



Final Report of Intellectual Output 2

DEVELOPMENT OF THE DIGIMATES METHOD FOR ONLINE GAME-BASED LEARNING

**Detailed description of the development of the DigiMates method and instructions for
lecturers on how to use the method**

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INTRODUCTION

In a changing, digitalized society and globally competitive environment, high-quality education is crucial to ensure social cohesion, competitiveness, and sustainable growth. To meet the demands of rapid change in the world and the needs of the digital natives (i.e. the new generation in higher education), who have unique characteristics of the digital age and are known as the most diverse generation we have ever had to teach, educators should follow modern educational trends and use different teaching methods and approaches enhanced by ICT to motivate and engage digital native students in the learning process (Nikolaidis et al., 2022).

One of the innovative learning approaches that can help educators address the needs, preferences, and demands of digital natives is game-based learning (GBL), defined as “an environment where game content and gameplay enhance knowledge and skills acquisition, and where game activities involve problem-solving spaces and challenges that provide players/students with a sense of achievement” (Qian & Clark, 2016, p. 51). Some of the existing research suggests that GBL positively impacts many outcomes relevant to the educational context, such as positively impacting attitudes and perceptual and cognitive skills (e.g. Connolly et al., 2012), increasing students’ motivation to learn and engage, providing opportunities for exploration and acquisition of new knowledge and skills, and stimulating students to more easily achieve and maintain undivided attention for a longer period (Emes, 1997; Qian & Clark, 2016; Al-Azawi, Al-Faliti, & Al-Blushi, 2016).

Although GBL has been introduced in various fields (e.g. computer science, biology, business, logistics, mathematics, physics, psychology, and statistics), the use of this innovative teaching method still needs to be improved in practice. According to Al-Azawi et al. (2016), the introduction of GBL is quite expensive and difficult. This Intellectual Output (i.e. IO2) aimed to develop the DigiMates methods for game-based learning, which enhance student engagement in e-learning, development of transferable skills and cooperation in virtual international teams.

To achieve the aim of the IO2, we reviewed the GBL literature to identify the methodological workflow for well-designed educational games, identify best practices of game-based teaching methods that can be used in existing courses to increase online student engagement and motivation and enable the acquisition of transferable skills (e.g. teamwork, interpersonal skills, problem solving, critical thinking, cross-cultural experience, and communication), and develop, test, and revise the game-based method. Building on existing literature and models (e.g. the Game-Based Learning Design Model by Shi and Shih (2015)), in what follows, we provide a comprehensive, step-by-step guidance on how to implement the DigiMates method into course didactics in a systematic, cost-and-time-efficient manner.

1 DEFINITION OF BASIC CONCEPTS

Game-based learning is defined as “an environment where game content and gameplay enhance knowledge and skills acquisition, and where game activities involve problem-solving spaces and challenges that provide players/students with a sense of achievement” (Qian & Clark, 2016). According to Pho and Dinscore (2017), game-based learning involves not only developing games for students but also designing learning activities that can incrementally introduce concepts and guide users toward an end goal. Game-based learning leans on game principles and applies them to real-life scenarios to encourage students to engage in learning through play and make the learning process more interesting by making it fun (Al-Azawi, Al-Faliti, & Al-Blushi, 2016).

Game-based learning and **gamification**, which is defined as the use of game design elements (e.g., points, penalties, leaderboards, and trophies) in a traditionally non-game context to influence behavior, are often referred to as similar concepts, but most researchers argue that they are related but distinct concepts (Liu, Shaikh, & Gazizova, 2020). The biggest difference between the concepts is that game-based learning uses a game as part of the learning process and turns a single learning objective into a game (i.e. using games to achieve learning outcomes), while gamification turns the learning process as a whole into a game (Al-Azawi, Al-Faliti, & Al-Blushi, 2016). Gamification in education is used to support the learning material, while game-based learning is a way to learn and achieve learning objectives through games (Fernández-Raga, Aleksić, Íkiz, Markiewicz, & Streit, 2023).

Some of the existing research suggests that GBL positively impacts many outcomes relevant to the educational context, such as positively impacting attitudes, and perceptual and cognitive skills (e.g. Connolly et al., 2012), increasing students’ motivation to learn and engage, providing opportunities for exploration and acquisition of new knowledge and skills (e.g. Emes, 1997; Qian & Clark, 2016), and stimulating students to more easily achieve and maintain undivided attention for a longer period (Al-Azawi, Al-Faliti, & Al-Blushi, 2016). GBL is fun and thus increases students’ interest and motivation in the subject. In addition, GBL activities are different from traditional curriculum activities and, therefore, may be perceived as a mechanism for disrupting routine, which may increase students’ attention and interest in absorbing new information. On the other hand, a review of the literature on GBL also revealed that some studies had not found clear evidence of a positive relationship between GBL and students’ high academic achievement or psychological development, suggesting that GBL may not be more effective than traditional classroom lectures (Qian & Clark, 2016).

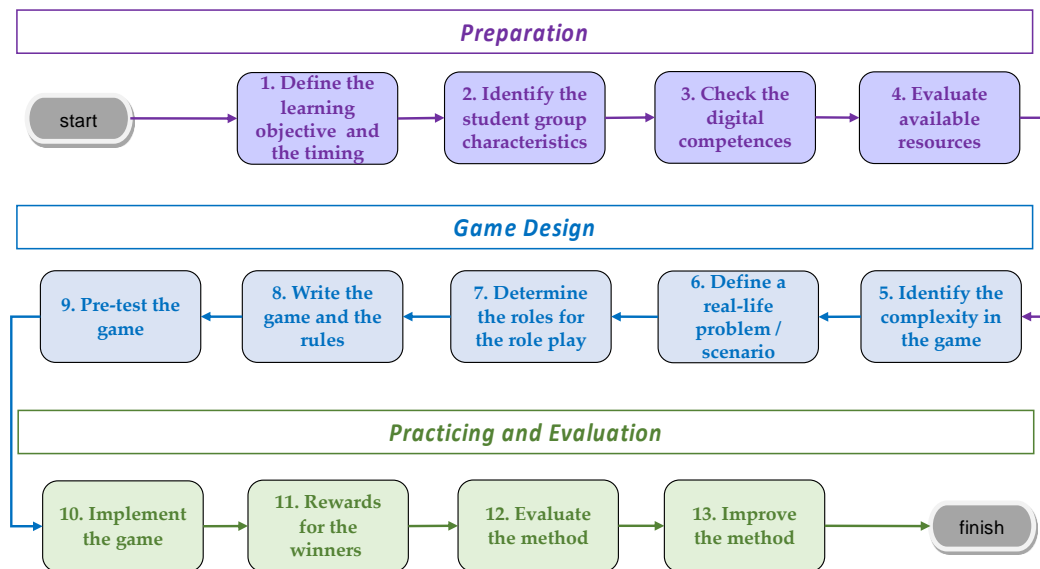
2 DESIGNING THE DIGIMATES METHOD

Based on a literature review and existing examples of game-based learning methods, we identified the main starting points on which we built the DigiMates method, with the aim of developing a method that is user-friendly and consequently more widely used. In order to achieve our goal, we considered the following requirements when developing the DigiMates method:

1. The method should be *easy to implement* from an organizational and technological point of view.
2. The method should be designed in such a way that the students are co-creators and co-players of the game (i.e. it must be *easy to use from the lecturer's point of view*).
3. The method should be *applicable in all areas of teaching*, regardless of the subject matter, and increase student motivation.
4. The method should allow a high degree of *flexibility* in terms of the way it is implemented (e.g. on which platform the game "runs") and the number of students involved in the game.
5. The method must encourage collaboration and (healthy) competition, as well as bring more **fun** to the learning experience.
6. The method should *allow virtual mobility* (i.e. easy integration of students into the international environment).
7. The method should serve as a tool that *promotes the combination* of face-to-face and online learning.

Following the requirements described above, we developed the process and steps for the comprehensive implementation of game-based learning in higher education as part of the DigiMates project, which we followed in developing the DigiMates method and are shown in Figure 1. A detailed general description of the process and steps for developing the game-based learning steps is presented in an article titled "Development of a comprehensive process for introducing game-based learning in higher education for lecturers," which was published in the Sustainability journal.

Figure 1: Graphical representation of the process and steps for the comprehensive implementation of game-based learning in higher education.



Source: Fernández-Raga, Aleksić, İkiz, Markiewicz, & Streit, 2023.

In the following section, each step is described in detail using the DigiMates method as an example.

2.1 Preparation

2.1.1 Define the learning objectives and the timing

General description of the step: In the first step of the preparation phase, lecturers should identify and define the learning objectives and the competencies they want to develop through the game-based learning method based on the curriculum and the course of study. When defining the learning objectives to be achieved through game-based learning methods, the lecturer should consider students' interests and needs to ensure that the game is interesting and meaningful to students, thereby increasing the students' motivation to participate in the method. It is also important to set realistic expectations in terms of objectives and competencies, depending on how much time lecturers plan to devote to game-based learning.

Description of the step on the example of the DigiMates method: We wanted to develop a game-based learning method that would allow students to **experience virtual international collaboration**. Therefore, depending on the (time) availability of students and lecturers, each partner institution determined the courses in which they could test the method and the learning objectives they wanted to achieve with the DigiMates method. Below, we describe the courses and learning objectives we wanted to achieve by using the DigiMates method at each partner institution.

Spain. The Spanish partner decided to test the DigiMates method as part of the "*Fundamentals of Physics Applied to Engineering*" course. The learning objectives that the students were expected to achieve through the DigiMates method were the following: To apply the knowledge that the students have acquired in the course to a concrete example - the construction of a bridge.

Turkey. The Turkish partner decided to test the DigiMates method as part of the "*QMT 3001 Business Forecasting*" course. QMT 3001 Business Forecasting is a mandatory course in the 3rd year of the bachelor study at the Department of Business Administration at Dokuz Eylul University. The learning objectives that the students were expected to achieve through the DigiMates method were the following: 1. demonstrate a good understanding of averaging-based forecasting and smoothing techniques and time series modeling with regression, and 2. demonstrate their ability to analyze time series in a business environment using the appropriate methods with a high level of confidence.

Germany. The German partner decided to test the DigiMates method as part of the "*Intercultural Communication*" course. The learning objective that the students were expected to achieve through the DigiMates method were the following: To apply the knowledge acquired in the course and to demonstrate that the students are able to prepare case-specific information on intercultural communication.

Poland. The Polish partner decided to test the DigiMates method as part of the "*Corporate Finance*" course. The learning objectives that the students were expected to achieve through the DigiMates method were the following: 1. demonstration of the ability to read financial statements (e.g. income statement, balance sheet, statement of change in financial position), 2. demonstration of the knowledge of planning and budgeting, profit planning, working capital management, and 3. demonstration of the proficiency in the application of rules and standards of corporate finance to solve specific problems, especially in the context of the international cooperation.

Slovenia. The Slovenian partner decided to test the DigiMates method as part of the "*Project management 2*" course. Project management 2 is a mandatory course in the 2nd year of the master's study at School of Economics and Business of the University of Ljubljana. The learning objectives that the students were expected to achieve through the DigiMates method were as follows: 1. to apply the knowledge acquired in the course to a concrete practical international project and 2. to gain practical experience in managing and overcoming challenges when working in an international project team.

2.1.2 Identify the student group characteristics

General description of the step: In the second step, lecturers should identify the particular characteristics of the student group in terms of size and other aspects important for teaching, such as the homogeneity of the student's knowledge base, multicultural or multilingual back-ground, possible special needs, and the dynamics they experience. In this step, lecturers must also determine the

modality of the game. That is, whether game-based learning activities should be conducted only in person or face-to-face, exclusively online, or in a hybrid way.

Description of the step using the DigiMates method: Considering that we wanted to test the DigiMates method in the context of five courses in five different countries, each lecturer performed this step using his or her courses as examples. When the DigiMates method was ready for testing, the study process was at different stages in each partner school. At some partner schools, the study process was already complete and students were already preparing for the exam period. Therefore, we decided that each lecturer would designate a certain number of students (7 to 10 students) to participate in the testing of the DigiMates method.

Since the study process had already normalized by the time the DigiMates method was tested (i.e., the coronavirus measures were no longer in force and all partner schools were conducting the teaching process almost exclusively face-to-face), we decided to implement the DigiMates method in a hybrid form. The latter allowed students to achieve their desired goals through a combination of face-to-face (e.g., instructions for game-based learning activities were given by lecturer to students in person) and online networking and work with students at other partner schools.

2.1.3 Check the digital competences

General description of the step: In this step, lecturers should consider the digital literacies of both students and lecturers, as the level of digital literacy of key stakeholders significantly affects the development of the game-based learning method.

Description of the step using the DigiMates method: Based on the study, which was conducted with 728 students, 448 professors, and 313 staff from five participating universities, we identified six key digital competencies (i.e. 5.2 Identifying needs and technological responses, 2.4 Digital Collaboration, 3.1 Developing Digital Content in Global Business, 3.3 Copyrights and license, 2.3. Engaging in citizenship through digital technologies, 3.2 Integrating and re-elaborating digital content) that need to be developed for successful implementation of the method. For each competency, we then developed a course to help participants develop individual competencies. For more details on the digital competencies, research, and results, see the Intellectual Output 3 (IO3) report.

2.1.4 Evaluate available resources

General description of the step: To complete the preparation phase, in the fourth step, lecturers should assess the resources available for game-based learning activities. In this step, lecturers consider the possibilities offered by the university and other free and accessible resources (e.g., applications, websites, platforms, servers, Moodle) that can be used to implement the game-based learning method.

Description of the step using the DigiMates method: Based on the study conducted with 152 lecturers of the five participating universities, we assessed the available resources at the five participating universities that could be used to implement the method. The study revealed that the DigiMates partner universities have different available resources that had to be taken into account when developing the DigiMates method, i.e., the method had to be developed in a way that would allow international collaboration between students using existing resources (i.e., no additional equipment, programs, etc. had to be purchased to implement the method), thus making the method cost effective. The study also revealed that four different learning management systems (LMS) are used in five participating universities and access to the LMS is given only to students who are officially enrolled to the university or specific course. Adding further students to the LMS is technically possible but could require IT staff intervention (no self-enroll option) and could lead to further costs (LMS fee may depend on the number of users). Therefore, the DigiMates team decided to use local LMSs for activities that are implemented within individual universities and Instagram for international activities. Students and professors may create new Instagram accounts and profiles to keep their personal account and data safe when playing the game. When live and formal international communication between students is required, professors provide appropriate tools and links (e.g., Zoom meeting links) to make sure that professional licenses are used. For more details on the available resources, research, and results, see the Intellectual Output 4 (IO4) report.

2.2 Game design

In addition to the members of the DigiMates project, Nataša Potočnik - an expert in the field of gamification (subcontractor Escape Room Enigmarium®) - also contributed to the design of the game.

2.2.1 Identify the complexity in the game

General description of the step: In this step, the lecturers outline the complexity of the game. The complexity/difficulty of the game-based activity can be determined as regards the "Learners' Digital Competency Level and Characteristics". In addition, in lecturers' experience, one should start with a minimum of complexity when entering game-based learning. Only a small portion of the class learning content should be turned into a game experience. Game elements such as quizzes, puzzles, or even cardboard games can be used for the initial approach. If the game is to be played online, there needs to be adequate equipment. Such games can be easily used by lecturers without deeper knowledge in game development and programming. Another advantage of this minimal approach is that the existing lectures don't need to be changed greatly, since the games are only an addition to the existing teaching content. Games help students relax, encourage communication between strangers, and get to the heart of a topic. The adaptable structure of a simple game can give participants more confidence to express themselves and develop ideas.

Description of the step using the DigiMates method: The results of the research we conducted as part of the DigiMates project showed that the lecturers involved in the project had little experience with the game-based learning method and more than half have never had any training on game-based learning methods. Therefore, we decided to design the DigiMates method in such a way that it would not be too complex and thus difficult to use. The added value of this relatively simple approach to developing the DigiMates method is also that we wanted to use the project results to disseminate the use of the game-based learning method among lecturers who, like us, have little experience with it.

2.2.2 Define a real-life problem/scenario

General description of the step: Once the technical and budgetary requirements are known, the next step is to define the real-life problem/scenario and the story environment. Available resources and funding play an important role, as more activities require more resources (e.g., time, equipment, etc.).

Description of the step using the DigiMates method: Based on the learning objectives described above that we wanted to achieve with the DigiMates method, we prepared the following real-life problem/scenario. The real-life problem/scenario is based on a real event (i.e. collapse of part of a viaduct on the A-6 motorway in Spain) that occurred on June 7, 2022.

“According to the Traffic Subsector of the Guardia Civil and the Ministry of Transport, on Tuesday, June 7, 2022, part of the Castro viaduct in the province of León collapsed during refurbishment work. The incident occurred very close to the border between the provinces of Lugo and León. According to the authorities, the collapse of the Castro viaduct occurred in the Vega de Valcarce region of the province of León, at kilometer 431 of the highway heading towards A Coruña, very close to the border with the province of Lugo.

No injuries were reported and traffic flow was not affected because the collapsed section was still under construction and therefore not open to traffic. The cause of the collapse is still unknown and a full investigation has been launched. The viaduct has been undergoing refurbishment work for about twelve months. At the time of the accident, traffic was concentrated on the section with the two lanes normally used in the direction of Madrid. According to the Ministry of Transport, traffic was diverted from the A-6 at kilometre 431 onto the N-6.

The Ministry of Transport launched an investigation into the causes of the Castro viaduct collapse. In addition, in order to continue the work on the Castro viaduct as soon as possible, a call for tenders has been issued seeking an international group of students to propose a solution for the reconstruction of the collapsed viaduct, prepare a cost estimate for the proposed solution, and develop a work plan and schedule for the reconstruction of the Castro viaduct.

Your lecturer has decided that your university will participate in the tender. Therefore, he/she has selected a team of the best students, including you, with whom he/she will participate in the tender. The tender requires that the project team is international and includes students from different

disciplines (e.g. applied physics, economics, etc.) to meet all the requirements. The deadline for submitting applications for this tender is 7 weeks. Your role in this project is described in detail below.”

2.2.3 Determine the roles for the role play

General description of the step: In this step we determine substantive roles for students, keeping in mind that they should be well-defined, challenging, interesting, specific, and designed to stimulate student learning. The objectives and the story will define the number of roles and the number of students who will play the same role. It is important to design them in a way that there is competition and conflict in playing each role, this being a fundamental element of game-based learning.

Description of the step using the DigiMates method: Based on the learning objectives described above that we wanted to achieve with the DigiMates method, we prepared a specific roleplay for each group of students from a particular partner school. The students of each partner school have access to the description of their role (i.e. they do not have insight into the role play description of the other students of the other partner school).

Role play for Spanish students. Your main role in the international team is to make calculations on the basis of which you will propose a (technical) solution on how to restore the collapsed viaduct. In doing so, apply the knowledge you have acquired in the course Fundamentals of Physics Applied to Engineering. Your specific tasks in the international team are as follows:

- Study the additional study material provided by the lecturer.
- Find all publicly available information about the collapse of the part of the Castro viaduct. Since very little information about the Castro viaduct collapse is available in English, you, as a native speaker, are expected to communicate important information about the event to the other members of the international team.
- Search the Internet for all the information you need to calculate your proposed solution for repairing the viaduct (i.e. how you would build the bridge). You can make up information you do not have access to, but you must support each piece of information with a logical argumentum (i.e. you must explain what your assumptions were).
- Work with other students in your group to come up with a proposed solution (i.e. build a viaduct) that must be supported by appropriate calculations. The number of bonus points you receive when presenting your idea depends on the quality of your calculations that require you to apply the knowledge you have acquired in the course.
- Communicate regularly with other members of your international team and provide them with important information (e.g. the list of resources you will use to build the viaduct, the construction schedule, etc.) that they will need to prepare their part of the tender documents.
- Considering that you are covering the field of physics in the international project and the other team members do not know much about this field, your task is also to briefly, clearly, and concisely convey to the other members the essential knowledge from your field that the other



members of the international team ought to have in order to communicate effectively with each other. How you do this is entirely up to you. However, it is important that you find creative ways to communicate the basics of your area of expertise to the other team members (e.g. make short, fun videos, TikTok or Instagram post, etc.). At the same time, you need to find a creative way to verify that other team members have mastered the knowledge you are trying to impart to them.

- You are expected to communicate regularly with all your classmates who are also involved in the project.
- You are required to regularly attend joint meetings with other members of the international team.
- You are also supposed to regularly follow this project's profile on Instagram, which is intended for an asynchronous form of communication with other members of the international team. Any additional instructions or requests we receive from the Ministry of Transport will also be posted on the Instagram profile. Your task is to respond to these requests as quickly as possible, as this will also impact your final grade or reward.

Role play for Turkish students. Your main role in international team is to make a calculation to predict how many means of transportation (e.g., cars, trucks etc.) will cross the viaduct on a daily basis after its reconstruction, based on an analysis of trends in past and current data. Your calculations are an important contribution to the Spanish team that is developing a technical solution for the reconstruction of the collapsed viaduct. In doing so, apply the knowledge you have acquired in the course QMT 3001 Business Forecasting. Your specific tasks in the international team are as follows:

- Study the additional study material provided by the lecturer.
- Search the Internet for all the information you need to predict how much traffic will be on the viaduct when it opens. You can make up information you do not have access to, but you must support each piece of information with a logical argumentum (i.e. you must explain what your assumptions were).
- Work with other students in your group to make the prediction that must be supported by appropriate calculations. The number of bonus points you receive when presenting your idea depends on the quality of your calculations that require you to apply the knowledge you have acquired in the course.
- It is very important to be as accurate as possible in your calculations. Do not rush into anything. If the other members of the international team insist that they need information from you and you do not yet have accurate calculations, make it clear to them that you cannot yet give them that information.
- Communicate regularly with other members of your international team and provide them with important information that they will need to prepare their part of the tender documents.
- Consider the fact that you are the only members of the international team who have the knowledge of business forecasting and the other team members do not know much about this topic. Therefore, it is also your responsibility to briefly, clearly and concisely communicate to the other members the essential knowledge from your area of expertise that the other



members of the international team must have in order to communicate effectively with each other. How you do this is entirely up to you. However, it is important that you find creative ways to communicate the basics of your area of expertise to the other team members (e.g. make short, fun videos, TikTok or Instagram post, etc.). At the same time, you need to find a creative way to verify that other team members have mastered the knowledge you are trying to impart to them.

- You are expected to communicate regularly with all your classmates who are also involved in the project.
- You are required to regularly attend joint meetings with other members of the international team.
- You are also supposed to regularly follow this project's profile on Instagram, which is intended for an asynchronous form of communication with other members of the international team. Any additional instructions or requests we receive from the Ministry of Transport will also be posted on the Instagram profile. Your task is to respond to these requests as quickly as possible, as this will also impact your final grade or reward.

Role play for German students. Your main role in this international team is to ensure effective communication between team members who come from different cultural backgrounds. In doing so, apply the knowledge you have acquired in the course Intercultural Communication. Your specific tasks in the international team are as follows:

- Study the additional study material provided by the lecturer.
- Based on the knowledge acquired in the course, you are supposed to make an analysis that will allow you to describe and compare the different cultures of the participants of the international team.
- Based on the results of the previously mentioned analysis, you will work with other students in your group to prepare a short workshop that you will conduct with the entire team, the aim of which is to make the members of the international team aware of possible cultural differences that may affect teamwork. The goal of the workshop is to make the team members aware of possible cultural differences and stereotypes and thus improve the effectiveness of communication in the team. The number of bonus points you receive at the end of the project depends on the quality of the workshop that requires you to apply the knowledge you have acquired in the course.
- You need to carefully monitor communications (verbal and nonverbal, written and verbal) by members of the international team in various media (e.g., online meetings, Instagram profile, etc.). If you identify potentially inappropriate communication, you should take immediate action.
- When conflicts arise between team members, you must take on the role of moderator and play a significant role in resolving the conflict.
- Communicate regularly with other members of your international team and provide them with important information that they will need to prepare their part of the tender documents.



- Consider that you are the only members of the international team who have knowledge of intercultural communication and the other team members do not know much about this topic. Therefore, it is also your responsibility to briefly, clearly and concisely communicate to the other members the essential knowledge from your area of expertise that the other members of the international team must have in order to communicate effectively with each other. How you do this is entirely up to you. However, it is important that you find creative ways to communicate the basics of your area of expertise to the other team members (e.g. make short, fun videos, TikTok or Instagram post, etc.). At the same time, you need to find a creative way to verify that other team members have mastered the knowledge you are trying to impart to them.
- You are expected to communicate regularly with all your classmates who are also involved in the project.
- You are required to regularly attend joint meetings with other members of the international team.
- You are also supposed to regularly follow this project's profile on Instagram, which is intended for an asynchronous form of communication with other members of the international team. Any additional instructions or requests we receive from the Ministry of Transport will also be posted on the Instagram profile. Your task is to respond to these requests as quickly as possible, as this will also impact your final grade or reward.

Role play for Polish students. You are the only group of students on an international team with a secret mission. You must convince the other members of the international team that your only role in the project is to help plan and budget the project. But that's not actually your main role. Your main role in the project is to protect the interests of the construction company that will carry out the reconstruction of the viaduct. In doing so, apply the knowledge you have acquired in the course Corporate Finance. Your specific tasks in the international team are as follows:

- Study the additional study material provided by the lecturer.
- Study the financial statements of a construction company provided by the lecturer.
- Based on the analysis of financial statements, work with other members of your team to prepare a profit plan for the construction company you represent. The number of bonus points you receive for the profit plan depends on the quality of your calculations that require you to apply the knowledge you have acquired in the course.
- Based on the profit plan, argue that the costs of the project assessed by the Slovenian student team must be higher (to ensure a higher difference between costs and revenues - i.e., a higher profit). Other members must not suspect for a moment that you are actually representatives of the construction company. If there is a suspicion that this is the case, you will be automatically excluded from the team.
- Communicate regularly with the other members of your international team and provide them with important information that they will need to prepare their part of the tender documents. In doing so, make sure that you provide other members with information that is useful for your construction company.



- Consider the fact that you are the only members of the international team who have the knowledge of corporate finance and the other team members do not know much about this topic. Therefore, it is also your responsibility to briefly, clearly and concisely communicate to the other members the essential knowledge from your area of expertise that the other members of the international team must have in order to communicate effectively with each other. How you do this is entirely up to you. However, it is important that you find creative ways to communicate the basics of your area of expertise to the other team members (e.g. make short, fun videos, TikTok or Instagram post, etc.). At the same time, you need to find a creative way to verify that the other team members have mastered the knowledge you are trying to impart to them.
- You are expected to communicate regularly with all your classmates who are also involved in the project.
- You are required to regularly attend joint meetings with other members of the international team.
- You are also supposed to regularly follow this project's profile on Instagram, which is intended for an asynchronous form of communication with other members of the international team. Any additional instructions or requests we receive from the Ministry of Transport will also be posted on the Instagram profile. Your task is to respond to these requests as quickly as possible, as this will also impact your final grade or reward.

Role play for Slovenian students. In this international team, you are required to take on the role of project manager who is personally responsible for ensuring that all documentation required for the tender is produced on time and to a high standard. In doing so, apply the knowledge you have acquired in the course Project management 2. Your specific tasks in the international team are as follows:

- Study the additional study material provided by the lecturer.
- Your task is to lead the project team according to the project management knowledge acquired in the course. If the other members do not perform their task or do not perform it well enough, you will be penalized with minus points.
- You will convene an introductory meeting, establish the rules for cooperation and the dates for regular meetings, which will help you to monitor the process of implementation of the required activities by the international team.
- Together with your classmates, you will prepare a clear and concise draft report which will be used to monitor the progress of the project. You also need to set a schedule for when (and how often) the other members should submit the reports to you.
- Based on the input from other members of the international team, you must work with your classmates to create a work breakdown structure (WBS), schedule, resource plan, cost plan, and risk management plan for the project (i.e., rebuilding the viaduct). The number of bonus points you receive when presenting your work (i.e. plans) depends on the quality of your plans, which require you to apply the knowledge you have acquired in the course.

- Your key task is also to encourage other members of the international team to communicate and share with the whole team all the information that the team needs to work successfully on the project with which you will apply for the tender.
- Your task is also to motivate the members of the international team to contribute to the project and make them as active as possible on the Instagram profile, which is an important medium for asynchronous collaboration among your team. The evaluation of your work (and consequently the reward for the work done) also depends on the number of posts, likes and comments on the Instagram profile.
- When you receive additional information and requests from the Ministry of Transport, it is your responsibility to organize and distribute any additional work necessary to respond to the additional request in a timely manner.
- Communicate regularly with other members of your international team and provide them with important information that they will need to prepare their part of the tender documents.
- Consider the fact that you are the only members of the international team who have the knowledge of project management and the other team members do not know much about this topic. Therefore, it is also your responsibility to briefly, clearly and concisely communicate to the other members the essential knowledge from your area of expertise that the other members of the international team must have in order to communicate effectively with each other. How you do this is entirely up to you. However, it is important that you find creative ways to communicate the basics of your area of expertise to the other team members (e.g. make short, fun videos, TikTok or Instagram post, etc.). At the same time, you need to find a creative way to verify that the other team members have mastered the knowledge you are trying to impart to them.
- You are expected to communicate regularly with all your classmates who are also involved in the project.
- You are required to regularly attend joint meetings with other members of the international team.
- You are also supposed to regularly follow this project's profile on Instagram, which is intended for an asynchronous form of communication with other members of the international team. Any additional instructions or requests we receive from the Ministry of Transport will also be posted on the Instagram profile. Your task is to respond to these requests as quickly as possible, as this will also impact your final grade or reward.

2.2.4 Write the game and the rules

General description of the step: In this step, the combination of all the elements that we have already decided is united in a storytelling that is an engaging narrative of events. At this point lecturer should consider what support materials the students will need to be able to solve the challenges at each step. The wording of the rules, points, and prices can be crucial to continue the game, but because of the learning objective of the game, students must have many chances to continue in the game, so that they do not drop out. Rewards depend on the creativity of the lecturer.

Description of the step using the DigiMates method: In the following section, we present the game step by step from the point of view of lecturers and students:

1. **Lecturers** presents the real-life problem/scenario described above to students (in person or online) participating in the DigiMates game.
2. **Lecturers** introduces the students to the role-play written for a group of students from each partner school. The lecturer ensures that **students** understand what their role is in the international project and what is expected of them. It is critical that each group of students become familiar with their own role only (i.e., that they are not aware of the role of the other groups of students).
3. **Lecturers** create a (closed) Instagram profile intended for asynchronous communication between students, where they will also provide additional instructions to the students.
4. **Lecturers** shares with the students the additional material they need to study and estimates the time students will need to study that material and, depending on their role, gather the most important information they need for their work. Lecturers share this information with the lecturers from partner schools and as this information will present the basis for introducing additional requirements/tasks through which we will introduce elements of competition, time pressure, etc. Lecturers should make sure that all students have about the same amount of material to work with.
5. **Students** work in teams at each partner school on the activities they must complete.
6. **Lecturers** encourages students to creatively share any important information with other team members at the meeting and via their Instagram profile. At the same time, the lecturer ensures that students are aware that the number of posts, likes, and comments on their posts will earn them extra points.
7. When all **lecturers** assess that group work has developed sufficiently at each partner school, we post on the Instagram profile an additional request from the Ministry of Transport stating that each school's teams may consist of no more than two students (aim: introduction of the competition between the team members of each partner school). As a result, teams from each partner school are instructed to complete their task in pairs (rather than with their entire group of classmates). We inform the students that at the end we will evaluate the quality of each pair's work product and that only the pair with the most points will be included in the final project. This duo will also be rewarded for their work.
8. **Students** continue to work on their roles in pairs.
9. According to the scenario, the international student team has 7 weeks to prepare all the necessary documents to submit the project to the tender. **Lecturers** consider when it is appropriate to inform the students on Instagram that due to public pressure, the Ministry was forced to shorten the deadline for submitting the application documents. For example, the latter must be submitted in two weeks (the aim of this notification is to create time pressure).
10. As the submission deadline approaches, we post on Instagram **another item of news/additional request**. According to this, the Ministry has determined that it does not have the time to read all of the documents, which is why it requires international student teams to prepare a pitch of no more than 30 minutes in which all of the important information is presented to them.

Based on this pitch, which will take place on Zoom, the members of the commission (composed of lecturers) will evaluate the project and award prizes.

11. **Students** must convene urgent meetings to determine which pairs from each partner school will participate in the pitch and prepare its content.

Evaluation criteria are as follows:

- Quality of the tasks performed in relation to the roles described (the latter will be evaluated by the respective lecturers).
- Speed in responding to additional requests.
- Creativity in posting on Instagram.
- Speed and quality of student response (e. g. commenting, liking, participation in meetings, etc.)
- Peer evaluation of students (i. e. students in the same group evaluate each other for teamwork).

Lecturers must consider the course Syllabuses when preparing evaluation criteria. According to a survey of five universities participating in the DigiMates project, in four of them the assessment method is a required element of the syllabus and the assessment criteria is a required element of the syllabus in all surveyed universities. It is important to check that grading based on the results of the game is in line with the syllabus. The survey also showed that 45% of surveyed professors believe that the completion of tasks related to the gamified course can replace the exam but 55% are of the opposite opinion.

2.2.5 *Pre-test the game*

General description of the step: The last step of the game design phase consists of pre-testing the game to validate the game. For this step, it is crucial that the rules are clearly explained, and the measurement of this is done independently by the comprehension ability of each student. In this phase, a few students are selected to play a pilot version of the game to analyze the flow of the story, to say whether the game captures them or not, and to suggest improvements in the rewards of the phases, the possibility of adding new phases, tests, opportunities, resources or even the modification of the roles and scenarios. At this stage, developers also present the GBL method to some lecturers to check whether the method is written in a lecturer-friendly way.

Description of the step using the DigiMates method: As part of this step, we tested the DigiMates method. The testing included the following activities:

- We tested the method on a small sample of students. We collected students' feedback on the method and their suggestions for improvement.
- The method was discussed in a small number of lecturers, who provided their opinions on the method and offered suggestions for improvement.
- Appropriate rewards for the winners of the game were discussed with students and lecturers. The purpose of the rewards must be consistent with the learning objectives of the course, and

at the same time, the rewards must be designed to motivate students to actively participate in the game.

- We analyzed the feedback collected from different stakeholders (i.e. students, lecturers, and gamification experts) and modified the game design based on the results to improve the DigiMates method. The steps that were described in detail above are mostly based on revisions.

In the following section, we briefly summarize how we conducted the pre-testing, the main feedback we received from the different stakeholders, and recommendations we formulated based on the testing phase of the method.

2.2.5.1 Implementation of pre-testing

Pre-testing was conducted with a sample of volunteers in the courses listed in Section 2.1.1. Each partner invited students to participate in their course (e.g. the Spanish partners tested the method on a sample of 11 students in the Electronic engineering course, the Polish partners on a sample of 20 students in the International Business course, the Slovenian partners on a sample of 6 students in the Project Management 2 course), introduced them to the DigiMates method, and asked the students to participate in testing the method, commenting on it, and giving recommendations for improvements.

At this point we would like to stress that during the testing phase we found that when implementing the method in an international team, it is very important to: 1) pay close attention to the timing of the implementation of the method, as different partner universities start and end the study semester at different times; 2) take into account the specific rules of each partner university when planning the implementation of the DigiMates method (e.g. examination regulations, rules for awarding bonus points, etc.); and 3) before implementing the DigiMates method, be sure to determine whether and in what way participation in the method will affect the final grade of the course in which the method is implemented.

At the same time, we conducted a pretest with a sample of more than twenty lecturers who read the instructions for implementing the method, commented on the comprehensibility of the instructions for implementing the DigiMates method, and provided their recommendations for improvement.

2.2.5.2 Feedback on the DigiMates method from the different stakeholders and recommendations for improvements

Below are brief summaries of the key feedback we received from various stakeholders during the testing phase.

Students. Most of the students who participated in the test phase have not yet experienced a similar GBL method. Most have heard of gamification of the study process, they welcome it, but the majority said that so far, they have only experienced certain elements of gamification in their study process

(e.g., they have participated in various quizzes, collected points, etc.). Students want something new and believe that such methods could increase their motivation and engagement in the study process. This is especially true if the game is played in an international team, as they find this kind of experience of working in an international team very interesting. At the same time, they pointed out that the fact that they cannot express themselves in their native language, but have to prepare all content and communication in English, could influence their involvement in the implementation of the method (e.g., preparing Instagram posts).

Students provided the following feedback and recommendations to improve the method:

- When using the DigiMates method in an international team, it is very important that the students participating in the implementation of the method speak **English** very well. This will enable the students to express themselves in an appropriate way.
- The students really appreciated the fact that the DigiMates method was developed using a **real case**. We chose real cases to give students the opportunity to find as much publicly available information as possible. The students liked this idea, but made the recommendation that they would still prefer to get most of the **material** from the lecturers and only have to find certain information themselves.
- Most students like to **work in a group** and therefore they recommended that the tasks they tackle using the DigiMates method be solved in a group and rather than individually.
- The students liked the idea of forming several teams at each partner university to **compete for the best solutions**. They recommended that it would be good if all teams had the opportunity to present their solutions to team members from each partner university as well as to lecturers from all five countries. Specifically, each team from Spain, Turkey, Slovenia, Germany, and Poland could participate in the online session where they would present their work. Based on the presentation, all participants could choose the best solution (i.e., a winning team from each university).
- Students also provided recommendations for **rewarding or evaluating** their work when using the DigiMates method. The first recommendation in this regard is that it would be absolutely necessary to define very clearly from the beginning how many points or what percentage of the final grade of the course they can gain by participating in the implementation of the DigiMates method. At the same time, they recommended that it would be good if the first team (i.e., the winning team) got the most points, the second a little less, and so on. In addition, some students felt that participation in the DigiMates method should earn bonus points because the DigiMates method is designed in such a way that one team is always the best. This means that the other team cannot get all the points, which can have a (negative) impact on the final grade of the course.
- When testing the DigiMates method, we found that students prefer **different social platforms**, which must be taken into account when implementing the method. We assumed that students would use Instagram to implement the method. Some students have no problem using their private profile for gaming purposes, while others argue that it would be better to create a special account for using the method. In addition, some students said that they do not use Instagram and therefore it would be impractical for them to use it only for study purposes.

Students recommended choosing a platform that most students involved in the method are familiar with and use it to implement the DigiMates method.

- Some students really liked the "**double role**" they are required to play in implementing the DigiMates method.
- Although the students like that the DigiMates method is different from the methods they have used so far during their studies, they said that they would like to have very **specific instructions** on when, who, with whom, in what way they have to do the tasks when they participate in the implementation of the DigiMates method. This would make it easier for them to organize and divide their time and attention appropriately between the courses they take during the semester.
- Students liked the idea of introducing new, innovative methods such as the DigiMates method into the learning process, but at the same time they pointed out that it would not be good if such methods, which require a lot of student engagement, were **introduced in all courses** they have to attend during the study semester. They believe that this would not be feasible in terms of time. Furthermore, students recommend that the introduction of this method should not be an additional form of work in the course (e.g. in addition to seminar assignments, quizzes, etc.), but rather a basic form of work in the course.
- Students recommended that if the same real-life scenario and roles are used repeatedly in the course, it would be good to set up a **platform where different materials are collected** (e.g., those prepared by lecturers and those used/prepared by students). This would prevent students from using the solutions from previous years in a negative sense (i.e., changing them a bit and presenting them as their own without putting much work into them), but rather encourage each generation of students to build on the findings and solutions of previous generations. This would make the students' solutions even more creative and sophisticated each year.
- Students like the idea of working in a **multidisciplinary team**, but they raised the doubt that a possible misunderstanding of the specifics of a particular area could (negatively) affect their work. This would be especially problematic if the assignments completed as part of the DigiMates method were graded and made up a certain portion of the final course grade. Therefore, they recommended that the assignments of the individual teams be designed in such a way that they do not (strongly) depend on the knowledge and understanding of the work of students from another field.
- Students also pointed out that **scheduling** several local and international meetings could pose an issue when their regular schedules are very diverse and they need to combine their work and study obligations. They recommended that the schedule should be set well in advance.

Lecturers. Lecturers also found the DigiMates method interesting and they believe that they could use it to enrich the learning process in their course. In general, they think the method is feasible and like the fact that it is suitable for both beginners and lecturers who are more advanced in terms of using various platforms, technologies, etc.

Lecturers provided the following feedback and recommendations to improve the method:

- Lecturers emphasized the challenges related to student motivation and engagement following the COVID -19 pandemic and argued that the DigiMates method is a potentially interesting solution for addressing this challenge.
- Most of the lecturers think that the DigiMates method is well designed, but they feel that despite the fact that the method is designed to be time and cost efficient, implementing the method would still take a lot of time in the beginning to prepare the necessary materials and coordinate with partner universities. They therefore recommended that universities find a way to evaluate the additional effort required to implement the new method in terms of **work load**.
- Lecturers like the fact that the DigiMates method can be used online, in the classroom, and in a hybrid format. At the same time, they like the fact that the method is designed to be suitable for different courses (e.g. different number of students, course content).
- Lecturers liked that students must **co-create the game** and teach each other the content of the course they master and practice their presentation skills internationally. But careful considerations are needed if students with special needs are involved. However, this would be a valuable experience for students.
- Lecturers liked the idea of **multidisciplinary teams** and the fact that the DigiMates method allows for (virtual) internationalization at home, but at the same time they pointed out that it is very difficult to find a combination of courses in which students can successfully collaborate and complement each other.
- Lecturers suggested that when several courses are combined in the game, it is an advantage if the classes are of approximately the same size. Then several parallel games can be played. This affects competition but at the same time ensures that the students are actively involved during the whole game.
- Some lecturers expressed concern that the DigiMates method might be too complicated from the perspective of today's students who are generally not interested in proactively seeking out and absorbing new knowledge. At the same time, they recommended that universities **organize additional training on gamification** of the learning process, which would allow them to update the DigiMates method every year according to the acquired knowledge and trends. In this way, we would ensure that the DigiMates method is in line with the needs, requirements and desires of quickly changing generations of students.
- Some lecturers emphasized that they **do not use Instagram** and therefore feel that they would have a problem guiding and helping students when issues arise related to posts on Instagram. As a result, the lecturers made a recommendation: a) that when implementing the DigiMates method, a social network should be used that the participating lecturers know well, or b) that before implementing the method, a short training session should be organized in which the lecturers can familiarize themselves with how the selected social network works and that they have someone to help them when problems arise.
- Lecturers who already have some experience with gamification of the study process recommended that universities provide additional resources that could be used to **digitize the DigiMates method** and thus make it even more interesting for today's students.

- Lecturers recommended forming some sort of **(online) community** where lecturers using the DigiMates method can share experiences, best practices, materials, etc.
- Some lecturers believe that the method is suitable only for postgraduate students, who usually have no problems with communication in **English**. At the same time, they believe that the application of the DigiMates method in an international team could be controversial if it would represent a certain part of the final grade of the course. Namely, in the case of using the method at a public university, students might complain if the coursework required communication in a language that was not their native tongue.

Gamification expert. The expert who participated in the development of the DigiMates method gave some additional recommendations for further development of the method. The expert is the founder of Enigmarium®, the first Escape Room center in the Alpe-Adria region and a trendsetter in the field of gamification, which has already developed 25 original games in three EU countries.

The gamification expert gave the following recommendations that should be considered when applying the DigiMates method:

- The following gamification elements could be added to the GBL design to make it more appealing to students: a) **Progress feedback** - this allows players to locate themselves (and their progress) within a game. A progress bar or number of steps could be used. and b) **Acknowledgement** - feedback that praises specific actions of players (they can collect badges, medals, trophies, or solve missions) or achievement of levels - character levels, skill levels - or titles could be used.
- It is very important that students know the **rules of the game**: how to get the points and why these points are important. The rules of the game are one of the key elements of the game. It is very important that all participants know how to get the points and how many points they need to win to stay in the game. For example, students need five points each week. Each professor can distribute the points among the students at the end of the week according to his key.
- When implementing the DigiMates method, lecturers should make sure that all students have roughly the same **amount of material**.
- The expert also recommends the **numbering of assignments** (e.g., this is assignment 1 of five assignments). This can serve as a good motivator (knowing that you have five tasks to complete and that the game is not endless) - this is also the basis for "progress feedback."
- The expert recommends applying "**social pressure**" whenever possible. The pressure through social interaction with other players is one of the most important elements of gamification.
- The expert liked the Spanish-Turkish student conflict and found the Polish dual role interesting. The expert recommended awarding extra bonus points to the team that suspected that the Poles played a double game. Lecturers can give a **hint** that one team is corrupt in some part of the game (perhaps at the end of the game so that the Polish students are not

eliminated). According to the expert, this would give the game a big boost and a "fun" element.

- The expert recommends that the best team makes the **pitch**, but other teams can become the **jury** that evaluates the ends of the pitch. This makes them (the other teams that were not the best) feel like an important part of the project. In this way, everyone who participated in the competition benefits - even those who did not win.
- The expert noted that it is very important that all participants know how to get the points and how many points they need to win to stay in the game. For example, students need five points every week. Each lecturer can distribute the points to the students at the end of the week according to his/her key/rule.

Recommendations based on the content analysis conducted within IO1. Within IO1, we conducted content analysis based on the TIPEC model (for more details, see the IO1 final report). The analysis revealed several pedagogical and individual barriers that should be taken into account when designing the method. In Table 1, we briefly present the identified barriers (pedagogical or individual) that could be encountered in the design and implementation of the method and provide a recommendation on how to mitigate the identified barrier.

Table 1: Recommendations for mitigating potential pedagogical and individual barriers

Type of barrier	Specific barrier	Recommendation
Pedagogical Barriers	3.5.6. Lack of Pre-Course Orientation	When choosing the platform on which to "run" the game, lecturers should specify the technical characteristics of the platform, organize training, and/or provide technical support for using the platform. Namely, students need to be familiar with the platform and have the appropriate know-how to play the game successfully.
	3.5.3. Different Time Zone	When implementing the method with an international team of students, the different time zones should be taken into account when setting the schedule for the game-based activities.
	3.2.6. Tutor support/counselling sessions	Establish roles in a way that encourages mutual support. Also, ensure that students have access to lecturer support when needed.
	3.8.1. Lack of reliability of online assessment process	When creating evaluation criteria, the weighting of each performance criterion should be shared with students prior to using the DigiMates method.
	3.8. Assessing Performance	Students should be assessed individually.
Individual Barrier	2.4.1. Individual Culture	When identifying the characteristics of the student group, pay attention to the potential characteristics that arise from individual cultures. This is especially important when using the method with an international team.

2.3 Practicing and evaluation

As shown in Figure 1, the "Game design" phase is followed by the "Practicing and evaluation" phase, which includes the following steps: Implementation of the game, rewards for the winners, evaluation of the method, and improvement of the method. The goal of the DigiMates project was to develop and test the DigiMates method. Consequently, this phase (i.e. Practicing and evaluation) is outside the scope of the project, so we did not implement the game as part of the project, only tested it. However, as described in detail in Section 2.2.5, we performed all of the steps intended for this phase (i.e., implementing the game, determining rewards for winners, evaluating the method, improving the method) as part of the pretest.

3 CONCLUSION

The disruption of education caused by COVID -19 presented a major challenge to lecturers around the world. The situation required an adaptation of the organization of lectures and learning style to a fully e-learning supported context. Although the end goal was the same both in face-to-face and e-learning, the two systems differ in terms of learning environment and interaction (student-lecturer, student-material, lecturer-lecturer, and student-institution). Therefore, in e-learning, different approaches and methods are required for the teaching processes to achieve their goals and for students to acquire the intended competencies.

During the implementation of the DigiMates project, we gradually returned to the classrooms and started to conduct the study process in a face-to-face format. At the same time, we tried to maintain good e-learning practices that we had acquired during the COVID -19 pandemic and made greater use of hybrid learning.

Our experience shows that the success of e-learning, face-to-face or hybrid learning depends primarily on student engagement. Namely, regardless of the form of learning, it is not always easy to capture students' attention. Student generations are changing, and it is becoming increasingly difficult for students to engage with lecturers, content, and each other. Therefore, the introduction of various modern pedagogical methods to promote student motivation and engagement in (e-) learning is very welcome.

Gamification is certainly one of the plausible methods to be tested. Namely, research shows that GBL successfully motivates participants to engage with learning content and to engage with learning activities for longer periods of time. Moreover, gamification has been shown to be more effective in improving knowledge, skills, and satisfaction compared to traditional educational methods. Therefore, higher education institutions should integrate GBL into their existing curricula to promote student engagement and the development of transferable skills in an online environment and enable virtual internationalization.

There are a variety of ways to introduce your classroom to gamification of education; however, there

is no comprehensive overview of all gamification methods that have been used in the educational context. One of the most obvious drawbacks to educational gamification is the fact that lecturers are often unable to find a game that meets the requirements of the learning objectives. In addition, the cost of gamified learning varies depending on the type of system used. There may be costs associated with equipment, software, and faculty training.

As part of the DigiMates project, we therefore developed the DigiMates method, which is user-friendly, easily adaptable to different learning objectives, and cost-effective to implement to enable lecturers to increase student engagement in (e-)learning. The method meets the needs of digital natives who want to use digital technologies in the learning process and use their natural abilities to collaborate in teams to achieve learning goals. In addition, we assume that the method will allow universities to equip students with a wide range of skills and competencies, such as digital literacy, critical thinking, problem solving, entrepreneurship, teamwork, and many others. The DigiMates method is also designed to promote some internationalization at home.

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