Journal of Integrated Information Management

Vol 10, No 2 (2025)

Jul-Dec 2025

Exploring Problem-Based Learning Impact on Students' Motivation and Engagement in an e-Course Utilizing Microsoft Teams.

Konstantinos Bourdas, Georgia Kiriakaki, Maria Grigori, Anastasia Themeli, Christos Kytagias, Yannis Psaromiligkos

doi: 10.26265/jiim.v10i2.42401

To cite this article:

Bourdas, K., Kiriakaki, G., Grigori, M., Themeli, A., Kytagias, C., & Psaromiligkos, Y. (2025). Exploring Problem-Based Learning Impact on Students' Motivation and Engagement in an e-Course Utilizing Microsoft Teams. *Journal of Integrated Information Management*, *10*(2), 56–67. https://doi.org/10.26265/jiim.v10i2.42401

Journal of Integrated Information Management electronic journal

Exploring Problem-Based Learning Impact on Students' Motivation and Engagement in an e-Course Utilizing Microsoft Teams

Konstantinos Bourdas[1], Georgia Kiriakaki[1], Maria Grigori[1], Anastasia Themeli[2], Christos Kytagias[1], Yannis Psaromiligkos[1]

[1]Department of Business Administration University of West Attica, Athens, Greece,
[2]Department of Pedagogy and Primary Education, National and Kapodistrian University of Athens, Athens, Greece,
kostasbour@gmail.com [ORCID: 0000-0002-5220-6655], gkiriakaki@uniwa.gr [ORCID: 0009-0007-1205-9121], mgrigori@uniwa.gr [ORCID: 0009-0004-2437-8769], natashathem@gmail.com [ORCID: 0009-0002-1340-0604], ckyt@uniwa.gr [ORCID: 0000-0001-6037-0036], yannis.psaromiligkos@uniwa.gr [ORCID: 0000-0002-8420-8663]

Article Info

Article history:
Received 11 August 2025
Received in revised form 30 September 2025
Accepted 5 October 2025

http://dx.doi.org/10.26265/jiim.v10i2.42401

Abstract:

Purpose *- The COVID-19 pandemic has rapidly accelerated the implementation of e-learning across all levels of education. However, maintaining high levels of student motivation and engagement is a real challenge in a Technology-Enhanced Learning Environment (TELE), as the use of technology alone is a significant source of distraction. To address this challenge, at the Department of Business Administration at the University of West Attica, an e-course that utilizes a Problem-Based Learning (PBL) method that was delivered via the Microsoft Teams platform, was designed and implemented. Drawing on this conceptual framework, the primary aim of this study is to investigate the effect of PBL on students' motivation and engagement, as well as to explore students' perceptions of the PBL method.*

Design/methodology/approach *- A quasi-experimental pretest–posttest design was adopted in this study. Data were collected from 162 students using Microsoft Teams analytics and the Motivated Strategies for Learning Questionnaire (MSLQ), which was administered both before and after the completion of the e-course. To assess students' motivational orientations, a modified version of the MSLQ was employed, incorporating dimensions such as intrinsic goal orientation, extrinsic goal orientation, and self-efficacy for learning and performance. Students' perceptions of the PBL method were evaluated through open-ended questions, and their responses were analyzed using an inductive content analysis technique.*

Findings *- The analysis of the results reveals that our proposed e-course design approach enhances students' intrinsic motivation, self-efficacy, and engagement. Additionally, these findings are further supported by students' perceptions of working with the PBL method.*

Originality/value *- This study, despite its limitations, provides valuable insights into the limited research on the customization of Microsoft Teams platform from a pedagogical perspective to facilitate complex teaching methods, such as the PBL method.*

Index Terms — Problem-Based Learning (PBL); motivation; engagement; critical thinking; Microsoft Teams; Motivation Strategies for Learning Questionnaire (MLSQ)

I. Introduction

The epidemic of the novel coronavirus strain, 2019-nCoV, which emerged in January 2020 in China [1], swiftly spread worldwide, negatively impacting not only health and the economy but also almost every aspect of human activity. However, this crisis also gave rise to new opportunities for innovation and creativity. Particularly in the field of education, educational institutions worldwide have been called upon to reassess their operational methods. In the case of Greece, academic institutions have rapidly adapted to the demands of the new era since September 2020 by offering online courses through Learning Management Systems (LMS) and video conferencing tools.

The introduction of distance education posed new challenges. Specifically, personal interaction is now influenced by the capabilities of digital communication and collaboration tools, which can limit social interaction [2] and contribute to a sense of isolation among learners [3].

During and after the Covid-19 pandemic, when distance education was widely implemented, first-year students faced an even greater challenge. They lacked the opportunity to meet their peers and instructors face-to-face, which hindered their ability to develop a robust social network. Conditions of reduced social interaction, as documented in the literature, have been found to lead to a decrease in learning motivation [4], [5]. Building upon the aforementioned issues, we have developed an innovative approach for an e-course based on the Problem-Based Learning method in order to enhance students' motivation and engagement.

II. THEORETICAL BACKGROUND

Problem-Based Learning

Problem-Based Learning (PBL) is a student centered method that involves learners actively engaging in the process of solving meaningful, semi-structured, open - ended problems. This pedagogical method emphasizes learning through the process of problem-solving and cultivates high - order thinking skills. Rooted in the progressive ideas of John Dewey [6], [7], PBL promotes learning environments that enhance students' critical thinking, autonomy, and the ability to work both independently and in groups. PBL originated in the late 1960s at the Faculty of Health Sciences at McMaster University in Canada. It falls under the category of learner-centered learning methods, with the educator primarily functioning as a facilitator throughout the entire process. Additionally, the role of the educator focuses on guiding work groups and familiarizing them with the stages of the research methodology. Barrow [8] emphasized that PBL changes the role of the student from a knowledge receiver to an active learner through real-world problem solving. Since then, this methodology has been adopted in many fields, including medicine, nursing, and pharmacy.

The PBL method was not developed to facilitate the transmission of a large volume of cognitive information, a process that is more effectively served through strategies such as demonstration or presentation. On the contrary, through PBL, learners assume a more active and autonomous role in the learning process, developing the 4c's of 21st-century skills (collaboration, communication, creative thinking, critical thinking).

According to research findings [9], PBL plays a significant role in shaping learners' attitudes towards the learning process. Specifically, the relevant literature [10] indicates that learners who participate in courses structured based on the PBL method develop a positive attitude towards learning. This is in contrast to learners who attend classes based on "traditional" teacher-centered teaching methods, where strategies such as lectures, presentations, and demonstrations are dominant. Furthermore, in quasi-experimental studies [11], [12], [13] that applied the PBL method, an increase in learners' intrinsic motivation was observed, , while external motivation remained unchanged. Chung [14] proved that a structured implementation of PBL protocols in higher education supports the development of learners' motivation and critical thinking. It also fosters the transfer of theoretical knowledge into real-life contexts, particularly in the field of community-based rehabilitation.

However, it should be noted that in the initial stages of implementing the PBL method, learners may experience emotions associated with trauma, such as shock, rejection, intense reactions, resistance, and acceptance. This is due to the radical changes taking place in the learning environment, as they transition from lectures to research methodology and group work [15]. And only when learners overcome these intermediate stages and reach acceptance, will they realize that they have attained higher levels of performance.

As shown in **Fig. 1**, a PBL session begins with presenting a complex problem to a group of students, who gather additional information through experiments or research. During the investigation, students pause to review the data, pose questions and develop hypotheses about the problem's theme. They then discover ideas that require further learning aimed at solving the problem. Next, students split up to independently research the specific issues before regrouping to share their findings, reassess assumptions, and develop new ones. At the end, they engage in reflection and feedback to evaluate their understanding and progress toward a solution [16].

***Fig. 1**. The PBL cycle [17]*

Motivation

Motivation is a central concept in both educational and psychological research. Initially, the term referred to the internal state that motivates an individual to take action and maintain focus on specific activities [18]. Motivation is widely acknowledged as an internal condition shaped by personal and environmental influences. As noted by Sirhan et al. [19], it stems from a combination of internal elements and external stimuli, including reinforcement mechanisms. These interacting factors activate specific behaviors that aim to close the gap between an individual's current state and their desired goals [20]. In this context, motivation functions as a psychological force that energizes and directs behavior toward acquiring knowledge. According to Bishara [21], this is achieved through purposeful actions that lead to specific learning outcomes.

Building upon this foundation, Deci and Ryan [22] formulated an initial distinction between internal (intrinsic) and external (extrinsic) motivations. The term "internal" (or intrinsic) motivation refers to the internal process that guides an individual to choose to engage with a specific topic or learning activity. Learners with an intrinsic orientation towards goals are characterized by a genuine interest in the learning process and a desire to enhance their knowledge in the subject matter itself, without relying on external rewards

[23].

The term "external" (or extrinsic) motivation refers to the influence of external factors that guide an individual to engage in a specific learning process. External motivations include various types of positive reinforcements, such as recognition of effort or praise, as well as negative reinforcements, such as reprimands or punishments [24].

The role of motivation, both internal and external, is particularly significant in the learning process. Motivation enhances students' understanding that learning builds upon their capabilities and functions as an internal force guiding their actions. It encourages them to engage with what they consider meaningful and important, ultimately leading to improved academic performance [25]. Specifically, motivation is linked not only to the dedication of learners but also to their learning performance [26]. Furthermore, similar to motivation, self-efficacy also plays a significant role in the entire learning process. As defined by Bandura [27], self-efficacy refers to an individual's belief in their own ability to succeed in specific situations or accomplish specific tasks. According to Bong [28], self-efficacy is the second most crucial factor, after skills, in predicting academic performance. In detail, students with high self-efficacy believe that success and failure are the result of their own behaviors and abilities, rather than external factors. Consequently, students demonstrate increased engagement and exert more effort in their educational endeavors, thereby resulting in improved academic performance.

Microsoft Teams

Microsoft Teams (MS Teams) application was developed by Microsoft in 2016 and is a part of the Microsoft 365 product family. It is a digital communication and collaboration platform that effectively combines chat, video conferencing, and Microsoft's digital applications into a unified workspace. Its functionality is primarily based on the chat-centric workplace process. Each user of MS Teams is part of the larger community of certified Office 365 users and can create their own team or become a member of other teams comprised of certified users. When creating working groups, a default general communication channel is established. Users can utilize this channel to post messages, read announcements, store their work in cloud storage, conduct meetings, and add both Microsoft and third-party applications.

The MS Teams platform was chosen by Wester Attica University to implement modern distance education during the Covid-19 period. It was used alongside the Open e-Class and Moodle learning management systems, which were already being utilized to support asynchronous online learning.

Many tertiary education institutions worldwide use the MS Teams platform, and they have reported encouraging results. The platform offers several significant advantages, including reliability, the ability to share educational materials, and flexibility in terms of accessing recorded digital lessons at any time and from any location [29]. However, regardless of the platform used, the educator plays the most important role in developing positive attitudes among learners towards online learning [30].

III. METHOD

Research model

The research method employed in this study was a quasi-experimental one-group pretest-posttest research design. The quasi-experimental research design shares similarities with experimental research, but it does not meet the criteria for a true experimental design. While the independent variable is manipulated, participants are not randomly assigned to different conditions or orders of conditions [31]. However, most empirical studies in the field of education are quasi-experimental rather than experimental [32]. The selection of the quasi-experimental research design was carried out for purely practical reasons, as random assignment was not feasible. In a one-group pretest-posttest research design, one or more dependent variables are measured twice: once before and once after the treatment is introduced. The analysis of the differences between pretest and posttest scores indicates the impact of the experimental intervention. In our study, we conducted a quasi-experimental research for a duration of 7 weeks. The research procedure was as follows (**Fig. 2**).

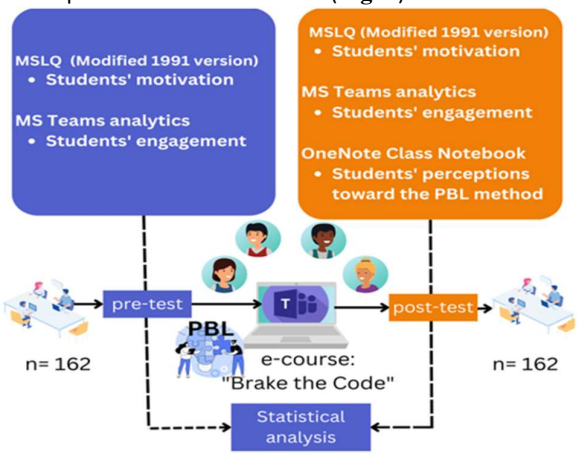

Fig. 2*. Research method process*

In detail, the independent variable was the "Break the Code" e-course, which was designed along the lines of the Problem-Based Learning (PBL) method. The dependent variables included student motivation and engagement.

Data was collected and analyzed using a mixed-methods approach to gain a clearer understanding of the impact of the PBL method. The results from the Motivated Strategies for Learning Questionnaire (MSLQ) were triangulated with other data sources, such as data from the Microsoft Teams report analytics feature and students' perceptions of their work through the lens of the PBL model, as recorded in the OneNote - Class Notebook application.

Research questions

This paper proposes the design, development, and implementation of an e-course on programming,

orchestrated along the lines of Problem-Based Learning (PBL) and delivered through the Microsoft Teams collaboration platform. In detail, the proposed instructional design approach describes how learning activities and learning environment (MS Teams) features are tailored to the five phases of the PBL teaching model. This is done by providing capabilities for the customization of an e-learning environment such as Microsoft Teams, while increasing its potential, to positively affect students' motivation and engagement. Under this main purpose, the research questions (R.Q.) are formed as follows:

To R.Q.1. To what extent does the e-course affect Students' motivation?

R.Q.2: What is the impact of the e-course design and implementation on students' engagement?

R.Q.3: What are the students' perceptions towards the PBL method and what learning outcomes do they believe they have attained?

Participants

The study sample consisted of 162 (97 females, 65 males; 59.1%, and 40.1% respectively) first-year undergraduate business administration students from the University of West Attica, who voluntarily enrolled in the e-course titled "Break the Code", as a part of "Introduction to Computer Science & Programming" academic course. The study population was selected to be first-year students instead of those in higher academic years. This decision was made because first-year students had recently entered tertiary education and had not yet developed established learning attitudes and behaviors. A characteristic that makes individuals more receptive to age-related changes [33]. Furthermore, the design and implementation of the e-course were carried out by a postgraduate student working on his master's thesis, under the guidance of two professors from the University of West Attica.

Data collection tools

Measuring motivation

To measure students' motivational orientations, we utilized a modified version of the Motivated Strategies for Learning Questionnaire (MSLQ). The MSLQ contains 81 items divided into two main sections: motivation (31 items) and learning strategies (50 items). The motivation section includes the following dimensions: intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, and test anxiety. The learning strategies section includes dimensions for rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time management, study environment, effort regulation, peer learning, and help-seeking [34]. The adapted version of MSLQ consisted only of the motivation section. Furthermore, the motivation section consisted of 21 items distributed into three dimensions: intrinsic goal orientation, extrinsic goal orientation, and self-efficacy for learning and performance. All the students were asked to answer the MSLQ before and after completing the e-course, "Break the Code." Responding was on a seven - point Likert Scale, ranging from "1 - Strongly Disagree" to "7 - Strongly Agree." As mentioned above, the students' perceptions of the PBL teaching and learning method, as recorded in the OneNote - Class Notebook application, were also analyzed to further support the results of the MSLQ questionnaire.

Measuring engagement

To measure students' engagement, we utilized the Microsoft Teams report analytics feature. This feature records the following data: the total number of publications, posts, replies, reactions, and active users. It is important to note that the term "active users" refers to the unique users who engage in any activity on Microsoft Teams during the specified date range for the user activity report.

Experimental e-course instructional design and learning procedure

This section presents a well-organized instructional design for learning based on the PBL method, as proposed by Arends [35]. This approach also refers to the customization of the Microsoft Teams platform, with a focus on incorporating embedded features as a crucial element of the design (**Table 1**).

Table 1*: Instructional design of the e-course "Break the Code".*

N.	PBL Phases	Strategies	Description of activities	Roles
1.	Orient students to the problem	Climate setting	1.1 Post a welcome message in the "Posts" Tab.	Educator
		Presentation	1.2 Present the problem and the mini syllabus.	Educator
		Think-vote-share	1.3 Ask recall questions using the "Voting" feature.	Educator
		Self-assessment (Pre-test)	1.4 Self-evaluation of students' motivation using MSLQ through the MS Forms application.	Students
2.	Organize students for study	Small group work	2.1 Create teams using the Microsoft Forms application.	Students
			2.2 Allocate roles using the Microsoft Forms application.	Teams
			2.3 Assign responsibilities (tasks per role) using the Microsoft Planner application.	Teams
3.	Assist independent and group	Guided research	3.1 Post supportive learning resources in the "Posts" Tab.	Educator
			3.2 Provide feedback through the "Posts" Tab.	Educator
			3.3 Study learning resources through the "Files" Tab.	Teams
			3.4 Update tasks progress using the Microsoft Planner application.	Teams
4.	Develop and present artifacts and exhibits	3-2-1 strategy	4.1 Search, evaluate, and document three resources in the "Collaboration Space" section of the OneNote application.	Analyst

			4.2 Post two questions in the "Posts" tab on the central channel of the e-course and respond to one inquiry from another team.	Analyst
		Small group work	4.3 Schedule team meetings using the" Calendar" feature.	Leader
			4.4 Develop a solution and conduct the initial code review (1st code revision).	Developers
		Collaborative coding	4.5 Conduct the second code review (2nd code revision) and submit the final deliverables through the "Assignments" Tab.	Leader
		Presentation	4.6 Present the proposed solution at a plenary session.	Leader
		Small group work	4.7 Update tasks progress using the Microsoft Planner application.	Teams
5.	Analyze and evaluate the problem-solving process	Self-assessment (Post-test)	5.1 Self-evaluation of students' motivation using MSLQ through the Microsoft Forms application	Students
		Group assessment	5.2 Group evaluation is conducted by team members collaboratively sharing their perspectives on working with the PBL method using OneNote application.	Teams
		Feedback	5.3 Post the completion certificates in the "Posts" Tab.	Educator

The entire educational intervention was structured according to the five phases of the PBL method. A detailed description of each phase of the instructional design is provided below:

In the initial stage of PBL method, students are presented with a problem that they are required to resolve. This problem involved developing a small-scale application to implement a specific encryption algorithm. Furthermore, the initial assessment of the students' motivation was conducted in this phase through the completion of the Motivate Strategies for Learning Questionnaire (MSLQ).

In the second phase of the PBL, teams were formed, each consisting of four individuals who were assigned specific roles and responsibilities. Specifically, the students were asked to choose among the roles of leader, analyst, and developer. So that each team will have one leader, one analyst, and two programmers.

In the third phase of the PBL, the analyst of each team searched for and posted three digital resources relevant to the problem to be solved. Furthermore, the analyst posted two questions and responded to one inquiry from another team. The publications were posted using the "Posts" tab on the central channel of the e-course, and respond to one inquiry from another team.

In the fourth phase of the PBL, the two developers in each team engaged in collaborative code writing with all the other team members. They also conducted the first code review on the initially configured code, while the team leaders conducted the second code review.

In the fifth phase of the PBL, team leaders presented their proposed solutions in a plenary session, while the other teams evaluated them through discussion. After the experimental intervention, the students' motivation was reassessed by having them complete the MSLQ self-report questionnaire. Finally, group evaluation is conducted by team members collaboratively sharing their perspectives on working with the PBL method. Specifically, group evaluation is conducted by writing a paragraph in the "Collaboration Space" section of the OneNote - Class Notebook application.

Roles and responsibilities

A significant number of studies and meta-analyses [36], [37] have documented that collaboration and internal competition within working groups lead to better learning outcomes compared to individual effort and interpersonal competition. Based on the proposed instructional design approach of the experimental e-course, students were divided into small groups of three to four individuals. This is because communication is easier in smaller groups, and it is generally easier to reach agreement compared to larger groups. Moreover, in larger groups, the challenge of finding a completely independent task often results in task overlap and eventually task merging [38]. To avoid the aforementioned dysfunction, students were assigned specific roles with predefined responsibilities. The selection of roles (leader, analyst, developer) was based on the demands in the job market within the business and programming sectors. It is noteworthy that the crucial role of the beta-tester was deliberately omitted, and its responsibilities were transferred to the entire team to enhance the sense of collective responsibility among its members. **Table 2** below presents the roles and their corresponding responsibilities.

Table 2*: Group roles aligned with specific responsibilities*

	Roles	Responsibilities
1.	Leader	• Plans and implements team meetings. • Conducts the final review of the solution (2nd code revision). • Submits the proposed solution.
2.	Analyst	• Searches, records, and evaluates three digital resources for the development of the solution. • Publishes two questions and responds to another team's inquiry.
3.	Developer	• Develops the solution in collaboration with other team members. • Conducts the initial review of the group's solution (1st code revision).

Customization of MS Teams

Two types of teams were created to meet the requirements of the proposed design for learning. The central e-class team, as well as separate teams were formed for each of the 51 working groups. The main team was created using the default template for class creation in Microsoft Teams. The class template (**Fig. 3**) includes the following tabs by default: "Posts", "Files", "Class Notebook",

"Assignments", and "Grades." Additionally, two more tabs were added: the "Team Declaration" tab for team selection and the "Self-Assessment Survey" tab for distributing the Motivation Strategies for Learning Questionnaire (MSLQ).

Fig. 3*. E-course's central channel tabs*

In detail, within the "Posts" tab, students had access to educator's announcements (**Fig. 4**). In the "Files" tab, students had access to the learning resources of the e-course, including the video recordings of the e-class sessions.

Fig. 4*. Announcement in the "Posts" tab on MS Teams platform*

In the "Class Notebook" tab, students utilized the OneNote application, which is seamlessly integrated into the Microsoft Teams platform, to compile a comprehensive list of supplementary learning resources (**Fig. 5**). Furthermore, by navigating between the "Class Notebook" sections, they also had access to the resources of other teams. Additionally, in the "Class Notebook" tab, each team wrote a paragraph describing their experience working with the Problem-Based Learning method. In the "Team Declaration" tab, students declared the composition of their team by completing the corresponding form using the Microsoft Forms application, which is integrated into the Microsoft Teams platform. The "Assignments" and "Grades" tabs are used for uploading assignments and evaluating submissions (deliverables).

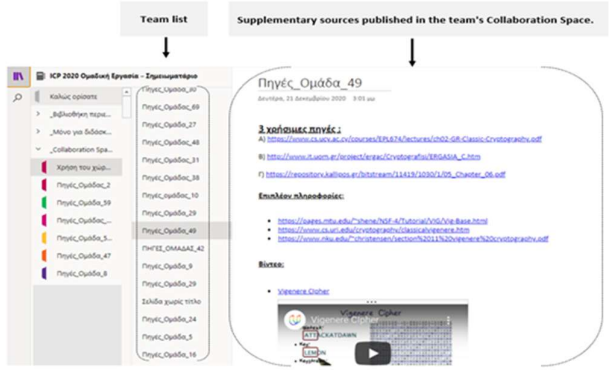

Fig. 5. *"Collaboration Space" section in the "Class Notebook" tab on the MS Teams platform.*

As mentioned above, a separate team was created for each group of students, with the following tabs: "Posts", "Files", "Plan", and "Meeting Notes". In the "Posts" tab, students communicated by exchanging written messages and files. In the "Files" tab, students had access to learning resources and the ability to upload and exchange their work. In the "Plan" tab, students recorded their individual progress on tasks based on their roles using the user interface of the Microsoft Planner application, which is integrated into the Microsoft Teams platform. Additionally, it should be noted that in the user interface of the Microsoft Planner application, tasks for each role had different colors (red, yellow, blue), corresponding to the three different roles (leader, analyst, developer) (**Fig. 6**).

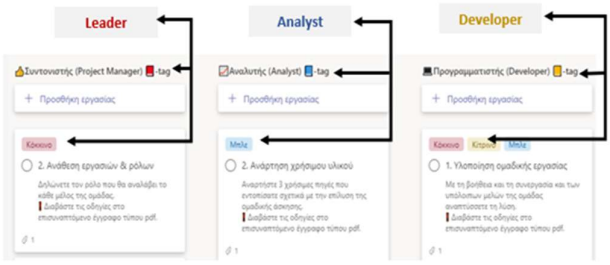

Fig. 6*. Task assignment in Microsoft Planner's user interface.*

This color-coding system made it easy to identify tasks assigned to each role. Finally, in the "Meeting Notes" tab, students could take notes during their team meetings.

IV. RESULTS

To measure students' motivational orientations, we utilized a modified version of the Motivated Strategies for Learning Questionnaire (MSLQ). The internal consistency of the pretest and posttest questionnaires was assessed by calculating Cronbach's alpha coefficients. Reliability analysis showed that all three sub-scales (intrinsic goal orientation, extrinsic goal orientation, and self-efficacy for learning and performance) had acceptable levels of internal consistency, with Cronbach's alpha values ranging from 0.72 to 0.94. These values are within the expected range reported in the MSLQ manual by Pintrich et al. [39]. The statistical analysis, we conducted through the IBM SPSS statistical software in version 23 and the significance level was set to 0.05.

Evaluating students' motivational orientations

In this study, the Wilcoxon signed rank test was conducted to assess the effects of the "Break the Code" e-course, which was designed along the lines of the Problem-Based Learning (PBL) method, on students' motivational orientations. The Wilcoxon Sign Rank Test was preferred, due to a non-normal distribution (Shapiro-Wilk test, $p < .05$) in all three motivation factors: intrinsic goal orientation, extrinsic goal orientation, and self-efficacy. The effect size (r) for the Wilcoxon signed rank test was also calculated by using the formula: $r=z/\sqrt{N}$ (r: effect size; z: z value; N: total number of pairs). **Table 3** displays the descriptive statistics for the motivational orientations before and after the e-course, as well as the results of the Wilcoxon signed rank test.

Table 3*: Wilcoxon sign rank test results of students' motivational orientations before and after the experimental intervention.*

	Pretest	Posttest

Subscales	Mean	Std.	Mean	Std.	Z	p
Intrinsic goal orientation	5.73	.68	5.97	.73	-3.73[a]	< .001*
Extrinsic goal orientation	5.37	1.12	5.37	1.11	-.53[a]	.595
Self-efficacy	5.03	1.08	5.42	.97	-5.58[a]	< .001*

Note: *p <.05

Given the above results, we can conclude that only the intrinsic goal orientation and self-efficacy subscales of MSLQ were significantly affected by the e-course. Further details for each of the students' motivational orientations are provided below.

Intrinsic goal orientation

The results revealed that intrinsic goal orientation scores were significantly higher after the intervention (Mdn=6.00, n=162) compared to before (Mdn=5.75, n=162), z=-3.73, p=.00 with a small effect size, r=.29. However, the small effect size of the differences between the students' scores on the intrinsic goal orientation scale in the pre- and post-tests indicates that the suggested instructional approach may have the potential to foster their intrinsic motivation.

Extrinsic goal orientation

The results revealed no significant difference in student extrinsic goal orientation scores before (Mdn = 5.50, n=162) and after (Mdn = 5.50, n=162) the intervention, z =-0.53, p =.59 with a small effect size <.01.

Self-efficacy for learning and performance

The results revealed that self-efficacy for learning and performance score were higher after the intervention (Mdn=5.63,n=162) compared to before (Mdn=5.13, n=162), z=-5.58, p=.00 with a medium effect size, r= .31.

Evaluating students' engagement

The engagement of students was assessed using the cross-team analytics report feature provided by the Microsoft Teams platform. This feature records the total number of posts, replies, and reactions, as well as the total number of active users. It also includes a trend line that shows the team activity during the specified time period. **Fig. 7** displays a significant increase in the total number of posts, replies, and reactions after the e-course completion.

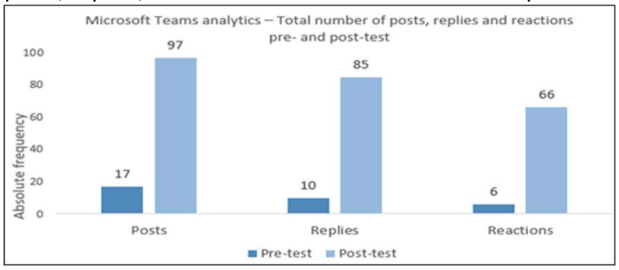

Fig. 7. *Comparison of the total number of posts, replies, and reactions before and after the experimental intervention.*

Moreover, after completing the "Break the Code" e-course, there was a noticeable increase in the total number of active users per day during the specified period. **Fig. 8** above illustrates the effectiveness of the intervention in promoting students' participation.

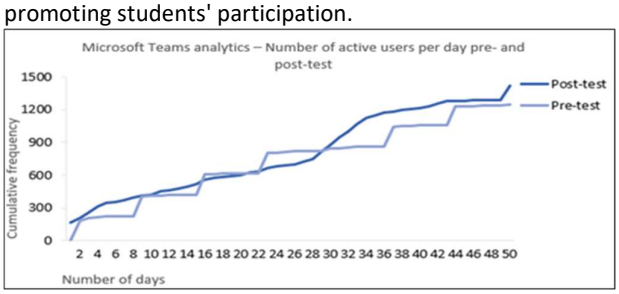

Fig. 8. *Comparison of the total number of active users over time before and after the experimental intervention*

Overall, considering the increase in the number of posts, replies, and announcements, as well as the increase in the total number of active users, the intervention had a positive impact on students' engagement.

Evaluating students' perceptions towards the Problem-Based Learning method

Students' perceptions towards the Problem-Based Learning method were assessed through an open-ended question. They were asked to collectively describe their personal experiences of working with the PBL method after completing the e-course. This open-ended question was also used to enhance the results of the MSLQ questionnaire.

The exploration of students' answers is conducted using the inductive technique of content analysis. Specifically, the researchers use participants' own words to code their responses, ensuring a precise interpretation. This method is commonly used to analyze students' perceptions of their motivation and learning strategies in a specific learning task. Moreover, the transcripts were independently analyzed by the researcher and a doctoral student. Initially, each reader reviewed the transcripts to identify common themes in the participants' responses. They then met multiple times to discuss, compare, and refine these themes until they reached a consensus. This process resulted in the three distinct themes, which are presented below (**Table 4**).

Table 4*: Coding categories for students' perceptions towards the PBL method.*

Category	Brief description	Exemplary statement
1.Knowledge	1.1 Development of an encryption-decryption program	We [acquired new knowledge] regarding [encryption] and [decryption] throughout this project.
2.Skills	2.1 Collaboration and teamwork	We developed [skills in collaborating] with new individuals.
	2.2 Communication	We had the opportunity to [get to know each other] and [establish communication].

	and exchange of ideas	
	2.3 Role distribution and assignment of responsibilities	Everyone [fulfilled their respective role], resulting in the [efficient completion of the project] without any tension.
	2.4 Information search and evaluation	We acquired the [skill of searching] for online resources and [identifying the most reliable] and relevant [information] that helped us accomplish our project.
	2.5 Use of the Microsoft Teams platform	We learned many new things, and one of them was the [familiarization] of all team members [with the Microsoft Teams platform].
3.Attitudes	3.1 Intrinsic goal orientation	This project allowed us to [engage] with a [very interesting] topic.
	3.2 Extrinsic goal orientation	By completing this group project, we are getting closer to achieving our main goal of [performing well] on the [final exams].
	3.3 Self efficacy for learning and performance	Despite the difficulties we faced while working on a demanding program, we[managed to successfully complete it], and we are [extremely pleased with the outcome].

Knowledge

This theme includes responses noting that in the context of the PBL method, learners had the opportunity to enhance their knowledge regarding the development of encryption and decryption applications. For example, one team noted that: we had the opportunity to [delve deeper into encryption] and [expand our knowledge].

Skills

This theme includes references noting the development of soft skills through the PBL method. For example, one team noted that: we developed [skills in collaborating] with new individuals. Another team mentioned that: we had the opportunity to get to know each other and [establish an effective communication]. Also, the role distribution was highlighted by a team that noted: each team member [took on their own responsibilities]. Moreover, a team pointed out that: [finding credible sources] for the project helped us [successfully complete it]. Many of the teams also emphasized the utilization of the Microsoft Teams platform. For example, one team noted that: we had the opportunity to [familiarize ourselves with the application of Microsoft Teams].

Attitudes

This theme refers to the students' motivational orientations. Most of the teams referred to the intrinsic goal orientation. For example, a team stated that: this project allowed us to [engage] with a [very interesting] topic. Another team highlighted the role of extrinsic goal orientation, noting that: completing this group project brings us closer to achieving our [main goal of performing well on the final exams]. Furthermore, another team highlighted the importance of self-efficacy for learning and performance. As they reported: there was excellent teamwork, flawless communication to [achieve the desired result], and [great consistency] in our scheduled meetings to [achieve the desirable outcome].

V. DISCUSSION

The results presented in the previous section can be further discussed in terms of the three research questions. To what extent is the design and implementation of the "Break the Code" e-course aligned with the Problem-Based Learning (PBL) method and delivered through the MS Teams affects?

R.Q.1.Students' motivation

This study examined the impact of the "Break the Code" e-course on students' motivation and engagement. It also explored students' perceptions towards the PBL method. The findings indicated that the proposed instructional design approach, based on the PBL method, had a positive effect on students' intrinsic motivation, self-efficacy, and no impact on students' extrinsic motivation. This pattern of findings is consistent with that already reported in the literature [40], [41], [42]. The increase in students' intrinsic goal orientation could indicate that students enrolled in the PBL e-course because they were genuinely interested in it. Moreover, the increase in students' intrinsic goal orientation was also documented through the process of data triangulation, using both quantitative data obtained from the MSLQ questionnaire and the results of the content analysis of the students' answers to the related open-ended question. For example, as reflected in the words of a team: the research and the project were [quite interesting] for all of us. On the other hand, no statistically significant differences were recorded in the students' extrinsic goal orientation, indicating that first-year students, at the beginning of their academic studies, are not affected by external rewards or grades. The above result is consistent with the fact that only one out of the 51 teams reported that: by completing this group project, we are getting closer to achieving our main goal of [performing well] on the [final exams]. Another crucial research finding is that the featured instructional approach enhanced students' self-efficacy, as they gained confidence in their ability to solve problems and succeed in their group project. The increase in students' self-efficacy, as recorded from the statistical analysis of the MSLQ data, is consistent with the findings from the content analysis of students' perceptions towards the PBL method. For example, one team mentioned: despite the difficulties we faced while working on a demanding program, we [managed to successfully complete it], and we are [extremely pleased with the outcome].

R.Q.2.Students' engagement

According to the analytics data from Microsoft Teams platform, there was an increase in students' engagement

before and after the experimental e-course. These research findings align with previous studies in the field of academic education, which have documented an increase in students' engagement after implementing the PBL method [43], [44]. Moreover, the increase in students' engagement was also documented in their perceptions of the PBL method. For instance, one team mentioned, we [gained interest] in something previously unfamiliar to us, such as cryptography. Another added: the topic of cryptography and decryption [fascinated us from every perspective]. Moreover, the recorded increase in the number of active users before and after the experimental intervention can be attributed to students actively engaging in learning processes and projects, especially when they find the subject matter interesting.

R.Q.3. What are the students' perceptions towards the PBL method and the learning outcomes they felt they obtained?

The proposed design for learning based on the PBL method had a positive impact on engaging students in finding solutions to real life work-based situations. These findings agreed with works done by Gijbels et al. [45] and Nerali et al. [46], where learning in PBL format promotes teamwork, collaboration and improves the communication and the interaction among the group members. Furthermore, other learning outcomes of the PBL method, such as the development of critical information retrieval skills and a deeper understanding of knowledge, are often cited as some of the main benefits of this approach [47], [48].

VI. Conclusions

In light of the COVID-19 pandemic, educational institutions have increasingly adopted online learning across all levels of education. Consequently, educators are faced with the challenge of effectively utilizing the existing teaching methods in both synchronous and asynchronous learning environments to facilitate learning for students. However, when using video conferencing tools and learning management systems to support the whole learning process, learners usually lack motivation as the use of technology alone is a significant source of distraction. The purpose of the presented instructional design approach developed by this study in the context of "Break the Code" e-course, is to promote students' motivation and enhance participation. Based on the results from the MSLQ survey, which were triangulated with the data from the MS Teams platform and the students' perceptions toward the PBL method, this study confirms that the featured instructional approach, tailored along the lines of the PBL method, effectively fosters student motivation and engagement. Furthermore, considering the students' perceptions of their work through the lens of the PBL method, the proposed instructional design for learning is not only effective in promoting learners' motivation and engagement but also in promoting learners' deeper understanding of knowledge and fostering crucial soft work-based skills such as collaboration and communication. However, since the current research design lacks a control group, the repetition of the research with a larger sample and the inclusion of a control group are recommended to enhance the validity of the research findings.

VII. References

[1] A. A. Balkhair, 'COVID-19 Pandemic: A New Chapter in the History of Infectious Diseases', *Oman Med J*, vol. 35, no. 2, p. e123, Apr. 2020, doi: 10.5001/omj.2020.41.

[2] A. E. Widjaja, J. V. Chen, and T. M. Hiele, 'The Effect of Online Participation in Online Learning Course for Studying Trust in Information and Communication Technologies':, *International Journal of Cyber Behavior, Psychology and Learning*, vol. 6, no. 3, pp. 79–93, Jul. 2016, doi: 10.4018/IJCBPL.2016070106.

[3] D. U. Bolliger, S. Supanakorn, and C. Boggs, 'Impact of podcasting on student motivation in the online learning environment', *Computers & Education*, vol. 55, no. 2, pp. 714–722, Sep. 2010, doi: 10.1016/j.compedu.2010.03.004.

[4] I. Yukiko, *Online Education for Lifelong Learning*. Idea Group Inc (IGI), 2007.

[5] P. g. de Barba, G. e. Kennedy, and M. d. Ainley, 'The role of students' motivation and participation in predicting performance in a MOOC', *Journal of Computer Assisted Learning*, vol. 32, no. 3, pp. 218–231, 2016, doi: 10.1111/jcal.12130.

[6] J. Dewey, 'Essays in experimental logic', *The University of Chicago Press*, 1916, doi: https://doi.org/10.1037/13833-000.

[7] J. Dewey, *Essays in Experimental Logic*. SIU Press, 2007.

[8] H. S. Barrows, 'A taxonomy of problem-based learning methods', *Medical Education*, vol. 20, no. 6, pp. 481–486, 1986, doi: 10.1111/j.1365-2923.1986.tb01386.x.

[9] C. E. Hmelo-Silver, 'Problem-Based Learning: What and How Do Students Learn?', *Educational Psychology Review*, vol. 16, no. 3, pp. 235–266, Sep. 2004, doi: 10.1023/B:EDPR.0000034022.16470.f3.

[10] L. Wijnia, S. M. M. Loyens, and E. Derous, 'Investigating effects of problem-based versus lecture-based learning environments on student motivation', *Contemporary Educational Psychology*, vol. 36, no. 2, pp. 101–113, Apr. 2011, doi: 10.1016/j.cedpsych.2010.11.003.

[11] S. Pedersen, 'Motivational Orientation in a Problem-Based Learning Environment', *Journal of Interactive Learning Research*, vol. 14, no. 1, pp. 51–77, 2003.

[12] L. Martin, J. West, and K. Bill, 'Incorporating Problem-Based Learning Strategies to Develop Learner Autonomy and Employability Skills in Sports Science Undergraduates', *Journal of Hospitality, Leisure, Sport & Tourism Education.*, vol. 7, no. 1, Art. no. 1, 2008, doi: 10.3794/johlste.71.169.

[13] K. Bourdas, A. Melissourgos, and F. Paraskeva, 'Users' Experience in a Gamified Online Educational Environment'.

[14] E. Y. Chung, 'Facilitating learning of community-based rehabilitation through problem-based learning in higher education', *BMC Medical Education*, vol. 19, no. 1, p. 433, Nov. 2019, doi: 10.1186/s12909-019-1868-4.

[15] D. R. Woods, *Problem-based Learning: How to Gain the Most from PBL*. Donald R. Woods, 1994.

[16] S. Bridges, C. McGrath, and T. L. Whitehill, Eds., *Problem-Based Learning in Clinical Education: The Next Generation*. Dordrecht: Springer Netherlands, 2012. doi: 10.1007/978-94-007-2515-7.

[17] A. Alrahlah, 'How effective the problem-based learning (PBL) in dental education. A critical review', *The Saudi Dental Journal*, vol. 28, no. 4, pp. 155–161, Oct. 2016, doi: 10.1016/j.sdentj.2016.08.003.

[18] B. Weiner, 'History of Motivational Research in Education', *Journal of Educational Psychology*, vol. 82, pp. 616–622, Dec. 1990, doi: 10.1037/0022-0663.82.4.616.

[19] N. Sirhan, G. Heileman, and C. Lamb, 'Traffic Offloading Impact on the Performance of Channel-Aware/Qos-Aware Scheduling Algorithms for Video-Applications Over Lte-A Hetnets Using Carrier Aggregation', *International journal of Computer Networks & Communications*, vol. 7, pp. 75–90, May 2015, doi: 10.5121/ijcnc.2015.7306.

[20] S. O. Akinoso, 'Motivation and ICT in Secondary School Mathematics using Unified Theory of Acceptance and Use of Technology Model', *Indonesian J. Educ. Res. Technol.*, vol. 3, no. 1, pp. 79–90, Feb. 2022, doi: 10.17509/ijert.v3i1.47183.

[21] S. Bishara, 'Humor, motivation and achievements in mathematics in students with learning disabilities', *Cogent Education*, vol. 10, no. 1, p. 2162694, Dec. 2023, doi: 10.1080/2331186X.2022.2162694.

[22] E. L. Deci and R. M. Ryan, 'The general causality orientations scale: Self-determination in personality', *Journal of Research in Personality*, vol. 19, no. 2, pp. 109–134, Jun. 1985, doi: 10.1016/0092-6566(85)90023-6.

[23] A. Kapsalis, *Educational Psychology*, VI. Thessaloniki: Kyriakides Bros. – Publications S.A., 2019. Available in Gereek

[24] P. R. Pintrich, 'Multiple Goals, Multiple Pathways: The Role of Goal Orientation in Learning and Achievement'.

[25] S. Rach, 'Motivational states in an undergraduate mathematics course: relations between facets of individual interest, task values, basic needs, and effort', *ZDM Mathematics Education*, vol. 55, no. 2, pp. 461–476, Mar. 2023, doi: 10.1007/s11858-022-01406-x.

[26] R. E. Slavin, 'Educational Psychology: Theory and Practice, Tenth Edition'.

[27] A. Bandura, 'Self-efficacy: Toward a unifying theory of behavioral change', *Psychological Review*, vol. 84, no. 2, pp. 191–215, 1977, doi: 10.1037/0033-295X.84.2.191.

[28] M. Bong, 'Role of Self-Efficacy and Task-Value in Predicting College Students' Course Performance and Future Enrollment Intentions', *Contemporary Educational Psychology*, vol. 26, no. 4, pp. 553–570, Oct. 2001, doi: 10.1006/ceps.2000.1048.

[29] L. Rababah, 'Jadara University Students'Attitudes towards the Use of Microsoft Teams in Learning English as a Foreign Language', vol. 4, pp. 59–64, Sep. 2020, doi: 10.22158/sll.v4n4p59.

[30] J. @ E. Luaran, N. N. Samsuri, F. A. Nadzri, and K. B. M. Rom, 'A Study on the Student's Perspective on the Effectiveness of Using e-learning', *Procedia - Social and Behavioral Sciences*, vol. 123, pp. 139–144, Mar. 2014, doi: 10.1016/j.sbspro.2014.01.1407.

[31] T. D. Cook, *Qualitative and Quantitative Methods in Evaluation*. Beverly Hills, CA: Sage Publications, 1979.

[32] L. Cohen, *Research Methods in Education*. 2018.

[33] J. Nisbet and J. Shucksmith, *Learning Strategies*. London: Routledge, 2017. doi: 10.4324/9781315188652.

[34] P. R. Pintrich and A. Others, 'A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ)', 1991. Accessed: Aug. 04, 2025. [Online]. Available: https://eric.ed.gov/?id=ED338122

[35] R. Arends, *Learning to Teach*, 10th ed. McGraw-Hill, 2012.

[36] D. Johnson, G. Maruyama, R. Johnson, D. Nelson, and L. Skon, 'Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis', *Psychological Bulletin*, vol. 89, pp. 47–62, Jan. 1981, doi: 10.1037/0033-2909.89.1.47.

[37] D. W. Johnson and R. T. Johnson, *Cooperation and competition: Theory and research*. in Cooperation and competition: Theory and research. Edina, MN, US: Interaction Book Company, 1989, pp. viii, 253.

[38] G. Hedin, L. Bendix, and B. Magnusson, 'Teaching Software Development Using Extreme Programming', in *Reflections on the Teaching of Programming: Methods and Implementations*, J. Bennedsen, M. E. Caspersen, and M. Kölling, Eds., Berlin, Heidelberg: Springer, 2008, pp. 166–189. doi: 10.1007/978-3-540-77934-6_14.

[39] P. R. Pintrich, D. A. F. Smith, T. Garcia, and W. J. Mckeachie, 'Reliability and Predictive Validity of the Motivated Strategies for Learning Questionnaire (Mslq)', *Educational and Psychological Measurement*, vol. 53, no. 3, pp. 801–813, Sep. 1993, doi: 10.1177/0013164493053003024.

[40] N. Massa, M. Dischino, J. Donnelly, and F. Hanes, 'Problem-based learning in photonics technology education: Assessing student learning', 2009.

[41] F. Paraskeva, A. Alexiou, H. Bouta, S. Mysirlaki, D. J. Sotiropoulos, and A.-M. Souki, 'Motivating Engineer Students in E-learning Courses with Problem Based Learning and Self-Regulated Learning on the apT2CLE4"Research Methods" Environment', in *Learning Technology for Education Challenges*, L. Uden, D. Liberona, G. Sanchez, and S. Rodríguez-González, Eds., Cham: Springer International Publishing, 2019, pp. 189–201. doi: 10.1007/978-3-030-20798-4_17.

[42] S. Sungur and C. Tekkaya, 'Effects of Problem-Based Learning and Traditional Instruction on Self-Regulated Learning', *The Journal of Educational Research*, vol. 99, no. 5, pp. 307–320, May 2006, doi: 10.3200/JOER.99.5.307-320.

[43] C. Foo, B. Cheung, and K. Chu, 'A comparative study regarding distance learning and the conventional face-to-face approach conducted problem-based learning tutorial during the COVID-19 pandemic', *BMC Med Educ*, vol. 21, no. 1, p. 141, Mar. 2021, doi: 10.1186/s12909-021-02575-1.

[44] E. Unal and H. Cakir, 'The effect of technology-supported collaborative problem solving method on students' achievement and engagement', *Educ Inf Technol*, vol. 26, no. 4, pp. 4127–4150, Jul. 2021, doi: 10.1007/s10639-021-10463-w.

[45] D. Gijbels, F. Dochy, P. Van den Bossche, and M. Segers, 'Effects of Problem-Based Learning: A Meta-Analysis From the Angle of Assessment', *Review of Educational Research*, vol. 75, no. 1, pp. 27–61, Mar. 2005, doi: 10.3102/00346543075001027.

[46] J. T. Nerali, L. A. Telang, A. Telang, and P. V. K. Chakravarthy, 'Problem-based learning in dentistry, implementation, and student perceptions', *Saudi Journal of Oral Sciences*, vol. 7, no. 3, p. 194, Dec. 2020, doi: 10.4103/sjos.SJOralSci_15_20.

[47] M. L. Moliner *et al.*, 'Acquisition of transversal skills through PBL: a study of the perceptions of the students and teachers in materials science courses in engineering', *Multidisciplinary Journal for Education, Social and Technological Sciences*, vol. 2, no. 2, Art. no. 2, Sep. 2015, doi: 10.4995/muse.2015.3896.

[48] F. Sulaiman, 'Students' Perceptions of Implementing Problem-Based Learning in a Physics Course', *Procedia - Social and Behavioral Sciences*, vol. 7, pp. 355–362, Jan. 2010, doi: 10.1016/j.sbspro.2010.10.048.

VIII. AUTHORS

Konstantinos Bourdas

Konstantinos Bourdas is an ICT specialist with 17 years of experience in technology-enhanced learning, across both face-two-face and digital learning environments. He holds an MSc in Management of Educational Organizations, Department of Business Administration, University of West Attica, and an MSc in E-Learning, Department of Digital Systems, University of Piraeus. His work mainly focuses on the design and implementation of Computer-Supported Collaborative Learning (CSCL) environments, incorporating approaches such as project and problem-based learning, and blended instruction. His research interests center around the application of Artificial Intelligence in education and the use of educational data analytics to inform pedagogical decision-making.

Georgia Kiriakaki

Georgia Kyriakaki is a PhD candidate at the University of West Attica (Department of Business Administration). She holds a Master's degree in "Management of educational organizations" (University of West Attica). Her research focused on teachers' burnout. Her BA degree is in Pre-school Education (University of Athens). She has worked as a Pre-school educator for more than 25 years and as a kindergarten Director for 17 years in Athens Greece. Today she is seconded to the University of West Attica for research purposes.

Maria Grigori

Maria Grigori holds a degree in Primary Education from the National and Kapodistrian University of Athens and a Master's in Educational Management. Her research focused on quality in education. Since 2014, she has been teaching in private education and has participated in various training programs and conferences in the field of pedagogy. She is particularly interested in innovative teaching approaches and continuous professional development. Since November 2024, she has been pursuing a PhD in Business Administration at the University of West Attica, focusing on entrepreneurial education and the intersection of education, management, and innovation.

Anastasia Themeli

Anastasia Themeli holds a BSc degree from the Department of Pedagogy and Primary Education of the National and Kapodistrian University of Athens, Greece (2011). Her postgraduate studies include an MSc degree in Educational Technology and HR Development, from the National and Kapodistrian University of Athens (2017). She is a PhD Candidate at the Department of Pedagogy and Primary Education of the National and Kapodistrian University of Athens. Her main research areas are Learning Design, Learning Analytics, Assessment, and Risk Management in Education. Anastasia is a member of Hellenic Educational Society, a certified adult educator and a certified Moodle Educator.

Christos Kytagias

Dr. Christos Kytagias is currently an Associate Professor in the division of Informatics and Decision Sciences at the Department of Business Administration, University of West Attica. He is a member of the Research Laboratory "Digit-DSS Lab", focusing on digital transformation and decision support systems in business and education. His research interests include object-oriented programming, analysis and designing of information systems, design patterns and principles, Web software engineering, Data Mining, Machine Learning, Learning Management Systems engineering, learning analytics and AI in Education.

Yannis Psaromiligkos

Yannis Psaromiligkos is a professor at the Department of Business Administration, University of West Attica. His research interests include e-learning engineering, learning analytics, evaluation in e-learning, web engineering, object-oriented programming, and modeling. He has authored over 70

papers in international journals and conferences and has participated in more than 30 European and national projects. Yannis serves as the director of the Digital Transformation & Decision Support Systems Research Laboratory (DigiT.DSS.Lab) and the Postgraduate Program "Management of Educational Organizations" at the Department of Business Administration. Additionally, he coordinates the Center for Teaching and Learning at the University of West Attica.