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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).

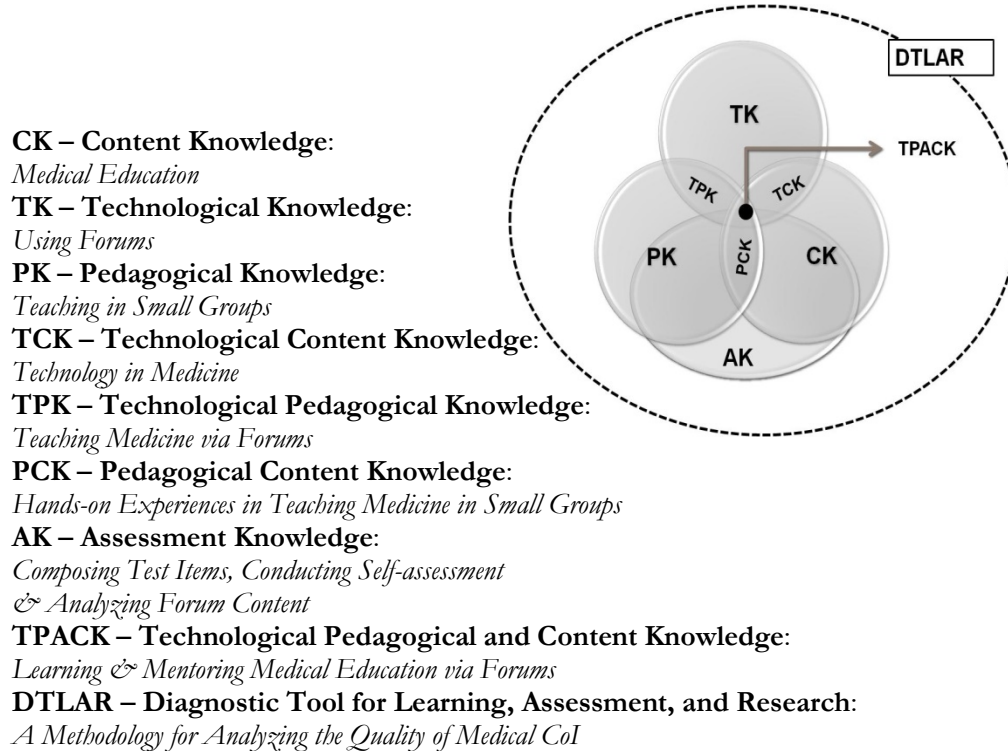


Figure 1: DTLAR incorporating the TPACK and Assessment Knowledge Model

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 to 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; Sanders, 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.

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.

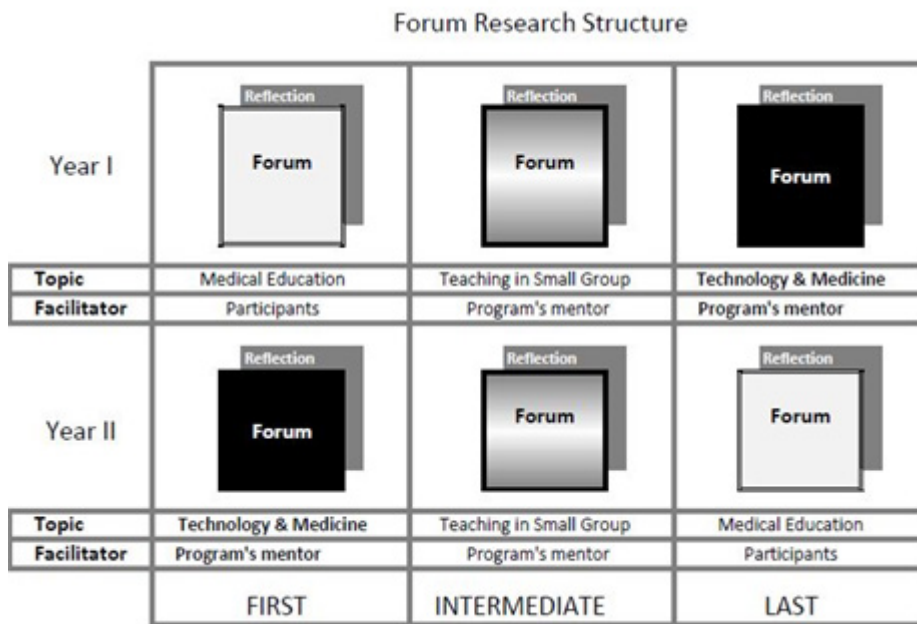


Figure 2: Community of Inquiry (CoI) topics, their sequence, and the type of facilitators in each program year

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 ($N_{\text{participants}} = 34/37$) and 303 statements from the reflections ($N_{\text{participants}} = 31/37$), 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
<i>Cognitive</i>	<i>Positive</i>	"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)
	<i>Negative</i>	"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)
	<i>Ambivalent</i>	"The level of expressed knowledge in the forum on the discussed topic [was different] compared with other topics [that were not discussed online]" (R_IMSF11)
<i>Peer Interaction</i>	<i>Positive</i>	"First I would like to thank you all, I feel I can learn from everyone..." (F_ESF112) "...[The forum helps in] enhancing the interaction and connection between our group" (R_ADFI11)
	<i>Negative</i>	"This is the first time for me to participate in such a forum and it was a failure for me" (R_RAFF11) "Personally I don't like the social networks like FACEBOOK ... (F_MSFF12)
	<i>Ambivalent</i>	"My obligation is to my peers [while talking about posting to forums]" (R_MFL12) "I felt obligated to participate" (R_NLFF11)
<i>Affective</i>	<i>Positive</i>	"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)
	<i>Negative</i>	"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
	<i>Ambivalent</i>	<i>"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 charismatic"(F_AKFL11)</i>
Teacher Awareness	<i>Positive</i>	<i>"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.</i>
	<i>Negative</i>	<i>"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)</i>
	<i>Ambivalent</i>	<i>"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)</i>
Time	<i>Positive</i>	<i>"Flexibility in time and location" (R_ASFL11) "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)</i>
	<i>Negative</i>	<i>"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)</i>
	<i>Ambivalent</i>	<i>"The best lessons need a lot of time..." (F_Z_AFF11) "[It is difficult] to divide my time resources between different activities" (R_IZFF11)</i>

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

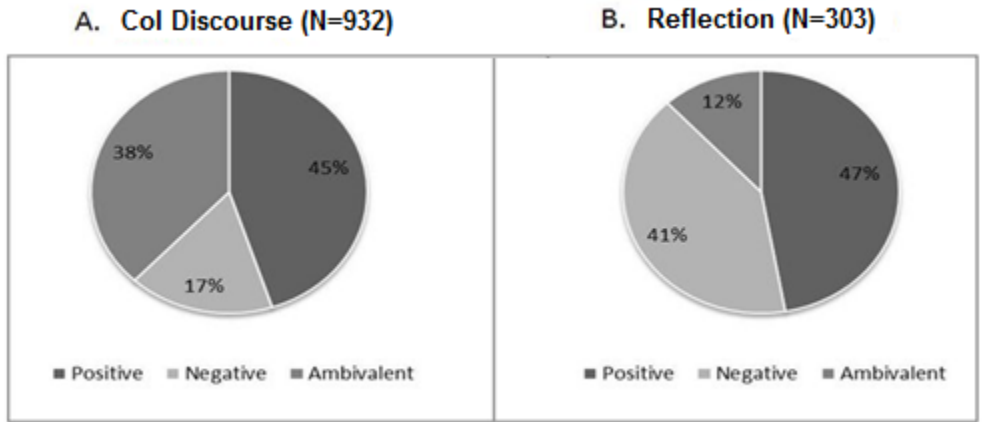


Figure 3: The distribution (%) of attitudes in Community of Inquiry discourse (CoI discourse, panel A) and in reflections (panel B).

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

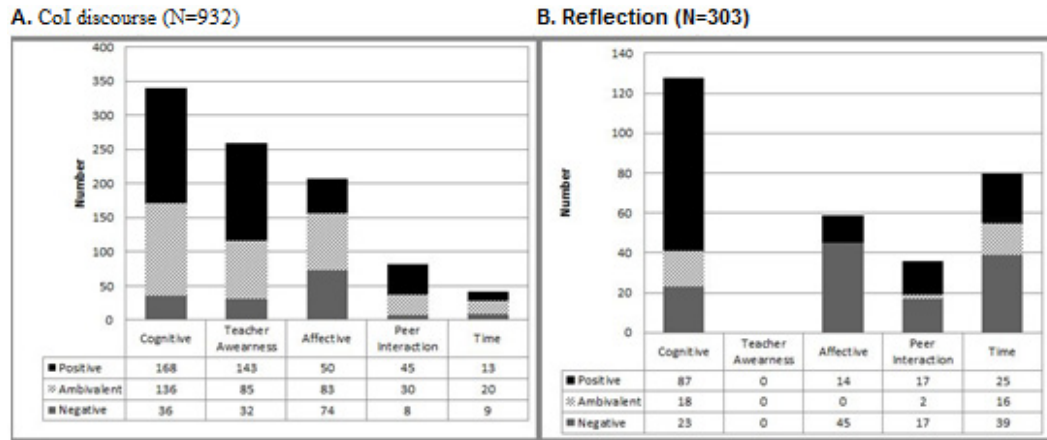


Figure 4: Division of statement types into categories for Community of Inquiry Discourse (CoI discourse, panel A) and reflections (panel B)

‘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.

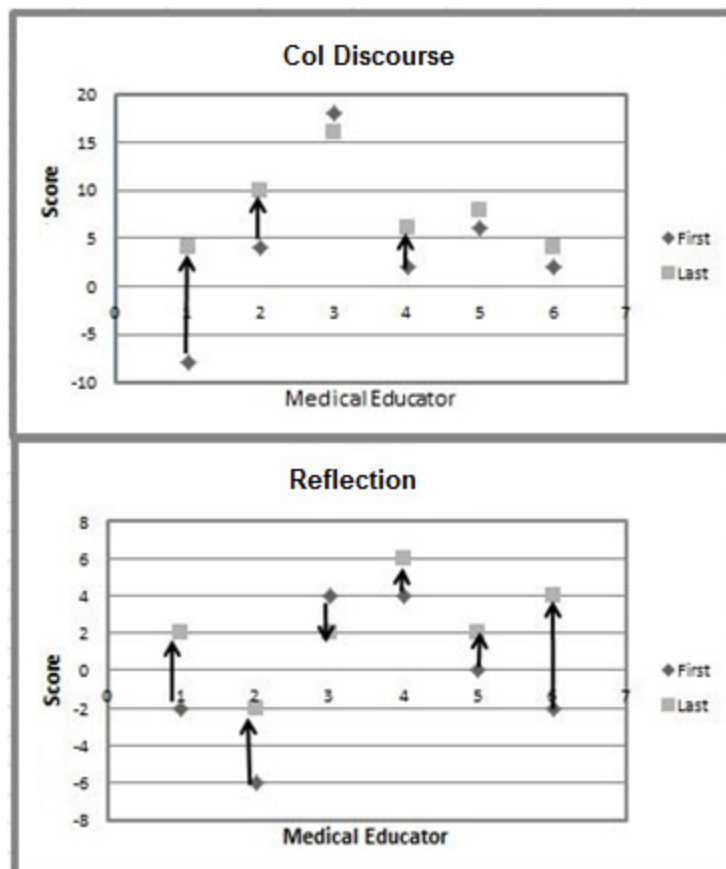


Figure 5: Change in attitude scores of six representative participants

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 adaptation, 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	Professional experience (Years)	Teaching experience (Years)	e-learning 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

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

BIOGRAPHIES



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