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Re-embracing MSL approaches in realities of emergent conditions

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Abstract

In recent years, educational routines have been challenged with emergent conditions related to COVID-19. These challenges impact how teaching, learning, and evaluations are being exercised. This paper describes and suggests an alternative approach to alleviate challenges related to evaluation activities required in programming courses during days of the pandemic. In such cases, emergent conditions restrict evaluation activities, and accordingly, we suggest that an overall experience should be seamlessly conducted across contexts and settings (Hwang & Chang, 2021). Thus, an activity provides lecturers and students with a smooth transition while shifting between the formal course and the evaluation activity. This activity is examined in light of ten dimensions concerning Mobile Seamless Learning (MSL) reflecting education exercised across context and settings. Accordingly, we conducted qualitative research to examine quotations from 23 students addressing the activity. We searched for students' insights concerning MSL dimensions, and their perceived potential to alleviate educational challenges in the realities of emergent conditions. This research indicates the potential of this alternative approach for an evaluation activity capable of coping with challenges experienced by lecturers and students during the time of COVID-19. Occasionally, and due to technical and administrative issues, MSL activities were perceived as challenging to conduct. We present the outcomes of our research efforts, as we hope to encourage lecturers to reconsider and re-embrace MSL activities as part of the practices they exercised during emergent conditions experienced in the days of the pandemic.

Keywords: Higher Education, Alternative Evaluation Method, COVID-19, Mobile Seamless Learning Dimensions

Introduction

Over the past few decades, activities aimed at Mobile Seamless Learning (MSL) have been addressed by researchers and practitioners who were searching for new ways to refine their efforts to offer new types of educational experiences (Safiah et al., 2020). Specifically,



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their efforts have been focused on searching for innovative activities intended to optimize outcomes that could be exercised beyond the traditional boundaries of the classroom (Arnold, 2019; Crompton & Burke, 2018; Lin et al., 2021; Liu et al., 2021). In this sense, technological innovations play a crucial role as they afford effective means to support and encompass educational interactions conducted across contexts and settings (Hamidi & Chavoshi, 2018; Hwang & Chang, 2021; Kohen-Vacs et al., 2019; Oyelere et al., 2018). Activities consisting of interactions conducted in such conditions emphasize the nature of the requirements related to the design, development, and deployment of such activities. The approach, exercised to design the activity, is intended to provide students with a seamless experience as they proceed along their learning paths, and interact across contexts and settings in a manner that enables meaningful outcomes achieved through an innovative and appealing experience (Chung et al., 2019; Curum & Khedo, 2021; Hwang & Chang, 2021; Kearney et al., 2020; Lin et al., 2021; McKenney & Brand-Gruwel, 2018; Plomp, 2013).

The design of MSL activities may include efforts targeted at the deployment of evaluating activities (Conderman et al., 2020; Sharples, 2009). Occasionally, designers of such activities may decide to rely on various theoretical frameworks, such as constructivism, socio-constructivism, and constructionism (McKenney & Reeves, 2018). In this sense, designers should address crucial aspects of educational design, including learning objectives, content structure, and workload planning. Additionally, they should address the exploitation of media content usable along with the learning experiences. No less important is their careful planning of evaluation experiences that are strongly tied to the desired learning outcomes (Lin et al., 2021; Rapanta et al., 2020).

In recent years, schools and universities have been challenged by emergent conditions associated with the novel pandemic known as COVID-19 (Cornock, 2020). In light of this new reality, these institutions were repeatedly impacted by lockdowns, which imposed disruption of their educational practices. In response, these institutions have been pushed to seek new ways to enable the continuation of teaching and learning in a manner that is adapted to the emergent conditions associated with the pandemic (Cornock, 2020; Naciri et al., 2020; Reynolds & Chu 2020). The scope of the impacted activities in these institutions has been varied and may include regular lessons, laboratory sessions, and examinations. Specifically, lecturers have been required to retain and conduct evaluation activities, despite these emergent conditions for examinations.

In many cases, teachers have intended to deploy evaluations as a flow of interactions that form part of MSL activities conductible across contexts and settings (Hwang & Chang, 2021; Liu et al., 2021; Zaidi et al., 2021). Hence, a flow of various kinds of educational activities that are customized and could be continuously exercised beyond the physical and temporal boundaries of the traditional classroom (Wong et al., 2015).

Accordingly, we suggest an alternative approach for an activity intended for evaluation adapted for such conditions. In such one deployed as an MSL activity, conducted with multiple phases, and which is offered as an educational approach that is comprehensive, meaningful, and appealing.

Literature background

Educational design is a general term that refers to the planning process of an educational curriculum, including its learning units (Plomp, 2013). During this process, practitioners exercise their efforts while designing and optimizing learning and interactions. Moreover, they focus on interactions practiced across phases and conductible as a comprehensive and educational activity. In some cases, these activities and their interactions may be exercised seamlessly across contexts and settings (Kohen-Vacs et al., 2019; Looi & Wong, 2013; Milrad et al., 2013; Safiah et al., 2020). These mentioned contexts and settings have been addressed by various researchers, who have described them as dimensions associated with MSL activities (Wong, 2015; Wong & Looi, 2011).

Table 1 illustrates an overview of MSLs addressed by the aforementioned researchers as we focus on our efforts.

As mentioned, MSL activities could be designed to serve evaluation purposes. Accordingly, such activities could be exercised as formative assessments, or summative assessments aimed at evaluation focused on learning outcomes (McKenney & Brand-Gruwel, 2018). In the sense of emergent conditions mentioned in the previous section, the design for such evaluation activity should be deployable across contexts and settings. Thus, this would enable the practice of educational interactions as part of an evaluation activity that is aligned with MSL dimensions (Branson et al., 1975; Budoya et al., 2019; Laurillard et al., 2013; McKenney & Reeves, 2018).

Table 1 MSLs proposed by Wong and Looi (2011)

MSL	Description of MSL
1	Encompassing formal and informal learning
2	Encompassing personalized and social learning
3	Learning across time
4	Learning across locations
5	Ubiquitous access to learning resources
6	Encompassing physical and digital worlds
7	Combined use of multiple types of devices
8	Seamless switching between multiple learning tasks
9	Knowledge synthesis
10	Encompassing multiple pedagogical models

In this paper, we present our research efforts to design, develop, and deploy an evaluation experience, which represents an alternative approach as part of an MSL activity adapted for times of emergent conditions related to COVID-19 (Elman et al., 2020). Therefore, in the following subsection, we elaborate on aspects that need to be addressed in order to deal with the challenge outlined.

Towards deploying evaluation experiences in MSL activities

The design process of educational activities requires that various aspects are addressed: these include learning objectives, tasks deployed to achieve them, and sessions for evaluation purposes (Dillenbourg et al., 2018; Schmitt & Newby, 1986). Additionally, these activities' designs should address physical or virtual modes in which learning is conducted. In many cases, these activities are conducted across contexts and settings in manners that concern MSL dimensions. In such cases, lecturers are challenged while aiming to design and offer evaluation activities that are conducted beyond the traditional boundaries of the classroom (Liu et al., 2021). In this sense, such intentions may be motivated by lecturers' concerns about their students' ethical behavior while being evaluated remotely. Specifically, we address challenges concerning dishonest behaviors conducted by students during remote exams intended to be conducted in as a traditional test mediated by Zoom (or like) tool (Amzalag et al., 2021). As implied, evaluation activities exercised in complex circumstances emphasize significant challenges that could lead to frustration among teachers and students. In these cases, designers of such activities are required to reconsider the approach for conducting the evaluation and must convert it into an alternative experience that could be offered in an alternative model.

As a part of our efforts, we conceptualized and designed an evaluation activity suitably adapted to the circumstances experienced in the time of COVID-19. Thus, an educational experience is deployable in conditions when social restrictions have been imposed on educational institutions. In this way, we suggest an alternative approach for evaluation offered as part of an MSL activity, which is practicable across contexts and settings (Wong, 2015; Wong & Looi, 2011). Thus, one such is suggested as an approach capable of alleviating challenges related to emergent conditions as experienced during the time of the COVID-19 pandemic.

In light of the above review, two main questions guided our research:

- 1) How did students perceive the evaluation experience as an MSL activity?
- 2) What are the perceived benefits of the evaluation experience conducted as an MSL activity?

Methodology

In conducting our research, we used a qualitative approach. We employed this method to support our efforts to understand educational activities that are considered complex and which are practiced in flexible contexts and settings. Furthermore, we did so because we were attempting to contribute to practices and theories related to these respects (Kennedy-Clark, 2013). The qualitative approach is utilized as we considered it to be a possible means enabling us to examine, analyze, revise, and improve the educational approach we describe and propose in this paper (Creswell, 2013; Dunning et al., 2008; Patton, 2015). We propose this activity as an innovative and unique approach for evaluation that we designed in light of the emergent conditions and restrictions experienced in times of the pandemic that have impacted (and continue to impact) educational processes practiced in higher education. We used this evaluation approach in courses focusing on basic skills in programming (Programming, i.e., Introduction to programming) as well as server-side programming (Programming-1, offered as the second level). In this sense, we emphasize that the mentioned courses were selected as one of the researchers teaches these courses. He implemented this evaluation approach in response to the emergent conditions he tackled in days of the COVID-19 pandemic.

Participants

Interviews were conducted with 18 students, from which 13 female students took the course Introduction to Programming. Additionally, four female students took the course on Programming-1, in addition to a single male.

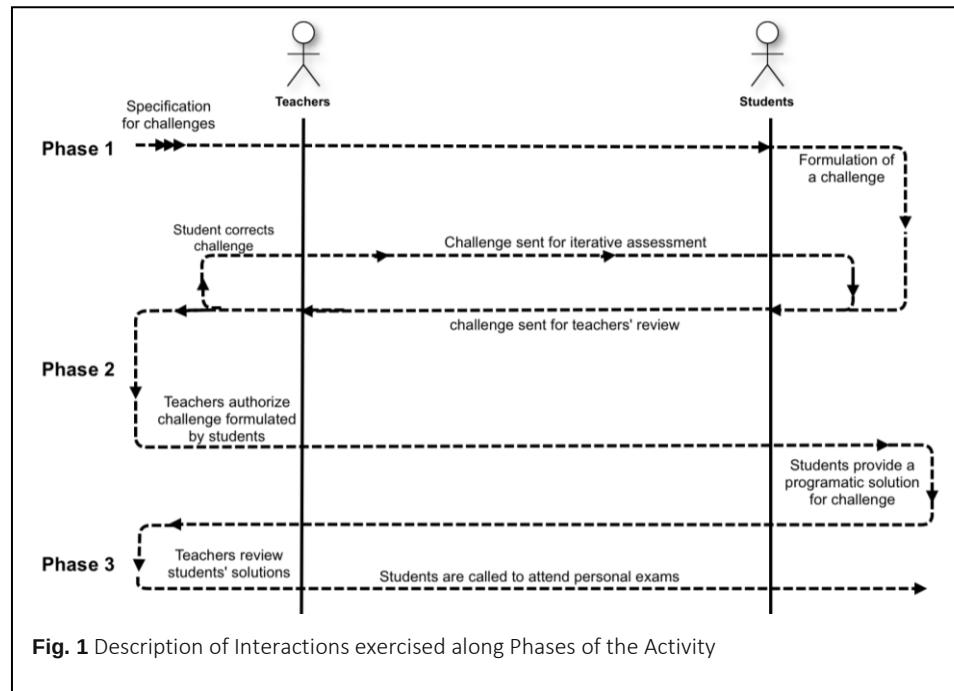
Alternative evaluation

This section presents the process of forming our suggestions for the evaluation activity. In Figure 1, we describe the interactions that teachers and students engaged in across phases of this activity.

In the first phase, the student attended an online meeting conducted with Zoom. There, they received a set of instructions explaining the procedure for the overall evaluation. Specifically, they were instructed to formulate a challenge that they would solve programmatically. They were encouraged to develop a challenging story on a theme chosen from a realistic setting.

In the second phase, students solved their challenge with verification from the teacher. In this phase, the lecturer and students verified that the challenge was aligned with the requirements of the course.

Students submitted their solutions to the MSL in the third phase and then had a 5–10 minute meeting with the teacher in which they argued and defended their solutions. Our



design of the structure of the activity relied on various educational aspects related to constructivism, which were also addressed to MSL dimensions.

Research tool

Interviewees were required to comment on aspects related to their feelings regarding the method of evaluation employed in the course. Interviewees commented on the theme they selected for their self-formulated challenge. Additionally, they were required to address other matters, including the preparatory phases offered before the evaluation. The researchers analyzed the data gained from interviews separately in order to assure the qualitative data's reliability.

Procedures

The introductory course was conducted in the summer of 2020, and the other course, Programming-1, was taught in the spring semester of the same year. Thus, the two courses were attended by different groups of students. These courses were offered as part of the curriculum in a public college located in the central district of Israel. In both of the courses, we used the same type of evaluation pattern, the aims of which were described in the previous section.

Students were required to answer a questionnaire that was shared with them via Google Forms. They were presented with a series of questions addressing various variables related to the evaluation experience and the learning outcomes. The second researcher interviewed

23 students who had volunteered to participate. All interviews were recorded and transcribed by the interviewer. The average duration of the interviews was half an hour.

Ethics

This research was authorized by the Committee for Ethics in the same institution with which the researchers are affiliated. The authorization was given following the grading and publishing of marks on the courses mentioned. The second researcher did not teach any of the courses, and therefore she conducted the interviews. Students offered to volunteer and participate in the transcribed interviews which were anonymized in the analysis phase.

Results

RQ1-Phase 1: Introduction of the preparatory phase

Students shared with us the learning approaches they exercised as part of their preparation for the evaluation activity at the end of the semester. They mentioned that affordance allowed them to select the theme of the use case presented in the evaluation activity. In other words, students were allowed to pick topics from their personal interests and combine them into the use case focused during the evaluation. Thus, they emphasized the challenge they were required to formulate for their evaluation. This challenge was developed to align with their interests or attitude. As implied, this challenge was self-formulated as a task that later needed to be solved programmatically. Students were required to send this task to their lecturers to be examined, so they could verify the relevance of the self-formulated task to the content and level required in the course. The following quotations reflect this process:

I liked the latitude to select a challenge related to a topic I sympathize with. Specifically, I like pets and selected a use case associated with a veterinary clinic (M2).

I am very aware of the details around the case I selected for my challenge, and this helps me a lot while intending to solve it. I think that knowing how to ask a question is way more meaningful in light of my ability to analyze the aspects of the challenge. In this sense, I [was better able to] understand how to break the challenge into small tasks (Sh2).

I was aware of my responsibility to formulate the question. As a consequence of that situation, I created my preparatory content to be ready to the maximum. I can tell that this form of examination is the most educational and practical I [have] ever experienced (Y2).

I reviewed all the exercises provided during the formal lessons of the course. Therefore, I started to create new tasks by composing mixed activities during the course. At some point, I managed to develop an exercise addressing all the content studied during the course, and I happily discovered that I was capable of solving it. I found that I felt utterly ready while practicing my preparation for the evaluation activity, way more prepared compared to [how I felt for] other and traditional exams (Y2).

I studied to understand and not to remember. I felt that I must thoroughly understand the materials we learned during the course (L2).

These quotations reflect informal learning that was exercised in addition to the formal learning contained in traditional courses (MSL-1). Students shared the fact that they practiced their own preparation in a manner personally adapted to their own and preferred style of learning (MSL-2). This informal learning was achieved as students used official learning materials provided in the course resources which were accessible to all of them (MSL-5). As the learning process for the evaluation activity was informal, students were provided with latitude to use learning content across time and locations (MSL-3, 4). Additionally, students could use learning content offered by the lecturer on the course site accessible in the Learning Management System (LMS) (MSL-7). Last but not least, students practiced the construction of new knowledge as they synthesized new learning content emerging from across the topics of the course (MSL-9).

RQ1-Phase 2

Students solved their self-formulated challenges following verification with teachers and addressed their efforts to their level and content as aligned with the prerequisites of the course:

I remember more details of the overall experience while comparing it to other tests. During the oral part (defense), I was required to describe in detail my solution, and therefore I [can] recall and know how to pinpoint my mistakes. For me, this represents much more meaningful learning (A).

I felt that the solution I created for my challenge encouraged me to be creative, implement things I did not plan, and dare to develop new things I did not formally learn. I can tell that I continued to learn new things even during the test (L).

During the exam, I learned a lot! I used the presentations offered during the formal lessons. I also used web resources to provide code examples. Eventually, I felt that I concluded this type of exam with much more

knowledge compared to my situation before I took it. This exam provided me with an excellent opportunity to complete a project from scratch (G).

These quotations emphasize that the solution implemented by interviewees for their own self-formulated challenges consisted of various types of scaffolding materials (MSL-5, 6). In addition, they mentioned that the exam provided them with another opportunity to learn during the evaluation experience (MSL-3, 4). They said that before and during the exam, they refined their understanding of the learning content, and synthesized new knowledge based on the content acquired during the formal course (MSL-9). As the interviewees self-formulated the challenge they had to cope with, we consider this process a personalized experience (MSL-2).

RQ1-Phase 3: Formative assessment, defense, and summative assessment

Mandatory meetings between the teachers and students were conducted in order to refine and verify the challenge according to the requirements of the courses. The following quotations reflect insights addressing contributory aspects associated with this refinement:

For me, the experience was a “blast” (in a positive way). Teachers read our suggestions for questions and allowed us to meet with them as necessary, which helped with the correction process of the formulated question (H). Teachers gave me a lot of space for constructive conversation; they listened, helped, and made me feel calmer. They provided the sensation that I was formulating something practical and relevant. There is a lot of added value when somebody suggests the right direction during this process (N).

In the following quotations, the interviewees discussed the evaluation provided by the teachers while they addressed the proposed solution for challenges developed by the interviewees.

Teachers provided comments during the meetings conducted during the evaluation activity (N.).

The feedback was good and included my code representing the solution (K.).

The quotations mentioned reflect that the various and perceived proceedings experienced by interviewees reflect most of the items in the list of MSLs introduced in a previous section. We could not find quotations reflecting interviewees' perceptions of students addressing MSL-10 that concerned the use of various pedagogical approaches. This could be explained by the fact that the students at these levels lack the necessary knowledge of

pedagogical methods. However, as mentioned in the section addressing the methodological approaches, the design of this proposed approach for evaluation consisted of the exploitation of knowledge and practices of various theoretical frameworks in the pedagogical field.

These quotes conclusively suggest that students essentially found this activity to be an educational, enriching, and engaging experience.

RQ2

This section addresses the second RQ, as we rely on the comments and conclusion in addressing the first one. As mentioned, the entire list of MSLs manages a seamless transition between contexts and settings incorporated in interactions experienced along with the phases of the evaluation activity. In this respect, we addressed the evaluations experienced along with this activity as an integral part of the learning process we intentionally conceptualized and introduced into the activity. As indicated in the answer for the previous RQ, the interviewees perceived this concept as they mentioned that they could learn significant new things during the evaluation activity. Furthermore, they implied that this evaluation felt like an integral part of the course (compared to what they would feel in a traditional exam). The interviewees mentioned the following in this respect:

I felt more relieved from the pressure I usually feel in regular exams. This felt more like a common homework task with grading. Furthermore, I think that this experience reasonably concluded the learning process experienced during the course (Sh).

I felt that this evaluation activity aligned with the course's continuation. This perception follows the affordance I was provided to formulate my own challenge and solve it entirely with the tools I acquired during the course. Accordingly, this test felt entirely like a continuation of the course (A).

I felt that the level and content in the exam were aligned with the regular tasks provided along the course. However, I thought it required a higher level of mastery (R).

The interviewees presented various insights addressing aspects concerning MSLs. The interviews were carried out with them following their participation in the evaluation activity. Their ability to cope with their challenge contributed to their sense of efficacy in the domain that the activity was aimed at. Interviewees perceived their self-efficacy during the evaluation activity:

This experience helped me a lot to develop self-confidence while coding my programs. I think that this change is prominent in light of feelings for coding I experienced during a previous programming course (Y).

The exam rang an inner bell saying: you can do it! ... By yourself and without any aid materials and in limited time (P).

The exam felt like any other assignment of the course ... but this one came with grading. Now, I'm supposed to solve the assignment by myself and implement the knowledge I acquired during the course. I felt that the challenge was practical and related to some real-life scenarios. It was not something vague like in other tests. I felt that I knew the learning material and was capable of coping with this challenge. This experience summarized the semester well (Sh).

These quotations reflect an overall positive impression resulting from the evaluation activity. Here, the participants have indicated their increased self-efficacy, as sensed by the interviewees. Furthermore, interviewees recognize the association between their self-formulated challenge and their realistic settings.

Additionally, self-efficacy was also perceived in the following manners:

I felt that this experience was exceptional as I did not study and memorize the content ad hoc for the exam. I really felt that I would remember the content following the exam. This is particularly different from other examinations I [have] experienced in my life. There was something special in this exam because it felt much more meaningful in terms of the educational experience. It was much more than memorizing the content [as is the case in other exams] ... I really enjoyed the exam: I remember my little sister sitting with me during my preparations, and she was surprised by how much I enjoyed this experience. It gave me the sense that teachers are really interested in my knowledge acquisition and [do] not [want] to fail me. Furthermore, I even took the questions my classmates formulated and solved them just for fun (Sh).

I had an excellent exam; I liked it, and I felt comfortable with it ... I felt relieved! Especially when I recall the previous programming course and its exam (B).

These quotes imply the positive attitudes expressed by interviewees.

This unique approach to evaluation provided opportunities to acquire skills required for adulthood and the twenty-first-century world of labor. These aspects include a flexible way of thinking, as well as lifelong learning, as discussed in the following excerpts:

Practical programming in real life would probably work similarly compared to what was experienced during the test. Thus, I experienced a real-life situation while using open content available to me anywhere and anytime. Additionally, I guess I'll encounter realistic challenges requiring me to use trial and error in the same way that was possible during the exam while using the development environment for coding (I).

Formulating my own questions or challenges is helpful, and this is something I take with me from this test experience. I think that this educational approach is applicable across subject matter as I practiced the same in a course on psychology as well as in another course on research methods. This experience encouraged me to ask myself questions enabling me to develop additional thinking skills (L).

These sentences reflect practices and skills acquired by students as a result of experiencing such a unique and adapted evaluation approach. These quotes imply the exploitation of such practices and skills in other contexts beyond the scope of the course. Interviewees spoke of the self-confidence they were able to acquire during this process. They mentioned that all this might contribute to their coping capabilities with realistic challenges relevant to the labor world. These insights indicate that such a unique approach to examination aligns with the relevant skills required as part of the toolbox of capacities expected from students graduating from higher education in the twenty-first century (Zhang et al., 2021).

Summary and future efforts

During the recent two years, numerous new situations were tackled by educational organizations that challenged their daily practices. In this way, challenges have emerged during the time of the pandemic, bringing teaching and learning practices into new educational contexts and settings. Accordingly, educational practitioners have been required to conceptualize new evaluation approaches adapted to learning in the light of these new contexts and settings. In some cases, this conceptualization has needed practitioners to adapt existing evaluation concepts to these new conditions. Occasionally, practitioners seek ideas for their evaluation approaches while relying on existing experiences adjusted for these unique circumstances.

In many cases, these efforts are motivated by educational practices focused on converting traditional exams into alternative, meaningful, and appealing approaches for evaluation that can be conducted across contexts and settings. One of the primary motivations for these prominent efforts emerged from teachers challenged by students being academically dishonest during tests conducted on Zoom (Amzalag et al., 2021). Thus, our evaluation approach deployed as a comprehensive and multiphase activity reflects MSL dimensions (Wong, 2015; Wong & Looi, 2011). Specifically, we address a possible experience including preparation for an evaluation as well as the evaluation itself. Moreover, we address such a process that consists of various forms of interactions including considered both informal and formal forms of learning (MSL-1). Interactions that students exercise as part of social and individual forms of preparations towards the evaluations and individually during the evaluation itself (MSL-2). Additionally, interactions are conductible across locations (MSL-3), and time (MSL-4) in which students rely on resources located ubiquitously (MSL-5). We address interactions that could be exercised both from the physical and digital worlds (MSL-6) while using various types of devices (MSL-7). Last but not least, such interactions address various types of educational tasks conducted as part of multiple pedagogical models encouraging students to perform synthesis of knowledge (MSL-8,9,10). As illustrated, the preparation for the evaluation as well as the evaluation itself, represent an authentic requirement emerging from realistic settings that correspond to various aspects as reflected in mentioned MSL dimensions.

We emphasize the structure of the action requiring, and in other cases allowing, students to interact in various modes adapted to the context and settings of the experience. The comprehensive design of the activity requiring students to interact across contexts and settings emphasized the challenge typically found in this type of activity. As in many other cases concerning the learning process practiced ubiquitously, we, as designers of the activity, considered and introduced approaches for enabling a seamless transition of students between the contexts and setting they interacted (Wong, 2015; Wong & Looi, 2011). In our current research efforts, we aim to design this to alleviate challenges related to the time of COVID-19.

In the previous section, we proposed numerous insights addressing the three phases of the evaluation experienced by students. Furthermore, students were about to identify the majority of the MSLs. In this sense, they failed to identify MSL-10 addressing the possible exploitation of various pedagogical approaches. We anticipated this situation, as the lecturer of the course does not reflect with the students on the pedagogical models they rely on during their practice during the course. Therefore, we acknowledge that all the MSL dimensions are manifested in the various interactions exerted, along with the phases of the evaluation activity.

As mentioned in the previous section specifying students' quotes, they successfully identified numerous aspects concerning the MSL dimensions. Moreover, they perceived educational benefits associated with the design of the activity enhanced by the MSLs. Students mentioned their enhanced sense of self-efficacy during and following the activity. In this sense, we emphasize the point that self-efficacy is considered a prominent aspect of educational processes (Aldholay et al., 2018; Chang et al., 2022; Hong et al., 2016; Prior et al., 2016; Zhang et al., 2021).

Prior et al. (2016) claimed that self-efficacy is an individual characteristic that plays a significant role in the use of technology. Furthermore, it is defined as the extent to which a student believes in their ability to successfully learn from an online course of study (Shen et al., 2013). Various scholars have concluded that there are significant positive relationships between self-efficacy and satisfaction (Chang et al., 2022; Hong et al., 2016; Zhang et al., 2021). Students also addressed the learning process they experienced as meaningful. Thus, a comprehensive activity is experienced as impactful, relevant, and appealing (Jackson, 2002; Lillyman & Bennett, 2014; McGarvey et al., 2015; Zhang et al., 2021).

Research limitations and continued efforts

This research was conducted in a college located in the central district of Israel and focused on two programming courses provided by the same faculty, and by the same teachers. Accordingly, this research should be examined in light of the institution's culture prominently influencing the nature of its course activities. Additionally, we acknowledge that other effects may occur from the content matter itself. Accordingly, we propose extending this research to different institutions (of higher education) and other subject domains. Furthermore, such an approach would enable the examination of a more significant number of subjects sampled for such research that is focused on alternative evaluation methods, both for regular times and emergent conditions.

We assume that educational organizations may find themselves once again experiencing emergent conditions for the same or different reasons in the future. In this respect, we propose our alternative evaluation approach as an adaptable pattern of activity that offers teachers and learners a meaningful framework for examination that could be implemented in unexpected circumstances. Therefore, in our next efforts, we will explore the applicability of the approach presented for evaluation in other subject areas. Thus, applicability requires learners to deal with learning materials significantly different from what was presented in the programming courses. In this case, we will examine the nature of adaptations that must be made in order to offer a meaningful evaluation approach. We intend to keep practicing, exploring, and refining this approach for evaluation as part of

our efforts to offer optimized ways to cope with unexpected circumstances, such as those experienced by educational organizations during the COVID-19 pandemic.

Abbreviation

MSL: Mobile Seamless Learning; LMS: Learning Management System.

Authors' contributions

Both authors contributed to this manuscript equally.

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Availability of data and materials

Not applicable.

Declarations

Competing interests

The authors declare that they have no competing interests.

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