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Alternative Approach for Evaluation Adapted for Times of Emergent Conditions

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Abstract: In this paper, we propose a unique approach for an alternative evaluation, designed, deployed, and optimized for times of crises such as those experienced during the eruption of the COVID-19 pandemic. In our approach, we rely on technological tools for supporting interactions conducted among lecturers and students. We suggest this evaluation activity incorporated with four phases that are interrelated. Thus, technologically supported interactions from an early phase are used in a later phase. This is done in a manner emphasizing the interdependency and chronological order of the phases practiced along with the evaluation. Our design efforts were exercised as we considered and aligned it to four meta-principles suggested by other researchers and widely adopted by researchers educators from around the world. Here we demonstrate the conduction of our research efforts as we deploy the evaluation approach in programming courses corresponding to a bachelor level. Our exploration efforts were exercised as we relied on qualitative methods used for analyzing quotes mentioned by 18 students attending semi-structured interviews. The findings of this research indicate that students perceive this evaluation activity as effective. Specifically, these students mentioned that this approach encouraged their capabilities to be autonomous in their learning process. Additionally, it fostered their creativity and emphasized their perception of the importance of a lifelong learning approach. Based on the mentioned principles and meta-principles we addressed in this paper, we suggest the existence of a new level of meta-principles consolidating the four ones focused on our efforts. There we address the current leaner expected to become a future citizen in a dynamic, flexible and technological society possibly encountering other challenges beyond the ones tackled in times of COVID-19. Accordingly, our suggestion for an alternative approach for evaluation is proposed as an educational pattern usable for the time of future normality as well as a way to cope with educational challenges in moments of future crises.

Keywords: Alternative evaluation approach, programming courses, higher education, meta-principles, COVID-19, emergent conditions

1. Introduction

In recent decades, organizations practicing education are increasingly impacted by changes resulting from various and possible factors, including social aspects, economic-related shifts, and other emergent crises potentially influencing their professionals and students. In such conditions, they must address such situations by adapting their efforts in manners capable of coping with such challenges(Chaturvedi et al., 2021; Fontdevila et al., 2021; Levchenko et al., 2017). To cope with crises consisting of dynamic conditions, educational organizations may select to employ innovative approaches exercised as part of flexible and innovative thinking. Moreover, in many cases, they do so while still relying on professional principles adopted and adapted to the context of emergent challenges (Dhawan 2020; Marouli, 2021). In this respect, kali and other searchers established a growing Design Principles Database (DPD) containing tools offered to educational practitioners and researchers as a set of convenient means for authoring their educational (Kali, 2006; Kidron & Kali, 2017). There, they suggest principles usable as design tools representing also exploitable as compass assisting lectures in their practices (Sagy et al.,

2018). This database includes principles relying on various theoretical frameworks such as constructivism, socio-constructivism, constructionism (McKenney & Reeves, 2018).

The DPD also includes high and comprehensive principles addressed as meta-principles. For example, one meta-principle addresses (a) making student's thinking visible. This meta-principle offers benefits for group-learning considering to practice efforts encompassed by documentation of the educational process. This meta-principle could be beneficial both for individual or group-work aspiring to reflect their educational process and outcomes beyond the boundaries of the classroom (Richardson et al., 2018). Another meta-principle addresses the (b) making of science accessible reflects repositioning the lecturer's role as the main source of knowledge. Thus, converting traditional teaching style to a more coaching type of education, fostering fruitful discussions enabling and students with better outcomes resulted from their individuals or group-work (Kizilaslan et al., 2019). In addition and in light of group work, the mentioned meta-principles, also emphasized collaborative learning in the sense of (c) helping students to learn from each other (Gillies & R.M., 2019). This meta-principle reflects the fostering dissemination of knowledge among peers involved in a collaborative learning process, potentially benefitting individual students as well as groups. Last but not least, we present another meta-principle addressing the (d) promotion of autonomous learning. This meta-principle reflects students encouraged to take best decisions and eventually capable to become self-reliant that may keep exercising their efforts also outside of the framework of the official classroom (Andriani et al., 2018). As implied, there is a growing community of researchers seeking to propose additional principles possible exploited and explored by educational stakeholders searching for additional means and approaches to design innovative, meaningful, relevant, and appealing activities representing state-of-the-art education (Kali et al., 2020; Linn et al., 2018). Moreover, such intends to refine and excel design practices of educational activities are demanded as a result of ongoing shifts in communities concerning various changes it may gradually experience. Additionally, such acknowledgment of principles may become crucial in cases of communities tackled by emergent conditions, suddenly demanded to make instant adaptations in their learning practices as a result of crises it is experiencing.

For the past year, educational institutions located worldwide, are facing the consequences of such a crisis known as COVID-19 (Elman et al, 2020). This pandemic is influencing various aspects of educational routines lecturers and students used to exercise on daily basis. Many of these consequences are emphasized in form of social isolation imposed and still impacting many schools and universities. In some extreme cases, schools shifted their mode of operation to remote learning. Accordingly and as part of intensions of education institutions struggling to cope and overcome educational challenges related to social isolation, they exploited their existing Learning Management Systems (LMS). Occasionally, these type of systems is used along with other tools such as google classroom or zoom enabling the transition of the traditional and synchronous classroom to the mentioned and emergent conditions (Cornock, 2020; Reynolds & Chu, 2020). In this respect, many of these educational organizations quickly discovered that technical transition should address design requirements concerning educational experiences adapted for such challenging times (König et al., 2020). This requirement for adaptation also concerns activities focusing on evaluation experiences practiced as part of comprehensive and educational activities challenges (Karalis, 2020).Accordingly and in this respects, in this paper, we present our suggestion for an alternative evaluation approach adapted for the mentioned circumstances. Specifically, an alternative approach for assessing students taking programming courses in bachelor level attending in higher education in times of social isolation imposing remote-learning. In this respect, we emphasize that we initiated our efforts as traditional exams were not possible to conduct (in many places still not possible).

Here, we present our efforts, to design, deploy and explore our evaluation approach encompassed by technological support. Specifically, we deploy a multiphase activity requiring lecturers and students to use technology for participating in a workshop practiced for evaluation purposes. As implied, we design this activity while seeking to foster well-known values and principles serving as a compass to orient practitioners' efforts to offer an activity representing state-of-the-art practice. We emphasize that this activity should be exercised while practicing innovative and flexible thinking. We deploy this activity as part of our aspiring suggest an evaluation activity that is technologically supported capable to offer a convenient way to cope with requirements for an evaluation in educational settings in light of emergent conditions such as those imposed on lecturers and students in times of COVID-19.

2. Research Aim and Research Question

In this research effort, we focus on two main aims. The 1st one deals with the examination of our deployment efforts. Thus, examining the adoption of previous practices implemented in traditional evaluations, adopted and consolidated into a unique evaluation approach optimized for coping with emergent challenges tackled in times of COVID-19. In this aim, we focus our observation on how the proceeding of this evaluation as a multiphase activity works in the realistic settings of the classroom conducted in those challenging moments. Additionally and in a further research aim, we examine the alignment of our evaluation approach to meta-principles mentioned in the previous section. As implied, one of the meta-principles required some adjustment in order to adapt it to the setting for which we suggest our evaluation activity (programming courses). In this respect, we examine the evaluation in light of the mentioned meta principles as we suggest an adjustment of the 2nd one, reformulating it to the repositioning of the lecturer's role in light of the programming courses aspired to made the corresponded content knowledge visible.

We postulate these research aims as we have in mind that along with our current efforts, we might discover additional and new principles also aligned to the proceeding of the practiced activity. Accordingly, we suggest the following research question:
How and to what extend the four meta-principles (as described in the introduction), manifest themselves along with the proceeding of the evaluation activity deployed in times of COVID-19?

3. Methodological Approach

In this research effort, we practiced a qualitative approach as we conducted Zoom interviews with students participating in the mentioned evaluation. The average duration of the interviews was half an hour. Interviewees were asked about their feeling concerning the affordance to select their own challenge and theme for their evaluation. In addition and during the interviewees, we examined their positions concerning the contribution of the formative learning and feedback that experience during the learning process. They were also required to address the benefits and challenges concerning the alternative evaluation method. Last but not least and as normally practiced in such interviews, we left some time allowing interviewees to bring additional comments addressing the evaluation that they consider interesting.

We then conducted a content analysis based on work exercised by researchers, each separately ascribing the transcripts of interviews according to topics and themes. Next, researchers compared the outcomes of their work. Since that compared aspects resulted in unsatisfactory similarities in terms of corresponded topics and themes, researchers discussed, clarified, and agreed on each of the quotations as they corresponded to an agreed category. Researchers proceed to data analysis only after achieving 80% compatibility of their categorization efforts. This research was conducted as part of two semestrial courses: Introduction to Programing, during the summer semester of 2020 (first-year students), and Programming-1 during spring semester 2020 (second-year students).

3.1 Evaluation Design

In this section, we present the structure of the evaluation activity including its four phases, along with the technologies we exploit to support each of them. The evaluation activity consisted of several phases which are interdependent on each other. All of the phases require lecturers and students to use technologies for various purposes including the Zoom tool exploited for conduction of synchronous meetings and Moodle LMS used for accessing the content in form of instructions needed for the evaluation and course content permitted to be used during the evaluation. Last but not least, occasionally, students could use Google Docs in order to share the editable documents (in real-time) as they formulate their own challenge corresponding to a theme from their realistic settings. In Figure 1, we demonstrate the evaluation activity, its flow of phases, and the technology used for supporting communication in each and across them.

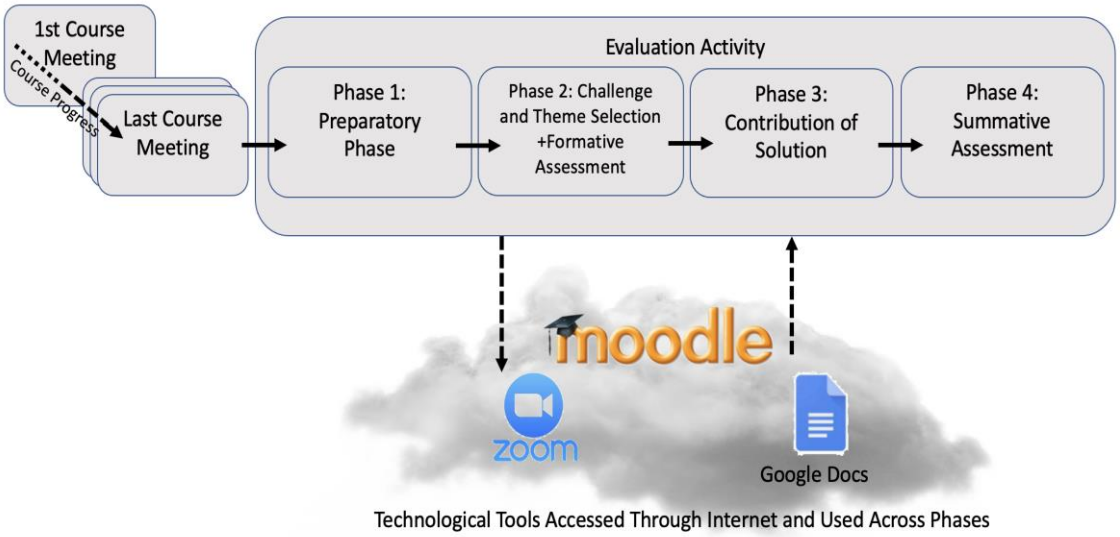

Figure 1. Illustration of Activity including its Interactive Phases which are Technologically Supported.

The figure above describes the activity spanning along with four phases of interactions practiced between lectures and students. In the 1st phase, students are being prepared for this activity. This phase is used in order to serve as a means for making steps between the course meetings and the evaluation activity more seamless. We do so as we consider this evaluation as a comprehensive part of the evaluation activity conducted following the course. Accordingly, we would like to communicate with students with this notion, making them feel that this is another step along the programming course and not a test that occasionally is perceived as a differential from the course. In this phase, we used Zoom for conducting online meetings. We also used Moodle LMS for accessing instructions for the evaluation as well as learning materials from the course.

In the next phase, students were instructed to formulate their own challenges they selected for evaluation. In this respect, they were instructed to formulate a question and were given the option to suggest a challenge reflecting a theme (topic or situation) from their realistic settings. We provided such affordance as we considered these aspects with potentials for enhancing students' engagement to the process exercised along with the evaluation. Later and in the same phase, lecturers and students meet on 1:1 synchronous meeting. This meeting was conducted in order to verify and adjust the challenge in an agreed way verifying students' suggestions includes meaningful content properly addressing the content learned during the course. Additionally, this was conducted in order to ensure that students' formulation of their own challenges are meaningful in light of the aims of the evaluation. In this phase, we used technologies including Zoom for conducting online meetings. We also used Moodle LMS for accessing instructions for the evaluation as well as learning materials from the course. Occasionally in this phase, we offered students to use Google Forms enabling common editing of a document usable for collaboratively formulation of students' challenge. Thus, for ensuring in a synchronous meeting between the lecturer and the student that challenge is appropriate for the aims of the evaluation.

The 3rd phase includes students' solutions of their own and adjusted challenges. Here they could summit lecturers to zoom meetings for asking different questions concerning clarification of the instructions of the evaluation (in the same way that is done in a traditional test). For this phase, we used Moodle LMS for accessing instructions for the evaluation as well as learning materials from the course.

The 4th and last phase is conducted following the submission of the authored challenge and solution as a PDF and code file submitted to a Moodle LMS. Then, the student attends a short (5 to 10 minutes) defense session in which he is being asked about different aspects of his own solution. In this sense, students are evaluated on the solution and not on the question he/she authored. In this phase, we mainly used Zoom for conducting the synchronous meeting.

3.2 Participants

The Interviews were conducted with 18 students attending bachelor degree in the domain of social sciences: 13 female and 5 male who took the course on Introduction to Programing, and 4 female and

one male who attended the programming 1 course. All the mentioned students voluntarily agreed to participate in semi-structured interviews focused on their experiences prior, during, and following they took the evaluation activity.

3.3 Ethical Considerations

In respect to ethical considerations, we emphasize that an authorization to conduct this research was approved from the comity for ethical affairs of the institution to which the researchers are affiliated. As part of this authorization and since one of the researchers was the lecturer in the mentioned courses, the authority instructed the researchers to exercise these efforts while emphasizing that the 2nd researcher will conduct the semi-structured interviews. Interviewees were told that they are allowed and for whatever reason to stop their participation in the interview (without jeopardizing them in any way). The researcher that conducted the interviews was responsible for making anonymized transcriptions. Thus, the 1st researcher was not able to correspond a comment with a specific student taking the interview. Interviews were conducted only following grade publishing in the courses. Conclusively, the research was authorized under the mentioned conditions and researchers accepted the conditions and conducted their efforts accordingly.

4. Findings

As mentioned and in the methodological section, we exercise our research efforts as we qualitatively analyze, data collected during semi-structured interviews. In this section, we bring a sample of collected data reflecting transcriptions of interviews conducted with 18 students taking both programming courses. The quotations brought in this section are presented according to the four phases of the evaluation and in correspondence of a meta-principle, they reflect.

4.1 Phase 1: Preparatory Phase

In this part, we address the preparatory phase referring all to the sessions prior to the evaluation experience. Student O. commented in respect to the meta-principle focussed on helping students to learn from each other and mentioned that: *"lecturers prepared us very well and provided us with a precipice explanation concerning the phases to be conducted along with the evaluation. I was not surprised and this is really great…Additionally, lecturers provided us with a stimulatory session to the assessment prior to the real experience.*

As for the meta-principle concerning the promotion of autonomous learning as well as another one concerning the repositions of the lecturer's role, student I2 told that:" *As the lessons in this course concluded, I was encouraged to gather and revisit all learning material and assignments. I even formulated various versions and combinations of new exercises based on the assignment given during the course. It made me feel totally responsible to my learning process*". In addition, student Y2 told that: "*We concluded the lessons of the course, and I was encouraged to review the materials we studied along the course. I even formulated self exercises mixing and combining different topics we covered in the Couse. It provided me the opportunity to experience formulation of my own challenges oriented to cover all materials we ever learned in the course. Just from these rehearsals, I completely sure that I am ready for any type of evaluation. I felt responsible for the implementation to the knowledge I acquired along the course* ". student L. said that this type of preparation fostered a set of mind which is more open, flexible and therefore made him more ready for the test.

From the mentioned quotations, we observe that students perceived themselves as responsible for their own learning process. Additionally, they expressed satisfaction as they manage to solve new challenges consolidating aspects focused along the course. They did it as they formulate their own questions consolidating their own selected challenge presented in light of a theme taken from their realistic setting. Additionally, their efforts reflect a meaningful learning process as they cope with challenges, intended to be solved along a process consisting of coding, debugging, and correction in phases of evaluation. Last but not least, students' capabilities to act autonomously was emphasized. In this sense, we notice that they did not mention the lecturer in respect of the solution process. In this light

and accordingly, the quotations illustrate three meta-principles reflected during the preparatory phase. We emphasize that the fourth principle concerning making learning visible was not identified in students' quotations corresponding to the preparatory phase. Additionally, we assume that the meta-principle concerning helping students to learn from each other would not be manifested in further phases of the evaluation. This is expected to happen as the students we instructed to take the evaluation as individuals.

4.2 Phase 2: Challenge and Theme Selection +Formative Assessment

In this phase, students were requested to select a challenge and a theme for the question they formulate for themselves. Students were encouraged to select a topic of the challenge and the theme that they may sympathize with possibly taken from their real life. Student T. mentioned that: "*I choose theme concerning real-estate companies and it helped me a lot as I used to work in such business and it represents a familiar domain for me*".

In the following quotations, we bring sentences indicating that the formulation of their own challenge implies a process encouraging students to practice higher thinking levels. Student T. mentioned that: "*personally, I think that the self-formulation of a challenge reflects an autonomous and higher thinking level. It reflects that such evaluation demands a higher level of mastery compared to traditional tests*". Another student named Sh. Told that: "*I think that when you knowing how to ask is much more meaningful than knowing the answer to a question*". Student R. added that "*formulating my own challenge represent a big advantage to me. I selected a Pizzeria as a theme for my question and such topic I sympathize assisted me while thinking in my own schemes*". Student L. told us that: "*Learning something while asking the question is a better approach offering support and encouraging students' creativity*". He continued and mentioned that: "*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 approach in a course on psychology as well as in another course on Research-Methods. Thus in all these courses I asked myself questions and developed my own thinking skills*".

Students' quotations indicate the cruciality of the affordance providing them opportunities to formulate their own challenge and use a theme from their realistic settings. Moreover, in such a way students' engagement in the evaluation experience is enhanced and represents another of various benefits of the evaluation activity. These benefits reflect various meta-principles including promotion of autonomous student, making thinking visible, and repositioning of lecturer's role. Additionally and in respect to some quotations, students implied on engorgement to adopt lifelong learning approaches possibly representing an additional principle beyond the mentioned four meta-principles.

4.3 Phase 3: Contribution of Solution

In this phase, students were supposed to answer the question they formulated and then adjusted by lecturer. Student P. said that: *"The exam in this format permitted me to better express myself as I had the opportunity to show there my acquired skills*". Student G. pointed out that during the evaluation he used presentations and examples provided along the course. He added that: "*I felt that I am concluding the evaluation with more knowledge compared to what I felt that I know prior to that experience*". Student Y. mentioned that "*as I began to solve my own challenge, I felt that something did not work well…It caused me to reconsider and decompose my challenge into small units each corresponding to a different topic learned during the course*". Student Sh. Concluded and pointed that the fact that "we solved our challenges on the real development environment enabled us to rethink things, debug and correct….all resulting in a much more meaningful learning process".

Student Y2., mentioned that: "*the evaluation provided me with a great opportunity to experience coding in real-life conditions. I acknowledge that occasionally the lecturers won't have answers to every question and therefore I'm required to a kind of autodidacticism skils…I have no dough that this approach represents an excellent and simple way to learn while being evaluated while understanding things instead of memorizing*".

In the mentioned quotations, students pointed out that they concluded the evaluation activity with more knowledge compared to their perceived amount of knowledge prior to their engagement to this experience. Students mentioned real-time debugging practiced during the proceeding of the

evaluation reflecting their capabilities to act as autonomous students. Accordingly, we consider that these quotations reflect various meta-principles including promotion of autonomous learning, repositioning of lecturer's role, and making thinking visible. In addition and following some of the quotations, we observe that students are concerned and address the demands they are expected to face in the professional world they would meet in the modern and labor market.

4.4 Phase 4: Summative Assessment

The last phase was conducted following to submission of students' answers to their own formulated challenge that was later adjusted by the lectures in the course. Student I. mentioned that "*I had to attend the defense following the submission of my solution, I arrived at this phase while being quite confident with my solution and therefore it felt easier to answer my own questions*". Student Sh. added that: "*During the defense, as I built my own solution, it felt easy and I wasn't nervous or stressed*". Another student named L. said that "*When I entered to my defense, I calmly talked to the lectures and explained to them the elements of my code and I showed to them my understanding in it*". Student Y2., commented that during this phase, teachers asked him to explain the program he coded and also required him to provide some elaboration on the thinking process exercised during the coding. Last but not least, student P. told that: "I precisely understood for which aspects I would gain a lower grade. Thus, I understood exactly my mistakes!".

In these quotations, students emphasized their formulation of the challenge as its corresponding solution and therefore they approach the evaluation calmly and confidently. In this light, we point out that quotations reflect various meta-principles including promotion of autonomous learning and making thinking visible.

In this paragraph, we conclude and overall address all the phases as described in previous subsections. The mentioned quotation indicates over benefits of our proposed approach for evaluation approach. Here, we acknowledge that all four Meta principles outlined and are clearly manifested (along with quotations) in respect of all the four phases of the evaluation activity.

5. Discussion and Concluding Remarks

In this paper, we suggest a unique approach for a workshop activity serving evaluation purposes usable in programming courses taken by bachelor students. We deployed an activity consisting of four and interrelated phases in which lecturers and students used technological means for interacting with each other. This unique experience is suggested in response to the emergent conditions as presented in times of the COVID-19 pandemic. In this sense, the exploitation of technological means is crucial in light of conditions consisting of social isolation. Thus the design of interactions exercised along the phases was planned to be conducted in synchronous as well as asynchronous modes using technological tools for communication (Zoom), managing learning content (Moodle) and collaborative formulation of documents usable by lecturers and students collaboratively adjusting challenges to be coped during the evaluation activity (Google Docs). In this sense, we notice that the use of technological tools felt seamless and "transparent" for both lecturers and students converting these aspects to a non-issue.

We designed the evaluation activity as we considered four meta-principles as proposed by Kali and other researchers (Kali, 2006; Sagy et al., 2018). Specifically, one of the principles required a mild adjustment fitting it to the context of programming courses. In this sense, the aspect of making science visible was addressed here as making the course content (from programming courses) visible. In the quotations collected from the semi-structured interviews conducted with students attending the programming courses, we found that all four meta-principles are manifested along with the phases of the evaluation activity. The findings in these research efforts also indicate possible principles applicable to the proceedings of the evaluation activity. We found that the principle concerning lifelong learning is applicable to the aims of the evaluation and as reflected from students' quotations. We consider this principle critical for the development of citizenship in light of advanced, dynamic and technological societies. Additionally, this principle becomes crucial for fostering intellectual development and professional skills. Last but not least, it is also important for improving one's quality of life (Boeren & Whittaker, 2018; Tatarinceva et al., 2018). Moreover, this principle is becoming critical in light of the

dynamics of daily routines in the 21st century (Tatarinceva et al., 2018). We acknowledge that in order to encourage learners to adopt a lifelong learning approach, they need to be communicated and convinced on the relevance of content to be focused along their learning path (Bråten et al., 2018).

Accordingly, we propose that lifelong learning, as a principle dependent on relevancy, is crucial for optimizing the learning process as a means adapted for civic life and the labor market of the 21st century. Thus, we suggest the possibility to use higher level and additional meta-principle relying on the four meta-principles mentioned in this paper (Kali, 2006). We do so as we acknowledge that civic life and the labor market in the 21st century will present future citizens with a dynamic, flexible, and technological environment requiring peoples' creativity and higher thinking skills. Additionally, we suggest that current students (and future citizens), should be capable to access and exploit data and information from various and decentralized sources. They need to be able to work collaboratively in various group settings. Furthermore, they need to adopt capabilities making them autonomous learners. In order to capacitate current students (future workers) capable to successfully cope with the demands of the 21st-century labor market, we recommend the consideration and possible adaptations of all the mentioned properties. Furthermore, and while considering the cruciality of these sets of demands, we suggest the capacitation for the 21st-century market as a higher meta-principles relying on the four ones we focused on in this paper (Kali, 2006).

We consider our evaluation activity as an approach capable to address challenges corresponding in times of normality as well as of challenging moments such as those encountered in times of covid-19. In this respect and in correspondence to the mentioned in this section, we consider normality in the sense of modern life in the 21st century including requirements that would be demanded from citizens in this epoch. As mentioned we also aim this approach for challenging moments. Therefore, we emphasize that we offer our evaluation approach as an activity usable in other moments of crisis consisting of new types of emergent situations.

6. Future Efforts

In our future efforts, we intend to continue our design, development, and deployment activities focused on the refinement of our unique evaluation approach for additional subject domains. In this sense, we intend to explore the applicability of this approach across disciplines. Thus, we aim to examine and accordingly refine this approach beyond the domain of programming courses. Additionally, we acknowledge that the deployment of such an evaluation approach might be experienced differently depending on the organizational nature of the educational instruction practicing it. Therefore, in our future efforts, we intend to deploy the evaluation across institutions and by different lecturers from across domains as well as from different cultural environments corresponding to their institutions. We also aim to continue and explore additional principles and meta-principles applicable to our suggested approach for evaluation. Last and not least, we acknowledge that COVID-19 may represent a single example of a crisis among others humanity may tackle in the future. Therefore, we aim to suggest, explore and refine our efforts while suggesting this activity as an educational pattern that could be adopted and adapted for normal routines as well as for emergent conditions societies may encounter in future crises. In The coming efforts we intend to focus on the mentioned directions for research while using mixed-method of methodological approaches.

7. Limitations of Research

In this section, we bring several limitations concerning our research efforts. We acknowledge that this research was conducted with a relatively small amount of interviewees. Additionally, we used here a qualitative method of research. Finally, we focused our research efforts on two courses conducted in a single institution dealing with the same subject domain.

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