the differences between virtual learning and face-to-face learning. Eight essays were submitted and analyzed.

In addition, data included fully recorded synchronous lessons from the VHS repository of lessons. As noted before, the lessons in the VHS are recorded and are readily available to the VHS students as well as teachers and tutors. Furthermore, all homework assignments, solutions to the exams, and students' tests are scanned and kept in the repository so that they are readily available to the students' teacher at any given moment. This repository of data is conducive to our efforts in better understanding the experiences of students and teachers in the VHS.

In order to make sense of the data, we employed the SWOT analysis framework of Strengths, Weaknesses, Opportunities, and Threats. Historically, the SWOT analysis was put together in the second half of the 20th century by a group of researchers in the Harvard Business School (Chermack & Kasshanna, 2007) and has been since used as a research tool in various contexts (e.g., Westhues, Lafrance, & Schmidt, 2001). We imported the SWOT analysis framework for the purpose of this study in order to construct a legible picture of what the VHS offers and how it is experienced.

Teachers' perspectives data collection

A variety of both quantitative and qualitative tools were used to compile data on teachers' perspectives about their teaching in the VHS. A questionnaire that comprised 45 Likert-type questions and 10 open-ended questions was administered to the teachers through email. Globally, the questionnaire aimed to explore the teachers' perspectives on a variety of aspects associated with online teaching in general and with teaching in the VHS in particular. The closed-ended questions mostly pertained to the extent of utilization of the tools and features available to the teachers in the VHS, as well as to general details about the teacher's seniority and number of years teaching, his or her process of becoming an online teacher, their use of teaching tools and techniques, and their perspectives on the virtual infrastructure and the VHS's model of instruction. Additional sources of data such as field notes collected throughout the years of operation of the VHS, as well as notes from the end-of-year pedagogical development day were also included. Similar to the students' perspectives, recurrent themes emerging from the qualitative data were organized using the SWOT analysis framework.

Some open-ended questions that were given to the teachers included:

1) From your point of view, what was particularly successful this year?
2) What was particularly difficult this year?
3) What helps you advance the students?
4) What teaching techniques and tools are missing in your instructional field?
5) Do you attempt to increase your students' motivation and to improve their confidence in being able to succeed? If so, in what ways do you act to accomplish these goals?

RESULTS AND DISCUSSION

STUDENTS' PERSPECTIVES

The questionnaire included several topics that could provide some insights as to what students thought about the subject they chose to learn in the VHS, the teaching and learning process, their academic achievements in the VHS, the usefulness of the learning tools in the VHS, and the content of the subject learned. In light of the extent of the questionnaire, we chose to focus on selected statements in each of the topics. The selection of the statements was done to provide more insights about the teaching and learning model employed in the VHS as they were perceived by the students. Students' positions were collected through a five-point Likert-type scale (from 1=strongly disagree to 5=strongly agree). Table 1 illustrates students' perspectives about the instructional resources in the VHS while Table 2 shows the extent of usefulness students attribute to the available teaching and learning tools in the VHS. Table 3 illustrates students' general perceptions about learning in a virtual environment.

Table 1 shows that while the majority of students reported that the VHS prepared them well for the advanced level mathematics and/or physics matriculation exams and that they understood the content taught by the teacher, 26% and 33%, respectively, did not think the course they took prepared them well for the matriculation exam or that they understood the content taught by the teacher. Interestingly, the tutoring sessions was especially appreciated in helping students understand material and address difficulties because the percentage of students who expressed some level of dissatisfaction in relation to learning with the teacher decreased to about 15%. This finding indicates that the unique structure in the VHS of working with tutors is effective in providing the support students need in learning in the VHS as it mitigates difficulties students may experience understanding the content when they learn with the teacher in the larger group. In regard to homework, the question pertaining to the efficacy of homework in improving achievement had a comparatively lower average agreement rate of 3.62. In fact, while about 60% of the students reported that they thought homework helped them better understand the material at hand, 40% of the students believed it did not. As well, the question pertaining to garnering a meaningful experience from learning with students from all over Israel had an average agreement of 3.52. That is, 47% of the students did not believe they benefited from learning with students from other locations. These results may indicate that there is a need to attend to the contribution of homework to the learning of advanced mathematics and physics in the VHS and to the added value in forging student-student connections within the VHS. We now turn to the students' perceptions of the available tools in the VHS as shown in Table 2.

Table 1. Students' Likert-type rating of their perceptions of the teaching and learning in the VHS (n=86) (Numbers in the top row indicate Likert scale response)

Statement	1	2	3	4	5	Mean	Standard Deviation
The VHS prepared me well for the matriculation exam	0	4	19	35	28	4.01	0.86
I understood the content taught by the teacher	1	8	20	34	23	3.81	0.98
Tutoring helped me to better understand the material at hand	1	4	9	22	50	4.35	0.93
Tutoring addressed the difficulties I was experiencing	2	4	7	28	45	4.28	0.97
Homework in the VHS is treated more seriously than in traditional classes	7	6	13	25	35	3.87	1.25
Homework helped me better understand the material at hand and improve my achievements*	5	8	21	31	20	3.62	1.12
Learning with students from other locations in Israel was a meaningful experience for me*	6	14	20	20	25	3.52	1.27

*n=85

Table 2. Students' Likert-type rating of their perceptions of the available tools in the VHS (n=85) (Numbers in the top row indicate Likert scale response)

Statement	1	2	3	4	5	Mean	Standard Deviation
PowerPoint Presentations	1	4	16	38	26	3.99	0.89
Recorded lessons	9	14	13	23	26	3.51	1.36
Geogebra and dynamic simulations	11	21	30	14	9	2.87	1.16
Writing and speaking tools in the synchronic environment (chat, voting, writing)	2	2	20	29	32	4.02	0.96
Virtual labs (for students of physics)*	2	5	8	11	11	3.65	1.21

*n=37 as this question applied only to those who took physics in the VHS

Table 2 shows that, overall, the students felt that the available tools in the VHS helped them learn the advanced mathematics and physics. Note specifically the 75% and the 72% of students who reported that the PowerPoint presentations and the available tools of interaction, respectively, were perceived as contributing to their experience learning in the VHS. While students note that they learned most

from the PowerPoint presentations, the results reveal that fewer students (58%) took advantage of the recorded lessons accumulated in the repository. This may indicate a need to demonstrate the potential benefits of using the repository to remind students of this available tool and how they may use it. Notably, the difference in the efficient use of dynamic simulations such as Geogebra and virtual labs can be attributed to between-teachers' differences in teaching styles. This is an important finding as more attention needs to be put in providing guidance and support to the VHS teachers to increase the utilization of the dynamic tools that the platform offers. The contribution of the interactive tools available in the VHS indicates a cohesive cluster of satisfied students who see these tools are effective in contributing to their learning in the VHS.

Table 3. Students' Likert-type rating of their perceptions of learning in the VHS (n=86)
(Numbers in the top row indicate Likert scale response)

Statement	1	2	3	4	5	Mean	Standard Deviation
If I had a chance, I would prefer to learn the subject at my home school	8	13	18	25	22	3.47	1.28
If I had a chance, I would learn more subjects in the VHS	15	23	19	13	16	2.91	1.37
While learning in the VHS, I have acquired skills that are vital for the job market*	3	7	29	29	17	3.59	1.02
I will encourage others to take a course at the VHS*	4	9	17	24	31	3.81	1.18
I recommend every high school student takes a course at the VHS*	6	19	24	15	21	3.31	1.26
I am pleased with my joining the VHS	3	4	17	25	37	4.03	1.07

*n=85

Table 3 reveals students' perceptions of learning in the VHS. While the majority (72%) of the students expressed satisfaction with studying in the VHS, 46% of them wished they could take the course in their respective home schools. Indeed, while 33% of the students expressed interest in taking another course in the VHS, the majority of them (67%) reported that given a chance, they would not take another course at the VHS. Specifically, we noted a wider span of students' responses in the questions relating to their choice of learning in the VHS or recommending it to others. Whereas 64% of the students reported that they would encourage others to take courses at the VHS, only 42% noted they would recommend *everyone* (italics added) take courses in the VHS. This may indicate an interesting phenomenon as the latter specifically relates the possibility of having *every* (italics added) student take a course at the VHS. In regard to applying skills beyond the purposes of the courses taken in the VHS, students were divided in almost in half. One half of the students noted that they have learned skills they deemed useful for the job market; however, the other half noted that they did not deem the skills they have acquired in the VHS as essential for their future careers. These results may indicate some potential challenges with students maximizing a somewhat new, unfamiliar learning environment. Further research may shed light on these challenges and potentially help identify additional supporting mechanisms that students may need.

Table 4. Students' Likert-type rating of their level of satisfaction in the VHS (n=86)
(Numbers in the top row indicate Likert scale response)

Statement	1	2	3	4	5	Mean	Standard Deviation
I am pleased with my achievements in the subject I chose to learn in the VHS	3	5	21	30	27	3.85	1.05
I think I can do well on the matriculation exam in the subject I chose	0	3	15	42	26	4.06	0.79
My achievements in the VHS reflect my utmost efforts	5	15	25	22	19	3.41	1.18

Table 4 demonstrates students' levels of satisfaction of their achievements in the VHS, their expectations of succeeding in the matriculation examination in advanced level mathematics and physics, and their perceptions of maximizing learning in the VHS. While the majority of students report a high satisfaction with the VHS, some report that their level of satisfaction is not maximized. That being said, overall, students' expectations to succeed in the matriculation examinations are high. It seems that the diverse answers can be further explored through garnering additional input from the students that may shed light onto the factors that may hinder their satisfaction of the subject they chose to learn in the VHS.

To corroborate our understanding of students' perspectives of the VHS, an analysis was conducted of students' essays and their responses to the following two open-ended questions:

1) Looking back at your school years in the VHS, please note what things you were most pleased with.
2) Please note the things you would like to see changed in the VHS. These can be recommendations to the VHS team as to the general treatment of students, the virtual meetings with the teacher, the tutoring, the homework, or any other aspect that you think of.

Students' responses were categorized into the SWOT framework. We then noticed that each of these categories generated three subcategories. Table 5 shows the different categories and provides statements from students' input.

Table 5 demonstrates what strengths and opportunities versus weaknesses and threats the students attribute to learning in the VHS. In regard to the open-ended question, recurring themes that were framed as strengths and opportunities pertain to the high quality of teaching in the advanced-level mathematics and physics taught in the VHS, the advanced technology that the platform offered in learning the advanced-level courses, and the sense of the collective unit pride the students felt by attribution. In identifying recurring themes that pertain to weaknesses and threats, three main themes emerged. One was the issue of homework—heavy load and technical problems in submitting them electronically on a regular basis—the other was the challenge of using digital technology for long stretches of time, and the third the lack of school support and technological problems that were caused due to inadequate equipment. We find that these findings add important insights as to the VHS context-dependent challenges to be addressed and the affordances to be fostered.

Table 5: Analysis of students' written input using the SWOT model

Category		Statement
Strengths and Opportunities	The quality of the teaching staff (teacher and tutor) and teaching practices	☞ The teacher taught us in a way that makes it difficult to forget even after graduation, which allows us to understand everything in depth. The tutor was phenomenal. The way solutions were explained and the investment in making sure we do well and the solutions of exercises in addition to those presented in the lesson. ☞ Learning in small groups so that you get personalized attention, taking homework seriously and giving constructive and to-the-point feedback on your homework
	Technology and teaching materials	☞ No matter where you are, you can log on and simply attend the class even when you are sick at home or on a trip (with a laptop), and the lessons are recorded so that you can make up for missed material or refresh your knowledge ☞ The use of advanced programs, like Geogebra, that help in better understanding the material
	Unit pride	☞ The opportunity to get to know amazing teachers and new friends that I would have never met were it not for the course at the VHS ☞ I am most pleased with the exposure to scientific environment that my home school does not provide
Weaknesses and Threats	Homework (heavy load, technical difficulties uploading assignments electronically	☞ The way we had to submit homework was very frustrating. Each exercise had to be written in an orderly manner, scanned, and submitted with so many technical problems in the process
	The management of the lesson and the tutorial	☞ I wish the lessons were more to the point so that students would be fully engaged because it's very easy to lose your concentration when you sit at the computer
	Technology and the learning environment	☞ Put more emphasis on the responsibility schools have to provide an adequate learning environment such as computers and quiet classes to their students

While the strengths and opportunities highlight the positive aspects of the experiences of the VHS students that can also be built upon in times of increased pressure to work, the weaknesses and threats identified as such can be catalysts to identifying ways to redress emerging problems or to change pedagogical practices. For example, teachers may want to consider allowing students to submit group work or author and construct their own mathematical problems as group projects. This may not only mitigate the pressure associated with the heavy workload in the VHS, but also contribute to the sense of unit pride that has been positively viewed among some students.

In regard to the following open-ended question: *Some students think that face-to-face learning is preferable to virtual learning in preparing students for the future. Others believe that virtual learning is necessary to prepare students for the job market. What is your opinion?* Students' responses were categorized into three groups: 1. Strong preference to face-to-face learning; 2. A combination of face-to-face and virtual learning; 3. Strong preference to virtual learning, Table 6 illustrates the three categories and an example for each is provided from the data.

Table 6. Learning virtually versus face-to-face

Category	Students' statements
Strong preference to face-to-face learning	I think that the interactions among the students and between the students and the teacher are very important and it's far easier to manage a face-to-face discussion when you have multiple participants, this is why I think that face-to-face lessons are irreplaceable
A combination of face-to-face and virtual learning	On the one hand, learning in a virtual environment is very convenient. If I missed a lesson, it's recorded. There is an organized repository of the whole material. On the other hand, if I find something difficult to understand, I have no one to turn to for explanations because I'm the only one from my homeschool enrolled in the VHS. In addition, it's hard to learn about things that require tangible demonstrations (like labs…). However, thanks to the VHS, I developed habits of individual work and personal responsibility. After all, this is also important for the future.
Strong preference to virtual learning	I see virtual learning as preferable to face-to-face learning because of the advantages it carries: 1. The student can go over recorded lessons for missed classes; 2. Extensive support and an experienced staff that is there for the student all the way; 3. It's more convenient and allows to learn anywhere, anytime

The insights garnered from the students' responses are useful as they provide input about the students' beliefs about the utilization of each mode of rendering the material and thus can be used in directing and guiding students' work toward their preferences in working with others.

TEACHERS' PERSPECTIVES

Teachers' perspectives in regard to their experience of the VHS were equally revealing. Data were collected through a questionnaire that was emailed to the teachers. Twenty-two out of 28 (79%) of the VHS' teachers filled out the questionnaire and provided responses for analysis. In order to yield an initial impression of the teachers' perspectives, we coalesced the responses into two groups: agreeing with the given statement versus disagreeing with the given statements.

Table 7 shows the percentage of teachers who selected Agree, Strongly Agree, or Very Strongly Agree.

Table 7. Percentage (n=22) of teachers who agree with statements regarding pedagogical tools and instructional experiences in the VHS

Statement	Percentage (%) of teachers who Agree/ Strongly Agree/ Very Strongly Agree
During the lesson, I allocate time for students' questions	91%
During the lesson, I lead discussions over problems and solutions	77%
I notice which students are active during the lesson	59%
During the lesson, I used virtual labs, simulations, videos, or dynamic applications available on the VHS website	55%
I hear about students' difficulties and advancements from the tutors	64%
I am satisfied with the integration of the tutors as an inseparable part of the instructional team	77%
I am satisfied with my work as a VHS teacher	96%
I believe that my teaching in the VHS allows me to express my professional abilities	82%

Notably, while 91% of the teachers noted that they allocate time for students' questions during the synchronous lessons, 77% of them reported on leading discussions over problems and solutions, and only 59% noted that they gauge students' engagement during the lesson. To increase teachers' noticing of students' engagement, it may be beneficial to elicit students' input using the polling feature embedded in the platform and used by some of the VHS teachers on a regular basis.

In regard to using available tools, such as virtual labs, videos, and dynamic applications, only 55% of the teachers noted that they do so on a regular basis. This may reflect a need to provide added support and guidance to teachers in the utilization and the efficiency of using these tools. Such support may generate increased awareness of the affordances of the available tools and features that are embedded in the VHS platform or are readily available through the Internet. A principled utilization of available tools and features may substantially increase students' awareness of the context-specific benefits of learning in the VHS that are not readily available in traditional classrooms and potentially maximize their utilization of the affordances the learning environment provides.

An important input in regard to working closely with the tutors, who are university students majoring in STEM-related fields, sheds light onto the unique component that the Israeli VHS provides to its students. As mentioned above, the VHS students themselves identify the tutoring sessions as paramount to their learning—more than their learning with the course teacher. While most of the teachers (77%) acknowledge the indispensable contribution of the tutors in providing the much needed support and help to the students, only 64% of them work closely with the tutors to discuss students' progress, successes, and challenges. This may indicate a need to underscore the benefits of working in a principled manner with this extra manpower to ensure more effective learning of the material. Ongoing interaction between the teachers and the tutors builds upon the unique features that the Israeli VHS provides. All in all, the VHS teachers are satisfied with their role teaching in the VHS and in their professional resources.

The SWOT method was additionally used to organize and analyze the responses yielded from the open-ended questions and the field notes (Table 8).

Table 8. SWOT analysis of data collected from teachers

Main category	Sub-category	Representative statement
Strengths and opportunities	Fostering motivation and a can-do mindset among students	"[I] foster a supportive atmosphere that encourages students to present their ideas, even if they are wrong, and discuss them."
	Developing awareness to the students	"[I] sharpened my attentiveness and sensibility to the students especially because I do not see them."
	The design of and instruction in the VHS	"The combination of teacher, tutor, coordinators, and administration gives a feeling that everything focuses on the students and their learning."
	Quality of instruction	"I managed to reach accomplishments with some of the students that seemed impossible at the beginning of the year."
	Diversity of teaching methods	"It's important to recognize that each student sits in front of the computer during the lesson with an expectation for an opportunity to experience dynamic simulations"
Weaknesses & Threats	The interface between the different elements in the VHS program	"Homeschools do not attend to the special needs of the VHS students: Classes remain locked, there is no technical support."
	The teaching model in the VHS	"Reviewing homework is done by tutors some of whom have no pedagogical experience, which can act against us."
	The technological system	"The technological system was not always stable. Sometimes it even crashed in the middle of a lesson, or was really slow at both my end and the students'."

In organizing teachers' responses into the SWOT's framework of strengths, opportunities, weaknesses, and threats some themes emerged. A recurring theme among the teachers was the perception of the VHS environment as conducive to fostering motivation. Teachers noted that the structure and design of the VHS allowed them to pay close attention to the students and, in fact, get to know their students better than they do in a traditional classroom. The unique design of the VHS and the high quality of the teaching materials seem to be intertwined with increased awareness to the diversity in teaching tools and pedagogical practices.

In regard to the weaknesses and threats that were generated from the teachers' input, it was found that teachers identified some difficulties with working with homeschools in light of problems allocating quiet spaces and problem-free equipment. A recurring theme was also teachers' input concerning the need to ensure that the tutors gain some understanding of pedagogical practices before working with the high school students on mathematics and physics.

These findings shed light on the VHS teachers' perspectives of the unique affordances and challenges that are associated with the VHS. Specifically, while the teachers find pride in working in such a technologically and pedagogically advanced environment, they underscore the need to work more closely with the tutors and to ensure maximized support to the students in the homeschools.

CONCLUSION

The Israeli VHS was launched to address two very specific needs in the educational system. One was the shortage of qualified teachers who could teach advanced level mathematics and physics in the peripheral areas of Israel; the second was that many schools simply did not open advanced level mathematics and physics classes due to the small number of students who were interested in taking such courses. Since it was launched, the Israeli VHS has been growing steadily providing the much-needed classes to students in remote areas and in schools that do not provide the courses. In order to gain insight as to the perspectives of students and teachers of their experiences of the VHS, data were collected and analyzed. Some of the data comprised students' essays. While the analysis of the essays yielded important information about students' experience of the VHS, given the small sample size of the essays collected (see Onwuegbuzie & Leech, 2005) we suggest that further research needs to be conducted to explore how students experience the structure, design, and support system of the VHS following the implementation of some solutions to challenges that were identified in this paper.

In this context, we have reported students' perspectives on being a student in a VHS, as well as teachers' perspectives on their work. Our data tell the story of students and teachers who are cognizant of the privileges and the advantages of the non-conventional, country-wide online classrooms, but who are also aware of the difficulties and potential for improvement. The use of technology not only allows for a variety of teaching methods through the use of different digital applications such as Geogebra and virtual labs, but also provides students with diverse ways of expression during lessons, tutorial sessions, and assignments—ways of expressions that are different than those allowed or practiced in traditional classrooms.

Similar to current knowledge of virtual education (Clark & Berge, 2003; Hughes et al., 2007), the students in the Israeli VHS reported that the school modeled high-quality teaching and that they felt supported by their teachers and tutors through the small-group sizes and individual care that was provided to them. Keeping in mind the objective of enhancing the number of students opting in for advanced mathematics classes, we are interested in identifying the very mechanisms that can contribute to the realization of this objective through the use of the technological tools employed by the VHS. A recurrent challenge that arose in both the students' and teachers' data is the context-specific difficulty of orchestrating online education with the students' homeschools, as well as the technical and logistical challenges that come with conducting a virtual classroom. From the teachers' data, it appears that there is space for growth in terms of utilizing all the virtual tools available to teachers, and fully exploring the advantages that characterize the online classroom compared to the traditional classroom. Future research would need to focus on the use of available tools by teachers, and how a more flexible and varied use of technology affects student performance. In addition, future research may yield a better understanding of how the learning of the professional community of teachers and tutors helps keep students motivated to take the advanced course in mathematics and physics.

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