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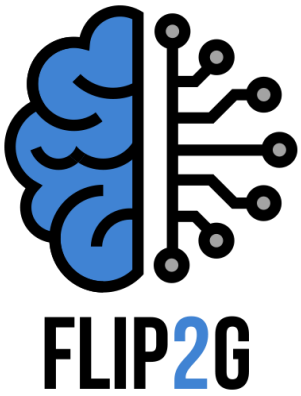

Deliverable 4.2

Pilot Report

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Deliverable factsheet

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Abstract:	**This deliverable discusses how the FLIP2G pedagogical model and platforms can work in practice, by providing detailed descriptions of the pilots that ran by the educational partners of the project. Essentially it presents a series of case studies in various settings (i.e. disciplines, level of study, delivery pattern), which can help educators understand how the project's outcomes could be applied in the case of their courses.**

Keyword List: **Learning design, learning plan, pilots, teaching delivery**

Consortium

	Role	*Name*	*Short Name*	*Country*
1.	Coordinator, PBL	Aalborg University	AAU	Denmark
2.	Games developer	Nurogames GmbH	Nurogames	Germany
3.	PBL, academic partner	University of Macedonia	UOM	Greece
4.	Data analytics	ARTIFICIAL INTELLIGENCE TECHNIQUES, SL	Artelnics	Spain
5.	Academic partner	Northumbria University	Northumbria	UK
6.	Flipped classrooms	EKPAIDEFTIRIA E. MANTOULIDI S.A.	Mantoulides	Greece
7.	Secondary education	Revheim skole, Stavanger Kommune	Revheim	Norway

Revision History

Version	*Date*	*Revised by*	*Reason*
V0.1	02/06/2021	Eleni Dermentzi	First draft of the template
V0.2	28/09/2021	Eleni Dermentzi	Adding number of learning activities in the template
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V0.4	14/12/2021	Muriel Gaelle Algayres	Updating AAU's section with the description of the second pilot
V1	15/12/2021	Eleni Dermentzi	Further editing after additional pilot description added by AAU

Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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List of Abbreviations

The following table presents the acronyms used in the deliverable in alphabetical order.

Abbreviation	*Description*
CMI	Chartered Management Institute
GUI	Graphical User Interface
ICT	Information and Communications Technology
LA	Learning Analytics
LMS	Learning Management System
OOP	Object-oriented programming
OSI model	Open Systems Interconnection model
PBL	Problem Based Learning
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UI	User Interface
UML	Unified Modeling Language
W/C	Week Commencing
WP	Work Package

Executive Summary

The current report provides a detailed description of the pilots ran by the educational partners (i.e. Northumbria University, Aalborg University, University of Macedonia, Mandoulides Schools, and Revheim School) of the FLIP2G project. The report was compiled using information that each partner provided by completing a reporting template with two main sessions: a) Learning design for the pilot and b) Delivery of the pilot. Each section of the report presents a unique case study of how the outcomes of the FLIP2G project (i.e. the FLIP2G pedagogical model, the game, and the Learning Analytics dashboard) can be used in practice in different settings.

As far as higher education is concerned, the three universities that participate in the consortium ran pilots with various types of learners. Northumbria University designed and delivered workshops in the area of Digital Business for Degree Apprenticeship students. Both pilots were delivered online, due to the Covid-19 restrictions that were in place at that time, but they followed a different delivery pattern; the first one was based on weekly workshops, while the second on block teaching (i.e. all the workshops were delivered within the same week). The advantages and challenges of each approach are discussed in the relevant section. Aalborg University delivered also their pilot online due to the Covid-19 restrictions. Their students were undergraduates and the pilot focused on object-oriented programming. The pilot followed the delivery pattern of weekly lectures. A second pilot with blended delivery (online and in class teaching) followed. University of Macedonia also relied on weekly lectures in the broader area of information systems (i.e. e-Government, analysis and design of systems, programming etc.) for their pilots, but some of these pilots were attended by postgraduate students. They were also able to run pilots of various sizes (the student numbers per pilot varied from 8 to 115) and ran some of them on campus, as the lockdown restrictions had been lifted by then.

Similarly, various pilots ran by the two schools that participate in the project. Mandoulides Schools ran one pilot with primary school students and one with secondary education students. Each pilot had around 100 students and ran in a physical classroom as any lockdown restrictions had been lifted by then. The pilots focused on the subjects of Informatics and Mathematics and in one instance it was possible to combine the FLIP2G outcomes with a hackathon. Revheim School on the other hand, ran a pilot with secondary education students in the area of social sciences with a specific focus on the topic of Imperialism. The pilot ran three times, all of which took place in a physical classroom.

The wide variety of the pilots in terms of subjects, delivery pattern, level of education, and educational systems (i.e. Danish, UK, Greek, and Norwegian) shows that the project's outcomes can be applied in a wide variety of settings. It is also interesting that despite the aforementioned differences among the pilots, the instructors seem to agree on the benefits of using the FLIP2G model and platforms: students became more involved in their learning and the instructors were able

to monitor their progress, provide personalised feedback, and identify topics/concepts that were perceived difficult from the students.

1 Introduction

1.1 Scope

The current report is the Deliverable 4.2 – Pilot Report (D4.2) of the FLIP2G project. The aim of the report is to provide a detailed description of the pilots that ran by each educational partner to test the FLIP2G pedagogical method and platforms. It includes the learning goals of each course, along with a description of the learning activities, learning material, and learning analytics used to support them. The report does not provide any information about the results of using the FLIP2G pedagogical method/platforms, as these are discussed in the Evaluation Report (i.e. D5.2).

1.2 Audience

The intended audience for D4.2 is the FLIP2G consortium, the European Commission, and organisations/members of the public (e.g. universities, schools, educators) interested in delivering courses that use the project's methods and tools.

1.3 Structure

The structure of the document is as follows:

- Section 2 explains the approach we followed to prepare the report, while the remaining sections (i.e. sections 3- 7) provide a detailed description of the pilots that ran by each partner, and more specifically,
- Section 3 – the pilots at Northumbria University
- Section 4 – the pilots at Aalborg University
- Section 5 – the pilots at University of Macedonia
- Section 6 – the pilots at Mandoulides Schools
- Section 7 – the pilots at Revheim School
- Finally, Section 8 concludes by summarising the similarities and differences among the pilots.

2 Methodology

To ensure that the report captures all the necessary details for each pilot, the WP leader created a template that each educational partner could complete by writing a short introduction about each pilot (i.e. number of students participating in the pilot, level of their studies, duration of the pilot etc.) and providing the details about a) the learning design and b) the delivery of the pilot.

In the first part, each partner could explain how they designed the course in order to meet the course's learning goals and utilise the project's pedagogical model (Figure 1) and platforms (i.e. the FLIP2G game and the Learning Analytics dashboard). More specifically, the pedagogical partners were asked to provide a list with the learning goals of the course, and then discuss the learning activities used to achieve these goals, the data generated by these learning activities, and how the learning analytics generated by the FLIP2G game were used to support these learning activities.

In the second part of the template, the educational partners were asked to explain how the course was delivered. They had to discuss how the learning activities took place (e.g. whether they were online/face-to-face, which platforms/tools were used to support them, how students received feedback/were assessed etc.) and provide specific examples (e.g. screenshots) to illustrate their points. The instructors could also discuss any interventions they might have made in the learning design/delivery of their course after collecting the data generated by the learning activities (e.g. LA, feedback from students, students' performance etc.).

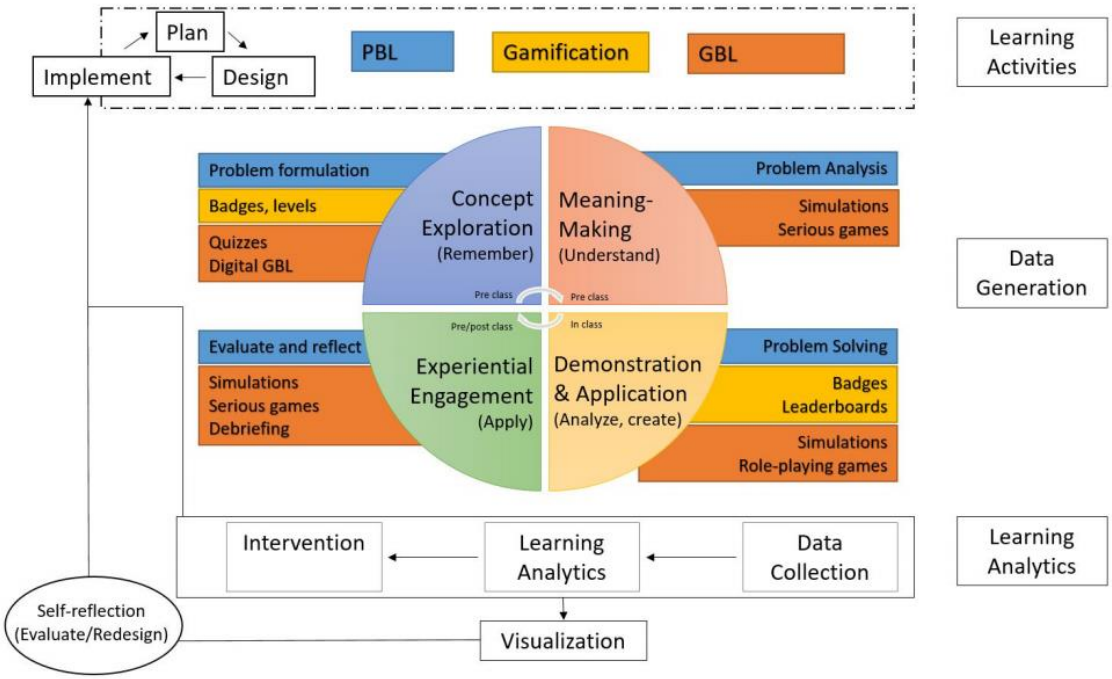


Figure 1. FLIP2G learning model (FLIP2G D2.2)

3 Northumbria University

The FLIP2G pilots at Northumbria University were delivered to two different Degree Apprenticeship cohorts: a) a large group of professionals from various industries that study for an undergraduate degree in the broader area of management and b) a small group of police officers studying for a similar degree. While the theory of the two courses is the same, the learning material and delivery patterns differ in the ways discussed below. The differences between the two pilots have allowed the instructor to evaluate the effectiveness of the pedagogical model and game in different settings (the main points will be discussed in the pilots' Evaluation Report). Both pilots ran online due to the Covid-19 restrictions that were in place in the UK for the academic year 2020 – 2021.

3.1 Pilot 1 – Digital Business – Degree Apprenticeships (Open cohort)

Pilot 1 ran with 48 professionals from various industries (e.g. health, finance, education etc.) that study for a bachelor degree in the broader area of Leadership and Management. The degree is part of the Chartered Manager Degree Apprenticeship (https://www.managers.org.uk/education-and-learning/apprenticeships/level-6/) that students aim to complete to gain the Chartered Manager Status. Students have to meet specific criteria set by the Chartered Management Institute (CMI), which means that the courses delivered as part of the degree have to be designed in a way that helps students meet these criteria.

The chosen course, Digital Business (Table 1), focuses on the impact that digital technologies have on the operations of organisations and covers three themes namely, digital business strategy, digital marketing, and supply chain management/information systems. The delivery pattern for the current academic year is one 3-hour online workshop per week, for 6 weeks. The assessment of the course is a business report in which students have to discuss their organisation's/competitors' practices in the area of digital business. Student feedback is also used to evaluate the overall success of the course and identify areas for improvement in the learning design.

Table 1. Basic information about the course "Digital Business – Open"

Target Group	Subject	Time/Duration	Overall Objective	Success metrics
☐ Undergraduate university students ☐ Postgraduate university students ☐ Secondary education students ☐ Primary education students ☒ Professionals	Digital Business	Weekly workshops (w/c 25/01/2021 – w/c 01/03/2021): 6 workshops x 3 hours, 1 workshop per week	Understand how using online channels impacts upon different parts of the organisation. Three main themes are covered: 1) digital business strategy, 2) marketing, 3) supply chain management	Assignment marks Student feedback

			and information systems	

3.1.1 Leaning Design for Pilot 1

The Digital Business course has four main learning objectives:

1. To develop an understanding of the opportunities and challenges faced in business when utilising digital channels.
2. To appreciate the roles of different business functions in delivering a successful digital operation.
3. To develop skills in software applications utilised to monitor digital business performance and interpret data as a basis for future digital decision-making.
4. Develop an understanding of issues surrounding customer privacy and security when engaging in digital business.

In addition, the course aims to support students in meeting the CMI criteria in the area of digital business and new technologies, and more specifically, facilitate the development of knowledge and skills in the following areas (CMI, 2017):

Knowledge

1. Approaches to innovation and digital technologies and their impact on organisations, and how their application can be used for organisational improvement and development.
    a. Critically evaluate the impact of innovation and digital technologies on organisations.
    b. Evaluate the use of these for organisational development.
    c. Review the use of innovation and digital technologies in own organisation and make recommendations for improvement.
2. Innovation and digital technology's impact on data and knowledge management for analysing business decision-making.
    a. Analyse the impact of innovation and digital technologies on data and knowledge management.
    b. Demonstrate how this can be utilised for making business decisions.

Skills

1. Demonstrate the use of qualitative and quantitative analysis of information to identify service/organisational improvements and opportunities for innovation and growth.
2. Analyse information and data to benchmark against others.

To meet the above learning criteria, the workshops of the course were dedicated to a different topic each week to ensure that a wide variety of business functions are covered. Whenever possible, students were asked to use online tools/platforms relevant to the topic of the week (Table 2), so they can develop also some practical skills in the area of digital business. Students had also to use online platforms (i.e. Blackboard, Microsoft Teams, Office 365, FLIP2G game) to complete the learning activities of each workshop, which also facilitated the development of digital skills.

Table 2. Study Plan of Digital Business

Workshop	*Topics covered*	*Online tools/platforms used in the workshop*
Introduction to the course and Digital Business	Digital business models Digital business strategies Examples of disruptive digital technologies	Mintel portal (https://portal.mintel.com/portal/login?next=/)
Digital Marketing	Online consumer behaviour Websites Search engine marketing Display ad marketing Email marketing Affiliate marketing Digital marketing metrics	Wayback Machine (https://archive.org/web/) MOZ – SEO software (https://moz.com/) SimilarWeb (https://www.similarweb.com/) Alexa Site Info (https://www.alexa.com/siteinfo) Nibbler (https://nibbler.silktide.com/)
Social Media Marketing and M-Commerce	Different types of social networks and online communities Social marketing process Mobile marketing Location-based marketing	Facebook analytics dashboard
Security and Ethics	Key security threats in the digital environment Cyber security tools Policies, procedures, and laws for cyber security Privacy and information rights	Targeted attack: The game (http://targetedattacks.trendmicro.com/) Various webpages with privacy policies

	Intellectual property in the digital age	
Information Systems and Decision Making	Enterprise Resource Planning Systems Supply Chain Management Systems Customer Relationship Management Systems Knowledge Management Systems Business Intelligence/Data and Decision Making	UK Open Data portal (https://data.gov.uk/) UK Office for National Statistics (https://www.ons.gov.uk/) EU Open Data Portal (https://data.europa.eu/euodp/en/data/) OECD Database (https://stats.oecd.org/)
Course summary and preparation for the assignment	Discussion on the topics that students wanted to cover in their assignments Writing business reports	N/A

The assessment of the course (i.e. a 2,500 words business report) aims to evaluate the students' progress in developing the knowledge/skills described in the above learning goals. More specifically, the assignment brief asks students to write a report that focuses on their workplace and covers the following two areas:

- Competitor Analysis: Comparison of the practices of 2-3 competitors (organisations that operate in the same/similar industry/sector) in an area of digital business important for the sector (e.g. social media marketing, cyber security, information systems etc.).
- Website Analysis: Discussion of web analytics/analysis of the website of their workplace.

Based on the analysis in the two parts, students have to develop recommendations for their workplace that could help the organisation to improve in the area of digital business. As it can easily be understood, students have to do research on the competitors' relevant practices and reflect on the practices that are followed in their workplace in order to complete the assignment. This means that while working of the course's assessment, students can collect evidence that will need later in their apprenticeship to show how they have met the CMI's criteria.

To facilitate the learning process and support students with their assessment, various learning activities have been designed with the help of the FLIP2G project's pedagogical model and platforms. The original plan for each workshop was:

- The pre-recorded lecture and any additional learning material (e.g. articles, videos etc.) become available on the course's LMS (i.e. Blackboard) a week before the workshop, so students have plenty of time to access them (pre-class activity).
- At the beginning of the workshop, students play the FLIP2G game to test their understanding of the learning material (in-class activity).
- A class discussion of the correct answers follows after all the students have completed the game. The instructor uses the FLIP2G dashboard to check the learning analytics for the session; if there is a particular question that students seem to find difficult (i.e. most of them have given a wrong answer) emphasis is given on the relevant topic during the discussion (in-class activity).
- Next, students are asked to join smaller breakout rooms on Blackboard Collaborate and start working collaboratively on the week's problems (relevant to the topic covered that week). They are free to choose any problem they feel is more relevant to their work environment (students tend to join breakout rooms with their colleagues/students from similar industries). The problems are available on Microsoft Teams that also gives a collaborative space to the teams, which is essential as the students are online. The available problems require students to search for information about their organisation/market and develop relevant recommendations/strategies. Their scope is relatively narrow, which allows the activity to be completed within the workshop. An example of a weekly problem can be seen in Figure 2 (in-class activity).
- The teams return to the plenary session (on Blackboard Collaborate) to present their findings to the other teams. A class discussion follows where students from other teams may contribute to the solution of the problem by offering insights from their workplaces/industries (in-class activity).
- Students are asked to complete the reflective journal for the week after the session. The journal is available on the Class Notebook on Microsoft Teams and includes prompts that help students reflect on their learning for that week. At the beginning of the page (an example can be seen in Figure 3) there is an indication how their answers can be linked to the CMI criteria. The goal is to guide them in collecting evidence that will be useful to them at the end of the apprenticeship. The journal also asks them to reflect on the score they received in the FLIP2G game; the aim of this question is to motivate them to check their learning analytics on the FLIP2G dashboard and possibly replay the game (e.g. if they realise that their score is low). The instructor has access to the reflective journal in real time and can add feedback/provide advice based on the students' responses as the Class Notebook on Teams is based on the OneNote software of Microsoft that stores documents on the cloud. Students are expected to check the feedback the instructor has left before the next workshop (pre/post class activity).

Open Data and decision making

Explore the following open data/statistics portals and try to identify datasets relevant to your sector/industry. What kind of decisions could the chosen datasets support in your organisation and why? How could different managers in your organisation use this kind of data? Are there any other portals that could be used by your organisation as sources of data?

Open Data UK: https://data.gov.uk/

Office for National Statistics: https://www.ons.gov.uk/

EU Open Data Portal: https://data.europa.eu/euodp/en/data/

OECD Database: https://stats.oecd.org/

Hint: Think about the various factors that affect your organisation. For example, even if your organisation operates only in the UK, you may still be affected by the EU market (e.g. due to your supply chain, your competitors etc.).

Figure 2. An example of a weekly problem developed for the Digital Business course

The questions are linked to the CMDA standards 5.1, 5.2 and 5.3.
Think about your organisation's goals, services/products/target audience that you mentioned in your reflective journal for w/c 25/1.
What kind of information systems would be the most important for an organisation like yours? Apart from the generic information systems (e.g. ERP, CRM, Supply Chain Management Systems etc.) consider also any specialised systems relevant to your industry (e.g. Electronic Health Records, Geographic Information Systems, Learning Management Systems etc.) when you answer.

Is your organisation currently using the required information systems? How does your organisation compare with the other organisations in your industry when it comes to the use of information systems?

Think about your own practice/job role.

- **What kind of data/information, do you manage/create as part of your role?**
- **What kind of data/information/knowledge, available outside your organisation, do you need in order to make decisions/complete your tasks?**
- **Do you use information systems to acquire/manage data/information/knowledge in your practice? What kind of improvements would you like to see in these information systems so your tasks/decision making process can be completed more effectively?**

Use the Web to research how your organisation could make better use of the Internet for knowledge management. What Internet information resources would be most useful to your organisation for decision making?

Finally, a little bit about your learning experience...
How could you use the knowledge you gained from this workshop to improve your own practice?

What was the score you gained after playing the game this week? Did you give any wrong answers? If so, which areas do you think you need to study further to improve your performance?

Figure 3. An example of the weekly reflective journal for Digital Business.

The above learning activities lead to data generation that help the instructor make adjustments to the course while it is still running. This includes:

- Learning analytics provided by the FLIP2G platform that show the performance/engagement of the students in/with the game.
- Solutions/findings/notes from the weekly problems that students have solved in teams. Students are asked to use the collaborative space provided in the Class Notebook (Microsoft Teams) to keep their notes during the teamwork.
- Students' responses to the reflective journal that help the instructor identify students that may find it difficult to answer the questions.
- Oral feedback from the students regarding the learning activities that is given during the class discussions.

3.1.2 Delivery of Pilot 1

As it is mentioned above, the pilot ran fully online due to the Covid-19 restrictions that were in place in the UK during the academic year 2020-2021. The University's LMS, Blackboard Collaborate, was used to ran the weekly workshops online. The cohort of 48 students was split into two smaller groups, each of which had the weekly workshop on a different day of the week. During the problem-based activities of the workshop, 4-5 breakout rooms were created on Blackboard Collaborate, which allowed a smaller group of students (e.g. 5-6 students) to work together on the problem. The instructor was able to join the the breakout rooms at any time to check whether students needed any clarifications on the chosen problem and discuss the team's progress in solving the problem.

It should be noted here that while half of the workshops ran according to the plan discussed in the previous section, an important change was made in the delivery of the course after the third session of the course. That was mainly due to the oral feedback received from the students and the consistently low scores of the second group of the pilot (Figure 5) that showed that students had difficulties answering the questions of the FLIP2G game. Feedback from the students showed that it was not always possible for them (due to the pressure coming from their work/familiy responsibilities) to complete the pre-class activities (e.g. accessing the recorded lecture), so they played the game without the recommended preparation. Based on that, the fourth session started with the instructor using the first hour of the workshop to recap the theory discussed in the pre-recorded lecture, which proved to be quite helpful for the students as the positive impact of the change was evident in their game score (Figure 5). In the fifth workshop, students were asked to play the FLIP2G game after the class (as a post class activity), which led to some students not completing the relevant quiz. In fact, the second group that had expressed difficulties in completing learning activities outside the class did not engage with the quiz at all (Figure 5), while students from the first group decided to play the game outside the class (Figure 4).

The last workshop (i.e. Workshop 6) was different from the rest as it did not focus on a new topic, but rather tried to summarise the main points from the previous workshops and prepare students for the course's assessment. This is where the learning analytics at a course level proved once again

to be quite useful as they helped the instructor identify the topics that needed to be discussed again due to students scoring low in the relevant quizzes. So, the last workshop was slightly different for the two groups as in the case of the first group, more emphasis was put on the topics covered in the third session (that is the session in which they scored in average lower than the rest; see Figure 4), while in the case of the second group, a wider range of topics was covered during the summary.

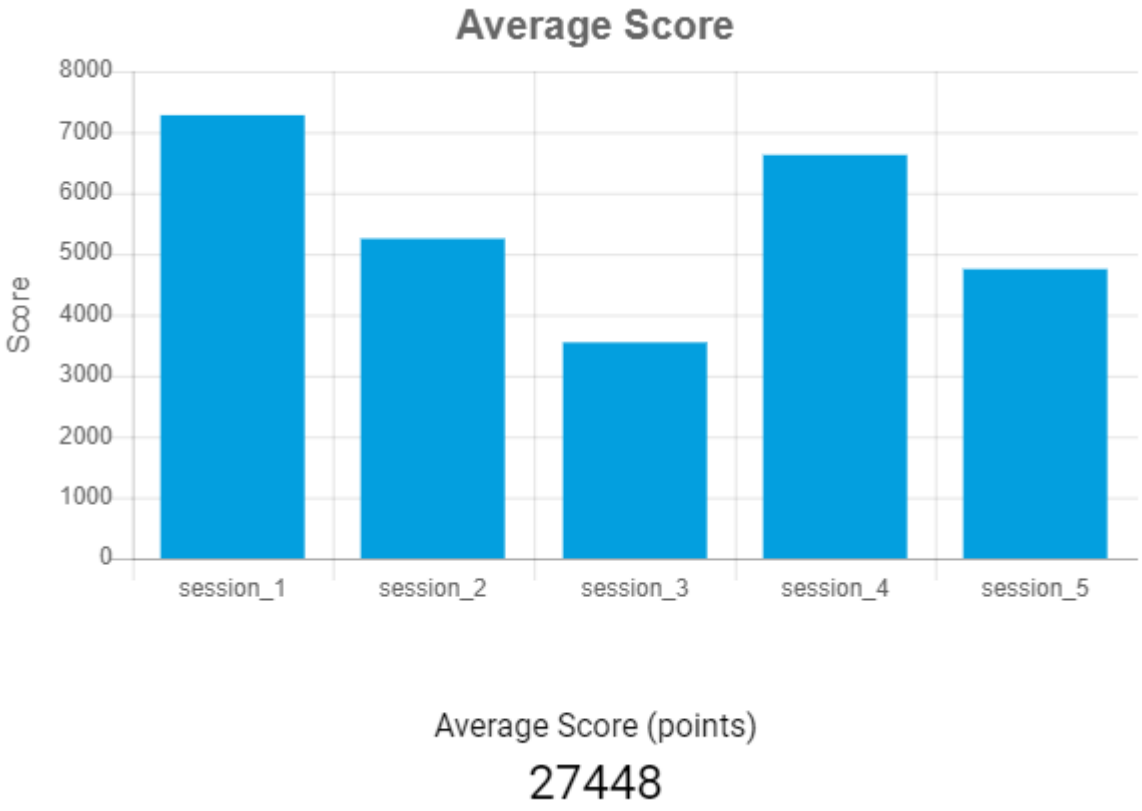


Figure 4. Score evolution for the first of the two groups that participated in the first pilot

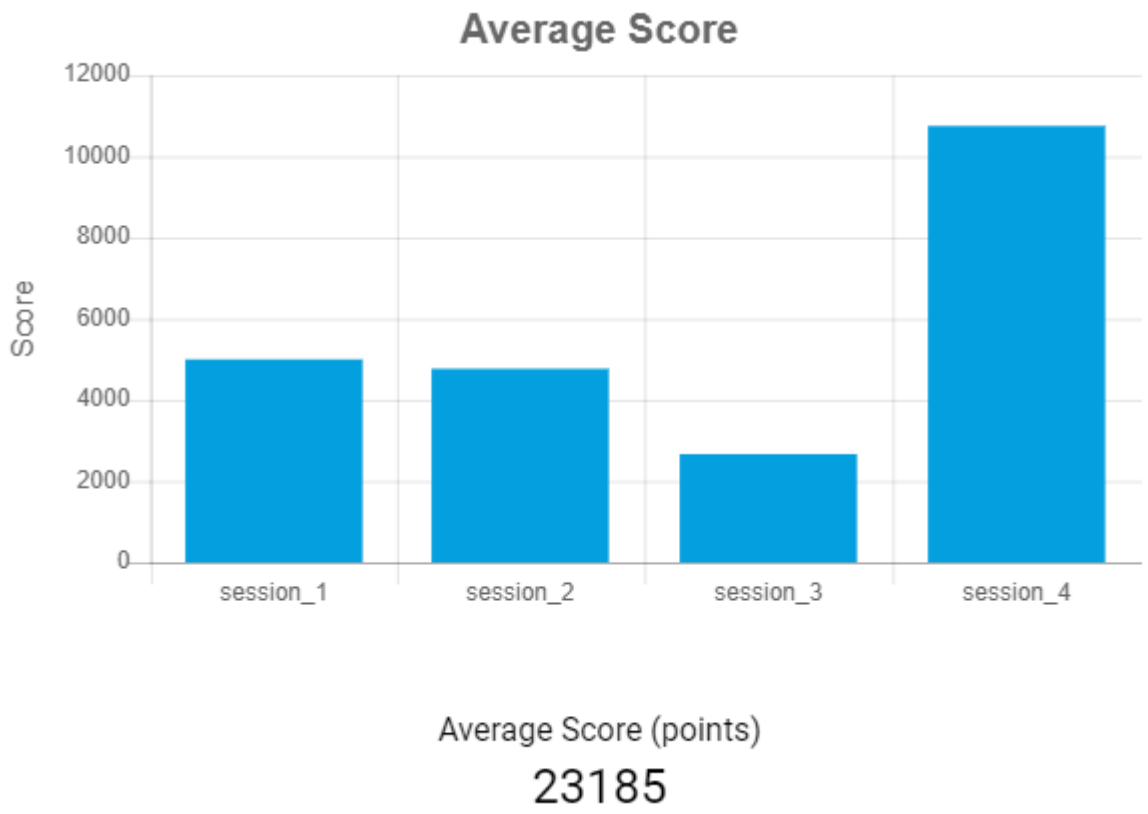


Figure 5. Score evolution for the second group that participated in the first pilot

At an individual level, the FLIP2G learning analytics were proven useful while providing personalised advice to the individual students regarding the topics they could discuss in their assignments (second part of Workshop 6). As students were free to analyse any aspect of digital business in the first part of their business report, a common question during the one-to-one discussions with the instructor was which topic they should choose. The instructor could use two sources of data to provide personalised advice to each student: a) the FLIP2G learning analytics dashboard (particularly the Score Evolution of the student) and b) the reflective journal. For example, the student, whose Score Evolution can be seen in Figure 6, showed a greater understanding of the topic covered in the fourth workshop (i.e. scored significantly higher in the relevant session). That piece of information, along with the fact that the student had completed the relevant page in the reflective journal in detail, indicated that it would be better for them if they focused on cyber security (i.e. the topic covered in session 4) in their assignment. Of course, the final decisions about the business reports were taken by the students after they started collecting information for the assignment and reviewed the relevant literature more carefully, but the FLIP2G learning analytics along with the reflective journal were a great starting point for them, while exploring the various topics. Also, for the disengaged with the course students (i.e. students that put little effort on completing the learning activities), the

absence of learning analytics and/or the blank pages in the reflective journal highlighted the need for them to be more active and take responsibility of their own learning.

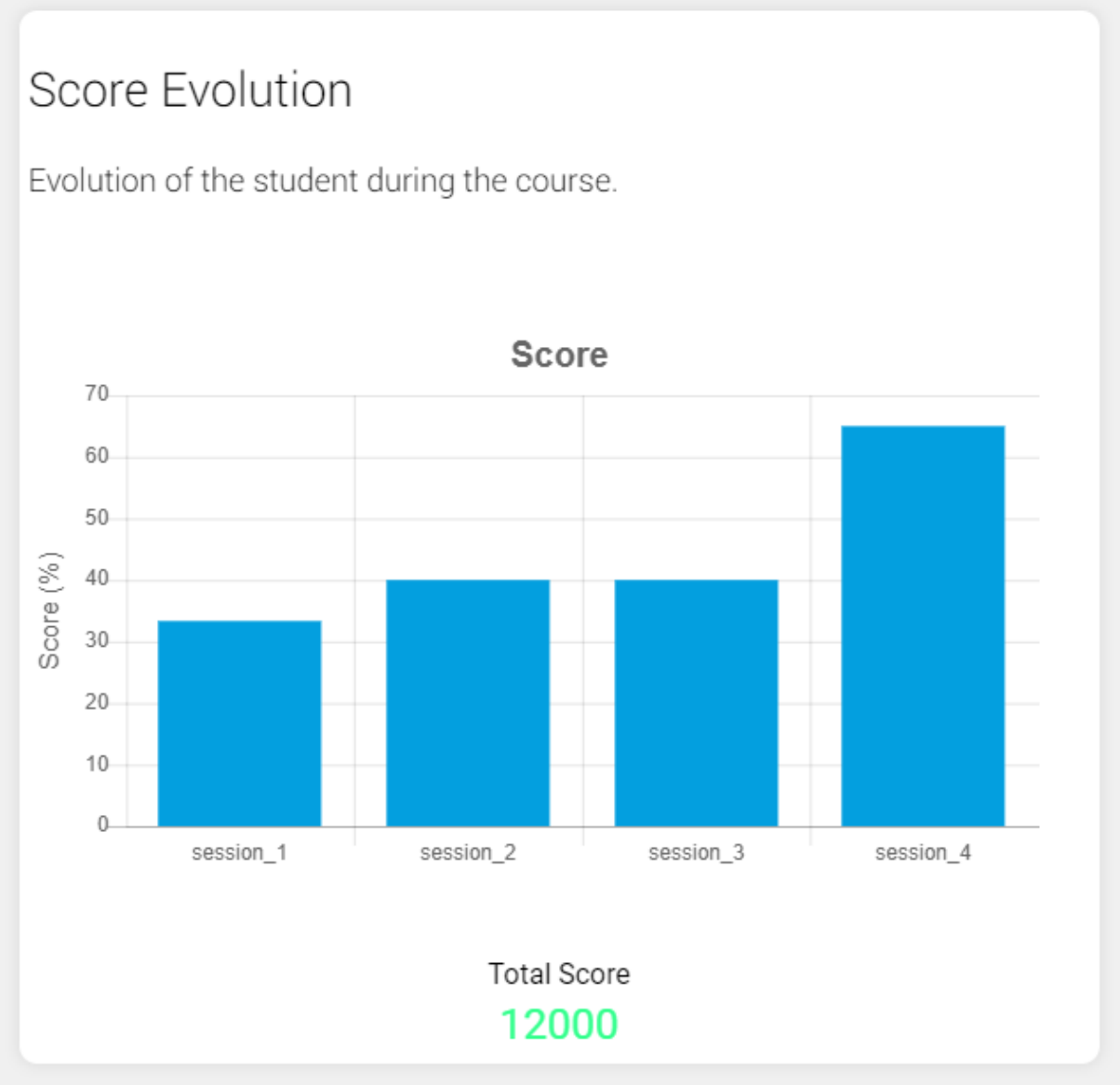


Figure 6. Example of a student's evolution during the first pilot

3.2 Pilot 2 – Digital Business – Degree Apprenticeships (Closed cohort)

Pilot 2 ran in late April with 8 students, all of them coming from the same organisation (a police UK force) and studying for the Chartered Manager Degree Apprenticeship. While this course has significant similarities with the course used in Pilot 1, there is an important difference in terms of delivery (Table 3), which followed the block teaching model (i.e. all the sessions of a course take place in a small period of time e.g. within 3-4 days).

Table 3. Basic information about the course "Digital Business- Closed"

Target Group	Subject	Time/Duration	Overall Objective	Success metrics
☐Undergraduate university students ☐Postgraduate university students ☐Secondary education students ☐Primary education students ☒Professionals	Digital Business	Block teaching (27/4/2021 – 30/04/2021): 6 workshops in total (1 or 2 workshops of 3 hours per day)	Understand how using online channels impacts upon different parts of the organisation. Three main themes are covered: 1) digital business strategy, 2) marketing, 3) supply chain management and information systems	Assignment marks Student feedback

3.2.1 Learning Design for Pilot 2

The learning goals for Pilot 2 were the same with the ones for Pilot 1 (see 3.1.1) however, the study plan (Table 4) was adapted to fit the needs of the sector (i.e. police forces). For example, instead of focusing on generic information systems (e.g. supply chain management systems), used mainly by companies, the course covered information systems/databases used by police forces around the word. The aim was to help students understand how digital technologies can impact the way police forces operate. Similarly, instead of discussing digital marketing strategies that companies follow to engage their customers, the course focused on how digital platforms can be used for public engagement and other organisational goals (e.g. supporting recruitment of new police officers).

Table 4. Study Plan of Pilot 2

Workshop	*Topics covered*	*Online tools/platforms used in the workshop*
Introduction to the course and Digital Business	Digital business strategies for the police Examples of disruptive digital technologies relevant to the police	Mintel portal (https://portal.mintel.com/portal/login?next=/)
Digital Marketing	Digital public engagement Display ad campaigns for the police	Wayback Machine (https://archive.org/web/) MOZ – SEO software (https://moz.com/) SimilarWeb (https://www.similarweb.com/)

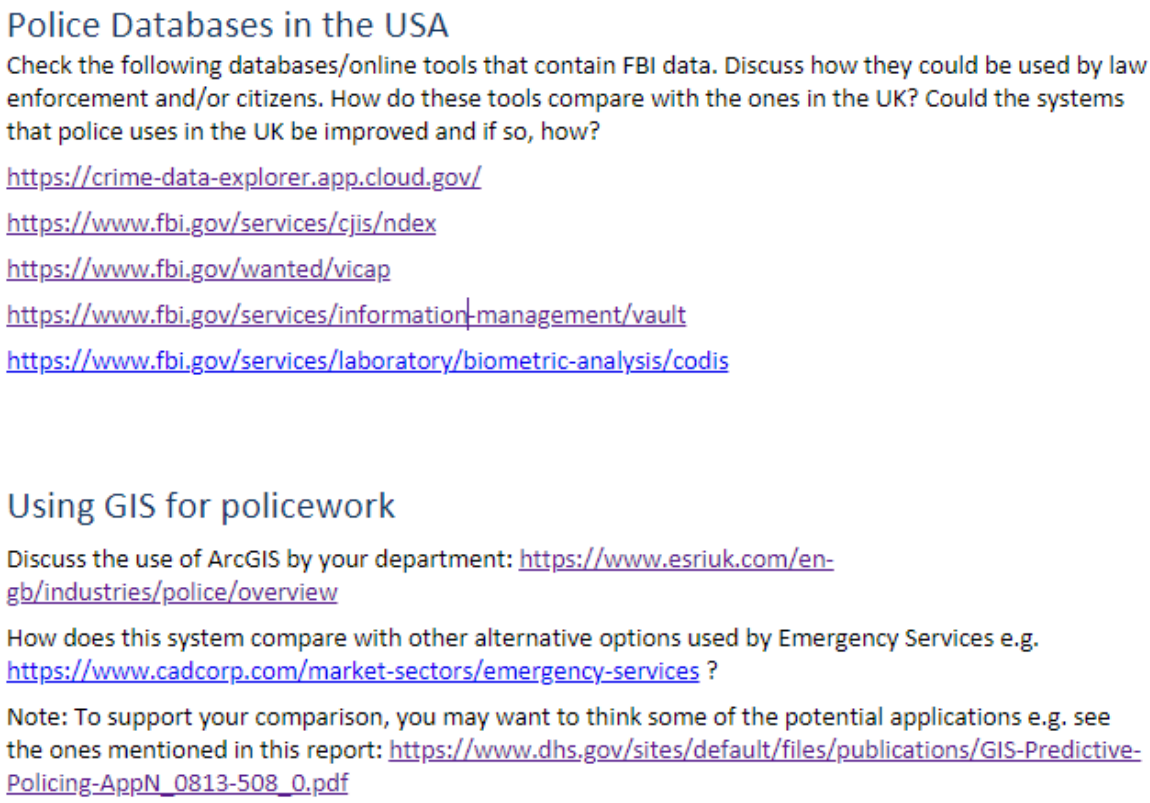
		Alexa Site Info (https://www.alexa.com/siteinfo) Nibbler (https://nibbler.silktide.com/)
Social Media Marketing and M-Commerce	Different types of social networks and online communities Social media campaigns for the police	Facebook analytics dashboard
Security and Ethics	Key security threats in the digital environment Cyber security tools Policies, procedures, and laws for cyber security Privacy and information rights Cybercrime investigations and digital forensics	Targeted attack: The game (http://targetedattacks.trendmicro.com/) Privacy policy of the organisation's website
Information Systems and Decision Making	Using police databases for decision making Information systems for the police Geographic information systems	Open Data UK https://data.gov.uk/dataset/d174ce54-1cc2-4cb2-963b-91ae703d989a/crime-statistics UK Data Service https://www.ukdataservice.ac.uk/get-data/themes/crime Open Data – UK police https://data.police.uk/data/statistical-data/ FBI Crime Data Explorer https://crime-data-explorer.app.cloud.gov/pages/home FBI Vault https://www.fbi.gov/services/information-management/vault

Course summary and preparation for the assignment	Discussion on the topics that students wanted to cover in their assignments Writing business reports	N/A

Changes were made also to some of the planned learning activities, as the block teaching delivery pattern did not leave much time for pre/post class activities. For that reason, the following learning activities were planned for Pilot 2:

- The pre-recorded lectures and any additional learning material (e.g. articles, videos etc.) for all the sessions of the course became available on the course's LMS (i.e. Blackboard) a week before the workshops, so students have plenty of time to access them (pre-class activity).
- At the beginning of each session, the instructor summarised the main points from the pre-recorded lecture to ensure that even students that did not have the time to complete the pre-class activity, could participate in the session (in-class activity).
- Then, students played the FLIP2G game to test their understanding of the learning material (in-class activity).
- A class discussion of the correct answers followed after all the students had completed the game. The instructor used the FLIP2G dashboard to check the learning analytics for the session; if there was a particular question that students seemed to find difficult (i.e. most of them had given a wrong answer) emphasis was put on the relevant topic during the discussion (in-class activity).
- Next, students were asked to join smaller breakout rooms (3-4 students) on Blackboard Collaborate and start working collaboratively on the week's problems (relevant to the topic covered that week). They were free to choose any problem they felt was more relevant to their everyday practice. The problems were available on Microsoft Teams that also gives a collaborative space to the teams, which was essential as the students were online. The available problems were adapted to the context of the UK police (e.g. Figure 7) and required students to search for information about their organisation/target audience and develop relevant recommendations/strategies (in-class activity).
- The teams returned to the plenary session (on Blackboard Collaborate) to present their findings to the other teams. A class discussion followed where students from other teams could contribute to the solution of the problem by offering insights from their own professional practice (in-class activity).

- Students were asked to complete the reflective journal available on the Class Notebook on Microsoft Teams at some point before the submission of their assignment. The journal also asked them to reflect on the score they had received in the FLIP2G game; the aim of that question was to motivate them to check their learning analytics on the FLIP2G dashboard and possibly replay the game (e.g. if they realise that their score is low). The activity aimed to help them consolidate the knowledge gained from the workshops, prepare for the course's assignment, and collect evidence for the end-point assessment of the degree apprenticeship (post class activity).



Police Databases in the USA

Check the following databases/online tools that contain FBI data. Discuss how they could be used by law enforcement and/or citizens. How do these tools compare with the ones in the UK? Could the systems that police uses in the UK be improved and if so, how?

https://crime-data-explorer.app.cloud.gov/

https://www.fbi.gov/services/cjis/ndex

https://www.fbi.gov/wanted/vicap

https://www.fbi.gov/services/information-management/vault

https://www.fbi.gov/services/laboratory/biometric-analysis/codis

Using GIS for policework

Discuss the use of ArcGIS by your department: https://www.esriuk.com/en-gb/industries/police/overview

How does this system compare with other alternative options used by Emergency Services e.g. https://www.cadcorp.com/market-sectors/emergency-services ?

Note: To support your comparison, you may want to think some of the potential applications e.g. see the ones mentioned in this report: https://www.dhs.gov/sites/default/files/publications/GIS-Predictive-Policing-AppN_0813-508_0.pdf

Figure 7. Examples of problems designed for the police sector

With the reflective journals not being completed during the four days of the course, more emphasis was put on the learning analytics and students' oral feedback when making adjustments to course. Any data generated from the reflective journals could be used in case a student asked for an extra meeting before the submission of the assignment.

3.2.2 Delivery of Pilot 2

The online tools discussed in 3.1.2 were also used to support the delivery of Pilot 2. With all the sessions running in such a limited period of time, there was not much time to make significant adjustments to the course; besides, the plan for Pilot 2 was designed based on the data/feedback from the first pilot, which meant that the course was already well-tweaked. Thus, the FLIP2G learning analytics were mainly used to support the last session of the course, which provided a summary of the topics covered in the course and an opportunity to students to have one-to-one meetings with the instructor to get personalised advice/feedback for the assignment. Based on the course's analytics (Figure 8) special emphasis was put on the topics covered in session 3 (i.e. social media platforms), as students' average score was the lowest for that session. At an individual level, students' analytics were even more important for providing personalised advice, as the absence of the completed reflective journals at that point, meant that the learning analytics were the only data the instructor had for individual students. In cases, where a student had scored significantly higher in a specific session (e.g. Figure 9), the advice to the student was to focus on the topics covered in that specific session for their business report.

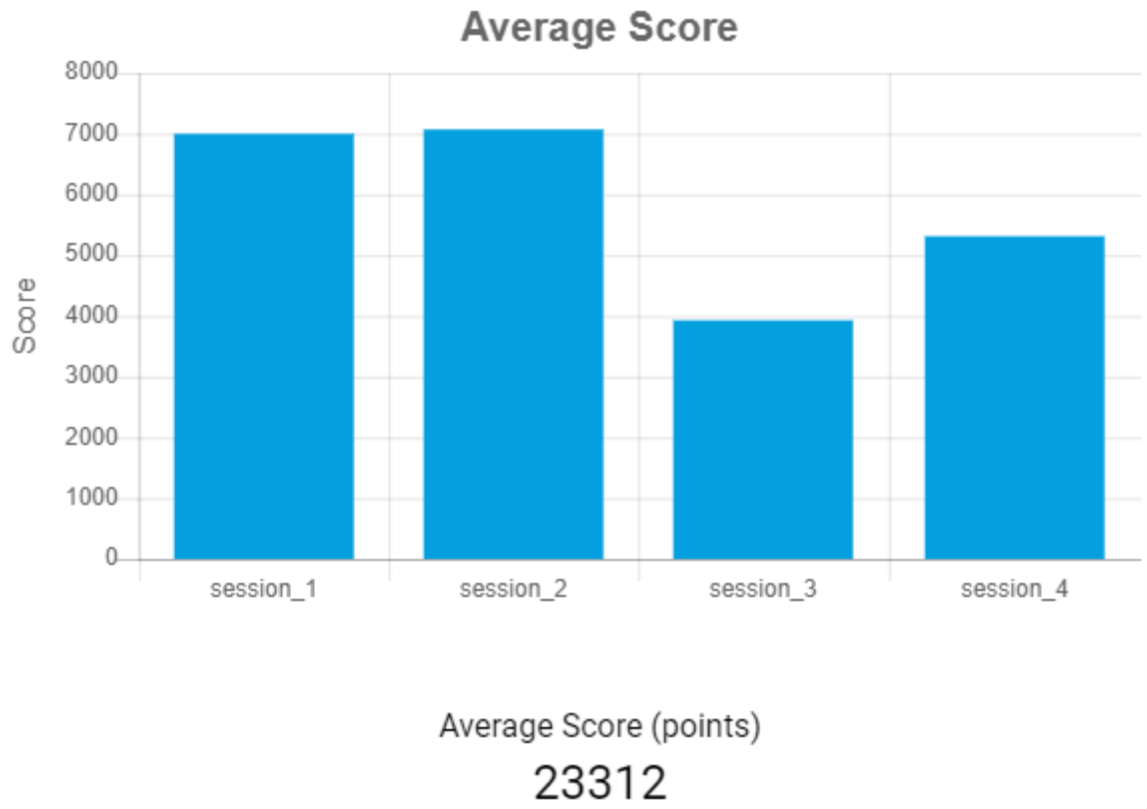


Figure 8. Score evolution for Pilot 2

Co-funded by the Erasmus+ Programme of the European Union

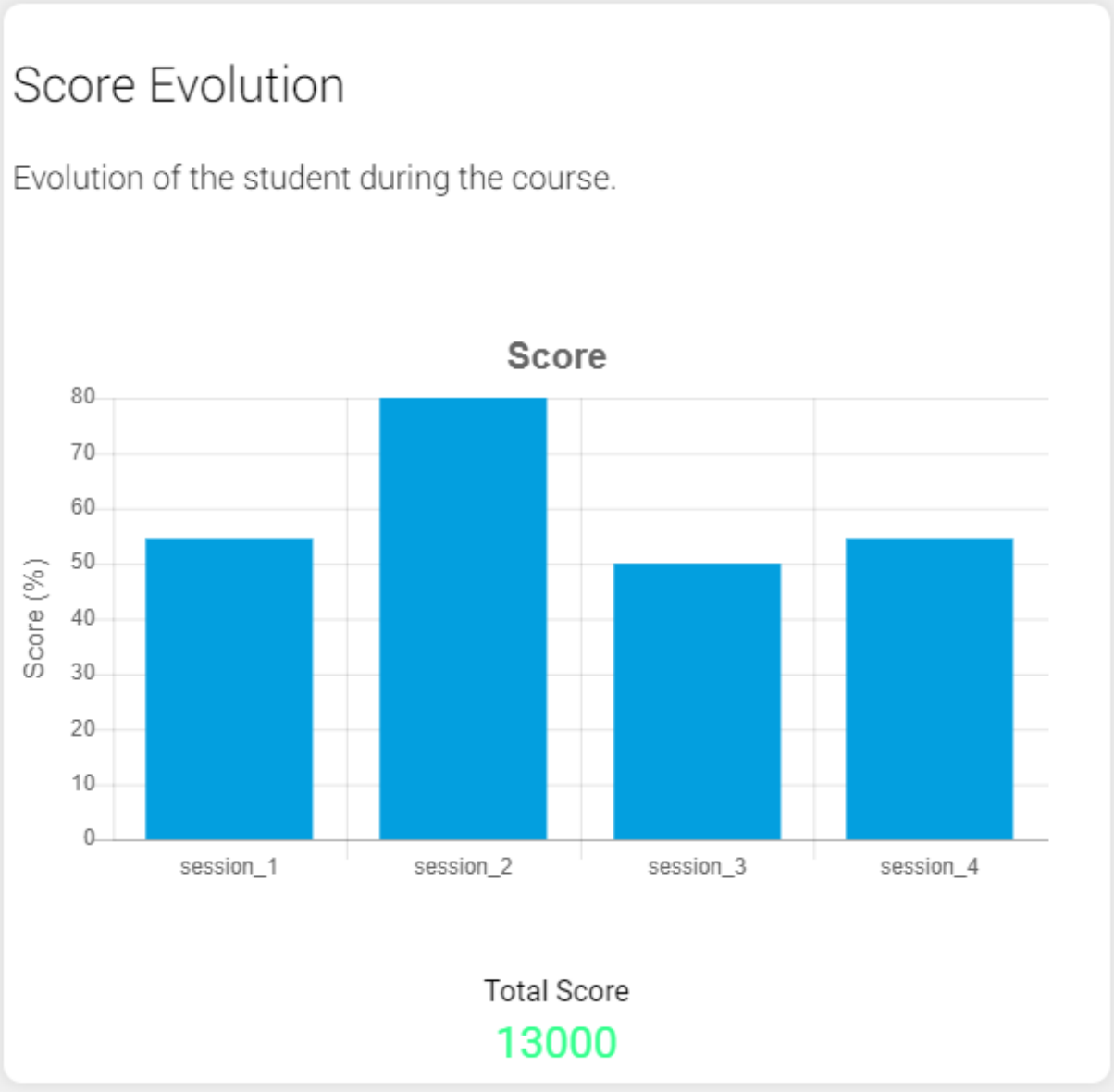


Figure 9. Example of a student's evolution during the second pilot

4 Aalborg University

The FLIP2G pilots at Aalborg University ran with 2nd and 3rd semester bachelor students at the Medialogy study program, who followed the "Programming for Interaction" course. The first pilot ran online due to the Covid-19 restrictions that were in place in Denmark during the spring semester 2021. The second pilot ran during the fall semester 2021 as a blend of online learning and on campus classes, due to Covid-19 restriction gradually fading out, but with continued option to follow the courses online.

4.1 Pilot 1 – Programming for Interaction – Medialogy

Pilot 1 ran initially with 64 students at the Medialogy bachelor program (https://www.aau.dk/uddannelser/bachelor/medialogi/). At the Medialogy study, students get a solid technical foundation, and they learn to combine technical skills with their knowledge of how people see, hear, and experience the world around them. They are taught how people interact with interactive systems and how they can get the systems interact with us. At this programme, students are taught in e.g. programming, virtual reality, mathematics, interaction design, human perception, design and analysis of scientific experiments.

By completing the chosen course "Programming for Interaction", the students should be able to design, programme, and evaluate interactive applications both on the standard PC platform as well as mobile platforms. Furthermore, this module seeks to introduce basic concepts from object-oriented programming. The module covers the fundamentals of the programming of graphical user interfaces (GUIs) as well as interactions in mobile and pervasive environments that afford touch or sensor-based interaction. The delivery pattern for the current academic year was one 4-hour online lecture per week, for 10 weeks. In each online lecture, students get assignments to be handed in by the next lecture. The assessment of the course is a mini project, where students must develop a mobile or desktop application, which supports a GUI and implements the OOP principles. Moreover, they must deliver a technical report describing the functionality of the application and explaining and reflecting on the development process. The module is evaluated by an individual written exam in the end of the semester. Students must successfully complete the weekly assignments and the mini project, in order to get access to the final exam. Student feedback is also used to evaluate the overall success of the course and identify areas for improvement in the learning design.

Table 5. Basic information about the course "Programming for Interaction"

Target Group	Subject	Time/Duration	Overall Objective	Success metrics
☒Undergraduate university students ☐Postgraduate university students	Introductory OOP desktop and mobile programming	10 weekly in-class sessions (03/03/2021-14/04/2021) & a mini project	Convey the knowledge for designing, programming, and evaluating	Successful completion of weekly assignments and of mini project Final exam marks

☐Secondary education students ☐Primary education students ☐Professionals		(submission deadline: 30/04/2021) (follows an academic semester)	interactive applications both on the standard PC platform as well as mobile platforms, and introducing basic concepts from object-oriented programming	Student feedback

4.1.1 Learning Design for Pilot 1

The objective with the Programming for Interaction course is that the students acquire the knowledge, skills, and competencies required for the actual planning, implementing, code generation, and evaluation of interactive applications. Students who complete the project module should obtain the following qualifications:

Knowledge

- Knowledge of fundamental Object-Oriented Programming (OOP) strategies and models used in software development
- Knowledge of rich pictures and use case diagrams to facilitate a user-centred design approach
- Knowledge of mobile development environments, debugging tools and methods for evaluation of mobile applications
- Understanding of basic design patterns relevant to mobile development (Model-View-Controller (MVC), singleton, etc.)
- Knowledge of GUI programming on both PC and mobile platforms
- Understanding the difference between sequential and event-based programme structures (e.g., event listeners, call-back functions)
- Understanding of working with files and file systems in programming
- Understanding different development methods (e.g., Waterfall, Spiral, Agile) in relation to software development

Skills

- Ability to apply OOP in development and design of interactive applications.

- Analyse, interpret and apply design patterns and basic models (entity-relationship diagrams, UI storyboards, or flowcharts, etc.)
- Must be able to implement event-based designs into functioning applications
- Must be able to apply an object-oriented approach to software implementation
- Must be able to implement an application with a GUI
- Must be able to develop, deploy, and test an application on a mobile device such as a smart phone or tablet (application)

Competencies

- Must be able to understand how to systematically design, programme, and evaluate interactive applications
- Must be able to analyse the problem domain and user requirements
- Must be able to synthesise the domain understanding into models (entity-relationship diagrams, UI storyboards, flowcharts, design patterns, etc.)

To meet the above learning criteria, the weekly lectures of the course were dedicated to different topics each week to ensure that all relevant areas are covered. Whenever possible, students were asked to use online tools/platforms relevant to the topic of the week (Table 6), so they can develop also their practical skills.

Table 6. Study Plan of Programming for Interaction

Lecture	*Topics covered*	*Online tools/platforms used in the workshop*
Concept Objects and UML	What is a model? What is an object? What is UML? - UML Diagrams (Class Diagram) Messages Public/Private interface Classes and Class Definitions Inheritance	StarUML software modeler (https://staruml.io/https://portal.mintel.com/portal/login?next=/)
UML cont. and Version Control	UML: Use Case Diagrams UML: Sequence Diagrams Version Control Git	GitHub development platform (https://github.com/) Git Resources (https://git-scm.com/) StarUML software modeler (https://staruml.io/https://portal.mintel.com/port

		al/login?next=/)
Introduction to OOP and Java	Defining Classes and Creating Objects Constructors Static Variables, Constants, and Methods Visibility Modifiers Data Field Encapsulation Immutable Objects and Classes The Scope of Variables The this Reference	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5) StarUML software modeler (https://staruml.io/https://portal.mintel.com/portal/login?next=/)
Thinking in Objects	Class Abstraction Thinking in Objects Class Relationships Wrapper Classes The String Class	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5) StarUML software modeler (https://staruml.io/https://portal.mintel.com/portal/login?next=/)
Inheritance and Polymorphism	Using the super Keyword Overriding Methods Overriding vs. Overloading Polymorphism Dynamic Binding The protected Data and Methods Preventing Extending and Overriding	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5) StarUML software modeler (https://staruml.io/https://portal.mintel.com/portal/login?next=/)
Intermediate OOP in Java	Exception Handling Abstract Classes Interfaces Interfaces vs. Abstract Classes Class Design Guidelines	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5) StarUML software modeler (https://staruml.io/https://portal.mintel.com/portal/login?next=/)

Android Fundamentals	App components The manifest file App resources	Android Studio - Android development platform (https://developer.android.com/studio)
Android Activities	Introduction to activities The activity lifecycle Parcelables and bundles	Android Studio - Android development platform (https://developer.android.com/studio)
Android Layouts	Write and load the XML resource Attributes Layout position Size, padding, and margins Common layouts (Linear, Relative, Adapter view)	Android Studio - Android development platform (https://developer.android.com/studio)
Android Sensors	Sensors overview Motion sensors: Android open-source project sensors, Rotation sensor, Gravity sensor, Linear accelerometer, Accelerometer	Android Studio - Android development platform (https://developer.android.com/studio)

The assessment of the course consists of a mini project and a written exam. The mini project should contain two items: the source code for a working piece of software, and a written report. The software must be a working, stand-alone computer program, written in Java that runs either on the desktop or on an Android device. The software should include at least three classes. The report should contain the following sections:

- Purpose of software and instructions on how to use it.
- Static structure and dynamic behaviour of software. Appropriate UML diagrams should be used to describe the structure and behaviour of the software (at least use case and class diagrams. Sequence diagrams are suggested but not required).
- Discussion: what was challenging, what was easy, what should be improved/extended if there was more time, and any other relevant reflection on the project.

The final written exam is an online quiz containing multiple-choice questions or short-answer questions without helping aids. The students get 4 hours to finalize the exam.

To facilitate the learning process and support students with their assessment, various learning activities have been designed with the help of the FLIP2G project's pedagogical model and platforms. The plan for each lecture was:

- The learning material (e.g. chapters of the text book, articles, videos etc.) becomes available on the course's LMS (i.e. Moodle) in the semester start, so students have plenty of time to access them (pre-class activity).
- The students play the FLIP2G game to test their understanding of the learning material (mainly pre-class activity but also in-class in the beginning of a few classes).
- The online lectures take place on MS Teams. A short summary of the topics of the lecture is given by the instructor, who also discusses questions that students may have. The instructor uses the FLIP2G dashboard to check the learning analytics for the specific game session before the lecture; if there is a particular question in the game that students seem to find difficult (i.e. most of them have given a wrong answer) emphasis is given on the relevant topic during the discussion (in-class activity).
- Next, students are asked to start working collaboratively on the week's assignments (relevant to the topics covered that week). The students tend to work with the students of the same group (students work in groups for a semester project module). The problems are available in Moodle that also gives a collaborative space to the groups, which is essential as the students are online. The available problems require students to develop software that can be also used for the mini projects. Their scope is relatively narrow, which allows the activity to be completed within the lecture. An example of a weekly assignment can be seen in Figure 10 (in-class activity). During this time, the instructor along with teaching assistants are available for questions, feedback, and guidance when needed.
- The groups return to the plenary session (on MS Teams) to discuss their solutions. The instructor showcases complete solutions or parts of them, while students can pose questions or propose alternative solutions (in-class activity).
- Students are asked to complete the weekly assignments after the lecture in case they did not have the time to do so during the dedicated time during the lecture and submit them in Moodle. Every student has to submit an individual hand-in even though they work in groups. Moreover, the students have to develop further their assignments in order to integrate them in their mini projects or develop from scratch parts of the mini project. At the same time, the students have to write parts of their report commenting on the software developed for the mini project or on the process of developing it (reflective process) (pre/post class activity).

The above learning activities lead to data generation that helps the instructor make adjustments to the course while it is still running. This includes:

- Learning analytics provided by the FLIP2G platform that show the performance/engagement of the students in/with the game.
- Solutions/findings/notes from the weekly assignments that students have solved in groups and submitted in Moodle.
- Oral feedback from the students regarding the learning activities that are given during the class discussions.

Exercises on Android Layouts

Exercise 1

Create an app with a button that says "Say Goodbye" and a text view that says "Hello world!". When the user clicks on the button, the text on the button should change to "Say Hello" and the text in the text view should change to "Goodbye world!".

Store all button and text view strings as constants in the strings.xml file, which you'll find in the res/values folder. You must access these strings using the getText() method which takes an id defined in R.java as its argument. You should access the TextView and Button using the findViewById() method.

For retrieving the strings from the strings.xml file, use the following statement (assuming the string you want to retrieve was saved with the keyname hello):

String string = getString(R.string.hello);

Exercise 2

Design a simple interface for writing an email message. Include a "To" field, a "Subject" field, a "cc/bcc" field, an area to write the message, a "Send" button, a "Save as draft" button and a "cancel" button. Customize the layout in order for the different views to occupy the space they need.

Figure 10. An example of a weekly assignment developed for the Programming for Interaction course

4.1.2 Delivery of Pilot 1

As it is mentioned above, the pilot ran fully online due to the Covid-19 restrictions that were in place in Denmark during the spring semester 2021. The University's LMS, Moodle, and MS Teams were used to ran the weekly lectures online. The cohort of 64 students had the weekly lectures on Wednesday mornings. Towards the end of the lectures, 13 students out of 64 decided to drop out from the study program. Morevoer, three students went on sick leave, so they were exempted from the course assignments and assessment. The reasons for the students dropping out (in the cases

these were communicated to the study administration) are not directly connected with the specific course.

By looking at the learning analytics, the teacher of the course could see which questions were challenging for most students, so that these were discussed during the in-class sessions. Figure 11 shows the average score evolution for all students who participated in each session. This overview helped to identify the sessions that were more perceived more difficult for students.

The learning analytics module provided also an overview of number of students who attempted each session (Figure 12). From this overview, it is evident that fewer students attempted the quizzes overtime. This is a common development during each semester that is also reflected in the number of students participating in the in-class sessions.

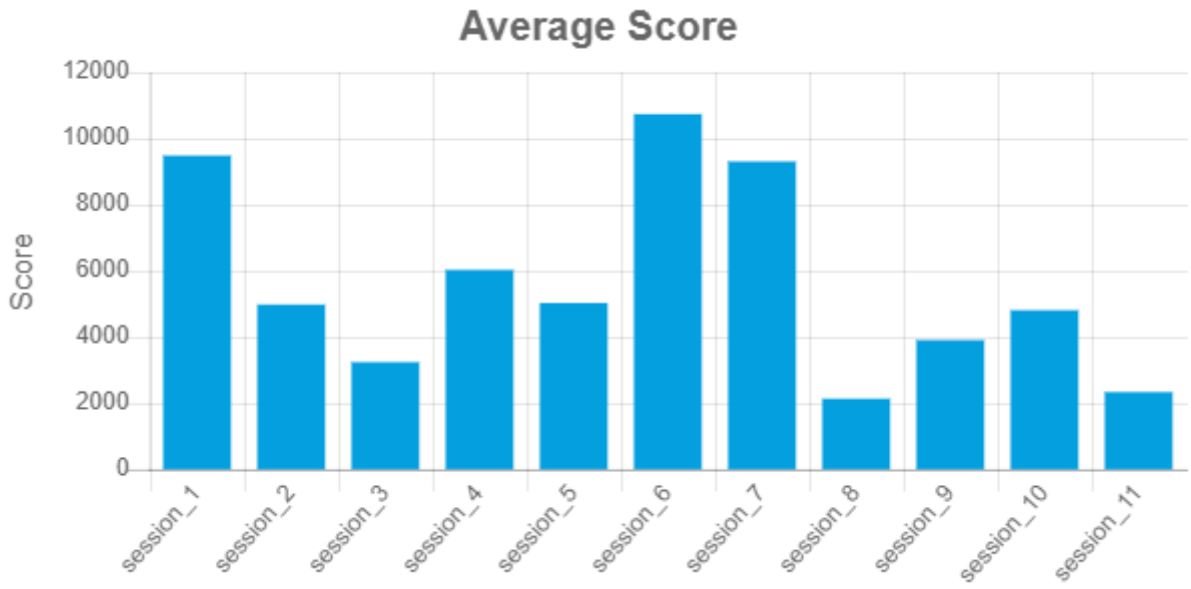


Figure 11. Score evolution for the Programming for Interaction course

Sessions	Game/Quiz	Session students
session_1	MED2 (1) Modeling	52
session_2	MED2 (1) UseCase	47
session_3	MED2 (1) UML_MP	38
session_4	MED2 (2) Intro OOP	38
session_5	MED2 (3) Thinking in objects	42
session_6	MED2 (4) Inheritance & Polymorphism	36
session_7	MED2 (5) Intermediate OOP	32
session_8	MED2 (6) Android Fundamentals	33
session_9	MED2 (7) Android Activities	31
session_10	MED2 (8) Android Layouts	30
session_11	MED2 (9) Android Sensors	30

Figure 12. Number of students who participated in each session

The learning analytics module also provides an overview of the score and engagement evolution for each student. From this overview, the teacher can see the five students with the highest scores and the five students with the lowest scores. From this analysis, the teacher could see and contact the most inactive students during the semester. In most of the cases, these were the students who dropped out. However, there were few students among them, who participated actively in the lectures. When the teacher contacted them, they said that they would complete all the quizzes towards the end of the semester, which turned out to be the case. Some of these students got high grades in the final exam. On the other hand, some of the best scoring students got low or average grades. Therefore, the performance in the quizzes could not be used as a sole predictor for the performance in the final exam or the possibility of students dropping out.

4.2 Pilot 2 – Programming of Complex Software Systems

Pilot 2 ran initially with 47 students at the Medialogy bachelor program. The second year of the Medialogy programme allows students to reinforce their technical knowledge and practical skills. Many real-world software systems are complex, involving multiple devices, processors, users, and complex algorithms. This module introduces several methods that are relevant when large software systems are to be developed and used. The objective is to give the students an understanding of object-oriented software analysis and design methods. Furthermore, an introduction to network programming and parallel programming, data structures and algorithms is also given.

By completing the course “Programming of Complex Software Systems” (PCSS), the students should be able to design, program and evaluate complex applications and network development both on PC and mobile platforms. The course introduces notions of network programming, algorithm

complexity and searching algorithms. The module consists of nine weekly in-class sessions, associated weekly assignments/reading, and a mini project. For the mini project, students in groups of 6-7 must develop a server-client application that can accommodate at least three clients in parallel. Students should also follow an agile software development process. Moreover, they must deliver a technical report describing the functionality of the application and explaining and reflecting on the development process. The module is evaluated by an individual written exam at the end of the semester. Students must successfully complete the weekly activities and the mini project in order to get access to the final exam.

Table 7. Basic information about the course "Programming of Complex Software Systems"

Target Group	Subject	Time/Duration	Overall Objective	Number of learning activities	Success metrics
☒ Undergraduate university students ☐ Postgraduate university students ☐ Secondary education students ☐ Primary education students ☐ Professionals	Advanced topics of programming	9 weekly in-class sessions & a mini project (follows an academic semester)	Convey the knowledge for designing, programming, and evaluating complex software systems involving multiple devices, processors, users, and complex algorithms	38 activities (e.g. exercises, videos, reading of textbook, quizzes, etc.)	Successful completion of weekly assignments and of mini project Final exam marks Student feedback

4.2.1 Learning Design for Pilot 2

The objective of the Programming of Complex Software Systems course is that the students acquire the skills, and competencies required for the actual planning, implementing, code generation, and

evaluation of server-client application and online networks. Students who complete the project module should obtain the following qualifications:

Knowledge

- Understanding of the basic concepts within object-oriented design and analysis (e.g., encapsulation, inheritance, composition, association, interfaces)
- Understanding the use of the UML language to produce and communicate object-oriented software design (structure, behavior, and interaction diagrams)
- Understanding of structure and tools for documenting code
- Understanding data structures for use in searching and sorting (graphs, linked lists, queues, stacks, trees, heaps, hash tables)
- Understanding the concept of algorithmic complexity, and Big-O notation
- Understanding of programming concepts related to networks: clients and servers, sockets, ports, IP addresses (static / dynamic), Ethernet addresses
- Understanding of digital application and communication protocols: OSI model, TCP and UDP
- Understanding of concepts behind parallel programming: processes, threads, scheduling, bottlenecks and deadlocks, shared data, mutex locks, race conditions
- Understanding of terminology and version control practices

Skills

- Produce and understand UML-based diagrams in order to work with object-oriented design and analysis
- Implement an object-oriented design from a UML description
- Select and apply appropriate data structures to create efficient search and sort applications
- Apply programming skills to implement a multi-threaded application that uses networks to communicate between two digital devices
- Use widely used software versioning system

Competencies

- Produce and implement object-oriented software designs
- Document an object-oriented software system using UML
- Evaluate existing code within networking and multithreading, evaluate its design and recommend improvements

- Design efficient solutions using advanced data structures to solve programming tasks, especially in the field of media technology
- Read and design algorithms, and analyze their complexity

To meet the above learning criteria, the weekly lectures of the course are organised to ensure that all relevant areas are covered and that the students can use the knowledge gained within their relevant projects. Whenever possible, students are asked to use the online tools relevant to the topics of the week. Students also used online tools (i.e. Microsoft Teams, Moodle LMS, FLIP2G Game) to communicate and complete the learning activities.

Table 8. Study Plan of Programming for Complex Software Systems

Lecture	*Topics covered*	*Online tools/platform used in the workshop*
UML and Software Engineering	Problem formulation (brainstorming, concept exploration, initial problem statement and initial UML diagrams)	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5)
Multithreading I	Problem analysis (concrete UML diagrams, final problem statement)	GitHub development platform (https://github.com/) Git Resources (https://git-scm.com/)
Multithreading II	Problem solving (design of system architecture)	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5)
Network Programming I	Problem solving (initial development of the client application)	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5)
Network Programming II	Problem solving (development of client application, initial development of the server application)	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5)

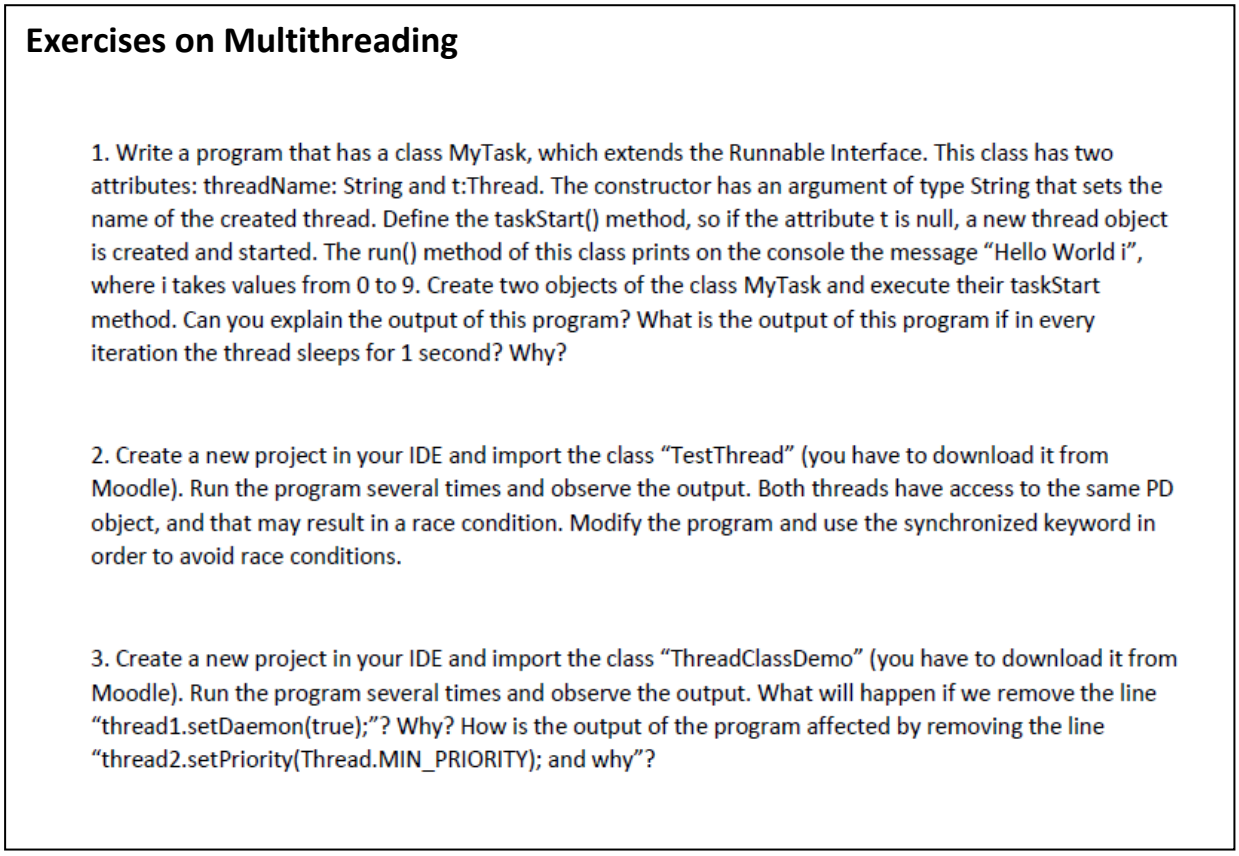
Algorithm Complexity	Counting instructions Worst-case analysis Asymptotic behavior Big-O notation Recursive complexity Logarithmic complexity	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5)
Data structures	Data structures Arrays/Linked Arrays Lists Queues Stacks	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5)
Sorting and Searching Algorithms	Searching algorithms: Linear search, Binary search Sorting algorithms: Insertion sort, Bubble sort, Merge sort, Quick sort	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5)
Trees, Hashing, and Graphs	Trees Definition Terminology Operations Subtrees and binary trees Sorting of trees Searching of trees Binary search Hashed search Breadth- vs. depth-first search Graphs	IDE Eclipse (http://www.eclipse.org/downloads/packages/eclipse-ide-java-developers/oxygenm5)

As with Pilot 1, learning activities were designed with the help of the FLIP2G's pedagogical model and platforms. Good practices and learning activities from Pilot 1 were continued and extended. The learning model was furthermore expanded since Pilot 1 to include more collaborative activities and data-driven interventions. The elaborated plan was made of the following elements:

- During the **concept exploration** phase, the learning material (e.g book chapters, articles, videos) is accessible on the class LMS (Moodle) from the semester start to give student plenty of time to get acquainted with it. When it was useful, learning material could be directly incorporated in the FLIP2G game through the improved teacher interface.
- During the **meaning making** phase, the students play the FLIP2G game which content is based on challenges from each lecture as preparation for the class meeting. We observed however that many students completed the pre-class quizzes after the class session, in preparation for the examination. Each class meeting would start with a multiplayer game session. During the multiplayer sessions, the teams of student players are invited to discuss the validity of their answers and give each other feedback. The emphasis on collaborative learning supports student engagement in the early stage of the class workshop session, and mixes them so that they do not always work with the same study partners from their project groups.
- The lectures were delivered both on MS Teams and in person. A short summary of the day's topics is given by the instructor, and a short discussion conducted with the students to assess their understanding of the workshop preparation. Using the FLIP2G Dashboard, it is possible to check which questions were challenging (i.e. with the most wrong answers) and give them more focus during the in-class discussions.
- During the **demonstration and application** phase, Students are then asked to work collaboratively on the week's assignment. The problems allow students to face challenges that will also be relevant during the work on their mini-project. Because of this, students tend to stay with the same study group partners. The instructor and teaching assistant can assist and answer students' questions.
- The **experiential engagement** phase invites the students to deepen their knowledge by exploring other avenues of learning. This phase concerns the completion of the students' mini-projects, with each student group being able to choose their own themes and approach to the mini-project.

The above learning activities generate data that helps the instructor make adjustments to the course during its runtime. This includes:

- Learning analytics that show the performance and engagement of students in the game
- Solutions and notes from the weekly assignments that students have solved in groups and submitted in Moodle
- Feedback from Pilot 1 and oral feedback from the students during the work sessions and questionnaire



Exercises on Multithreading

1. Write a program that has a class MyTask, which extends the Runnable Interface. This class has two attributes: threadName: String and t:Thread. The constructor has an argument of type String that sets the name of the created thread. Define the taskStart() method, so if the attribute t is null, a new thread object is created and started. The run() method of this class prints on the console the message "Hello World i", where i takes values from 0 to 9. Create two objects of the class MyTask and execute their taskStart method. Can you explain the output of this program? What is the output of this program if in every iteration the thread sleeps for 1 second? Why?

2. Create a new project in your IDE and import the class "TestThread" (you have to download it from Moodle). Run the program several times and observe the output. Both threads have access to the same PD object, and that may result in a race condition. Modify the program and use the synchronized keyword in order to avoid race conditions.

3. Create a new project in your IDE and import the class "ThreadClassDemo" (you have to download it from Moodle). Run the program several times and observe the output. What will happen if we remove the line "thread1.setDaemon(true);"? Why? How is the output of the program affected by removing the line "thread2.setPriority(Thread.MIN_PRIORITY); and why"?

Figure 13. An example of a weekly assignment in the Programming of Complex Software Systems course

4.2.2 Delivery of Pilot 2

The pilot had to be run partially online due to the slow transition process from Covid-19 restrictions, which started being lifted in Denmark at the start of the fall semester. Since students expressed satisfaction with the possibility of getting the lectures online, the lectures were systematically recorded, starting from session 2. Although the cohort started with 47 students, during the semester the lectures presence averaged around 20 students. After the lectures started in person again, several students chose to keep following the lectures from home. Figure 14 illustrates how students were distributed between the physical class and the online session on MSTeams.

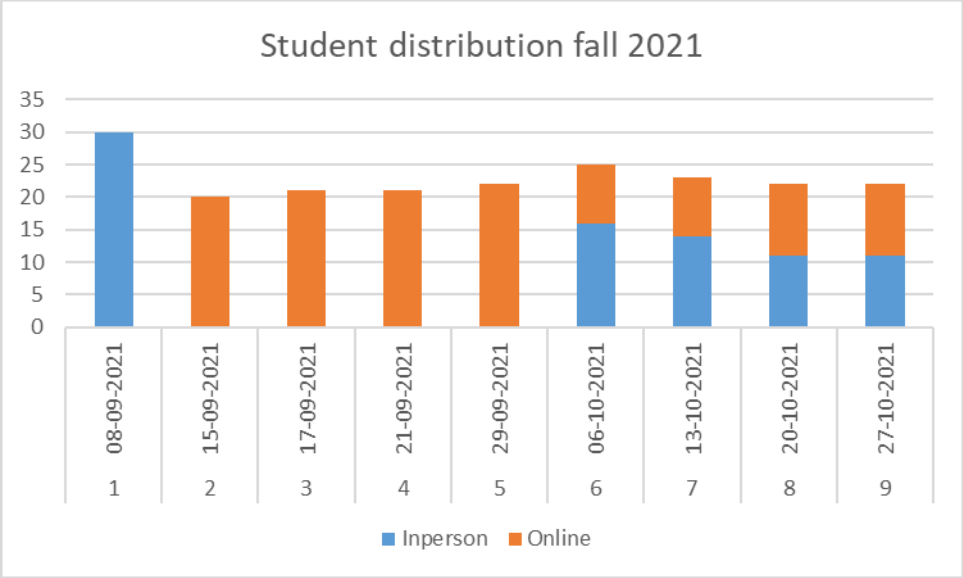


Figure 14. Student presence and distribution during pilot 2

A semi-structured interview run with the students' representatives reflected that some students indeed still preferred following the lectures online even after the campus reopening. Although the students admit that in their opinion receiving in-person interaction is better, material constraints such as travel time to campus, other tasks to do and personal obligation made it easier and preferable for some students to stay at home. It is unclear, however, if this phenomenon will endure in the long term or is only the short-term impact of close to 18 month of travel restrictions. Furthermore, disengagement during the lectures in the second half of the semester tends to be common as students start focusing more on their hands on projects and group activities, and is not connected to the specific course.

As with Pilot 1, the learning analytics provided an overview of the number of students who attempted each session, an overview of the score and engagement for each session. Figure 15 shows the average score for each session and Figure 16 the average engagement. As with Pilot 1, the number of students who attempted the quizzes tended to decline overtime, which is common over the semester and again not tied to a specific course. However, many students completed the quizzes in the second part of the semester, after the lectures were over.

Sessions	Game/Quiz	Session students	Sessions	Game/Quiz	Session students
session_1	MED3 (1) UML	31	session_1	MED3 (1) UML	43
session_2	MED3 (2) Multithreading	25	session_2	MED3 (2) Multithreading	41
session_3	MED3 (3) Multithreading_MP	27	session_3	MED3 (3) Multithreading_MP	41
session_4	MED3 (4) NetProgramming	20	session_4	MED3 (4) NetProgramming	38
session_5	MED3 (6) Complexity	15	session_5	MED3 (6) Complexity	38
session_6	MED3 (7) Data Structures	14	session_6	MED3 (7) Data Structures	39
session_7	MED3 (8) Sorting	12	session_7	MED3 (8) Sorting	38
session_8	MED3 (9) Trees	7	session_8	MED3 (9) Trees	38

Table 9. Number of students completing each session the 29/11/2021 (left) and the 14/12/2021 (right)

We can observe from Table 9 that only a minority of students were consistent with online preparation and that this number tended to decline over time. However, students used the online resources to prepare for the examination as most of the student group completed the quizzes before the end of the semester.

The average score remained however more consistent during Pilot 2 as compared to Pilot 1. This can be explained by the fact that the quizzes were streamlined to have an average of 6 to 7 questions by quiz and no quiz above 10 questions. The average engagement consequently was also more consistent with an average of 187 seconds by session. We can thus assume that, even if less students worked consistently with the platform, those who did during Pilot 2 tended to spend a little more time on each session and reach higher average scores (the average score by question answered raised from 580 during pilot 1 to 641 to Pilot 2).

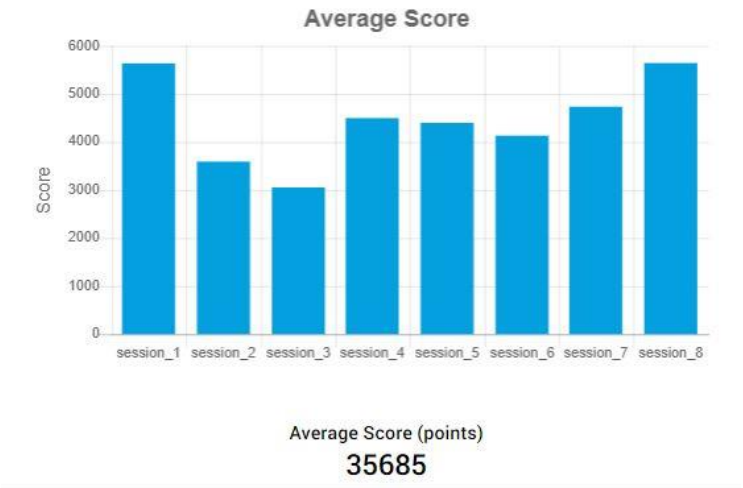


Figure 15. Average score per session - Pilot 2

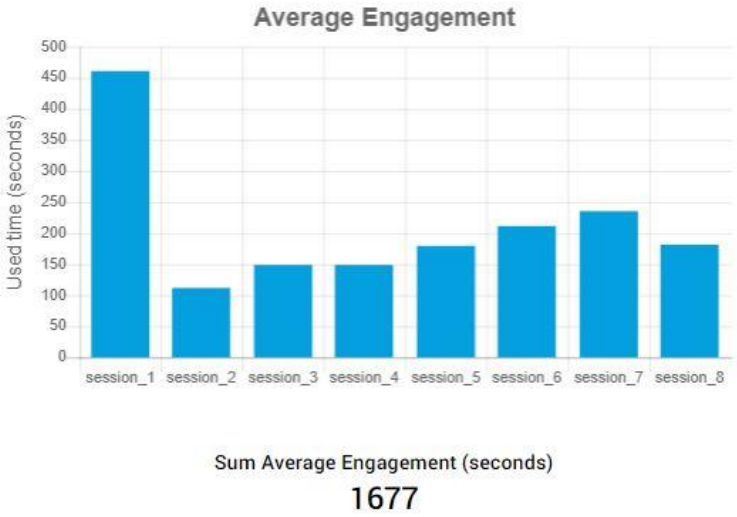


Figure 16. Average engagement per session - Pilot 2

The learning analytics module, providing information for the higher and lower students' performance in engagement and score, was used in Pilot 2 as it was in Pilot 1. From this analysis, the teacher could see and contact the most inactive students during the semester, which were given a specific reminder to complete their assignments. As of this writing the students are yet to complete their final exams, but as in Pilot 1 it does not appear possible to fully predict which students are still likely to drop out, as examples of late engagement to the platform and course material remain possible. However, it appears that reminders to complete the assignments were followed, since the number of students who completed the sessions was higher at the end of the semester.

The PBL elements of the pilots structured the students' mini-projects that they have to complete over the course of the semester. During Pilot 2, all 47 students who submitted their mini-project got a pass grade and were allowed to continue to the final exam.

5 University of Macedonia

UOM carried out a total of six pilots in the context of the FLIP2G project, four pilots during the fall semester of 2021 and the spring semester of 2021, and two pilots during the fall semester of 2021. Each course had a specific structure, and was re-designed according to the FLIP2G pedagogical model. The first four courses were carried out online due to the Covid-19 restrictions in Greece at the time of the pilots, which was on the fall semester of 2020 and the spring semester of 2021. The final two courses were carried out in the classroom, as the universities in Greece were open during the fall semester of 2021. The following table shows a short overview of the UOM pilots.

Table 10. Overview of UOM pilots

Course name	Semester	Number of students	Mode of delivery
e-Government	7th – Fall 2020	74	Online
Advanced information systems	8th –Spring 2021	8	Online
Innovative e-business systems	2nd (MSc) – Spring 2021	18	Online
Information Systems Analysis and Design	4th (BSc) – Spring 2021	229	Online
e-Government (2nd iteration)	7th – Fall 2021	~115	In classroom
Information Systems Analysis and Design	2nd (MSc) – Fall 2021	~40	In classroom

5.1 Pilot 1 – e-Government

The first pilot (Pilot 1) for UOM used the e-Government course, which is elective and runs during the 7th semester of the Applied Informatics programme. In total, 74 students were enrolled in the course for the fall semester 2020. During this course, students learn about basic concepts regarding e-Government, Open Government Data and Linked Open Data, Provision of Public Information and Services, One-stop Government, Interoperability and e-Participation.

The aforementioned topics were taught using the FLIP2G model, where students could access the game and the UOM's e-learning platform and read the provided materials before class. Each lecture was available in PDF format with a set of slides that contain in depth learning content for the course's topics. By completing this course, students are able to understand the role and capabilities

of implementing Information Systems in the Public Sector, use e-Government and e-Participation applications and develop simple applications based on linked open government data.

The course runs for 13 weekly 3-hour lectures, where lectures include:

- Brief presentation of the learning materials that students have already accessed and read
- Quiz with questions from the learning materials using the FLIP2G gaming environment
- Assignment presentations from student groups and discussion

The course assessment is carried out through a 50% - 50% grading mechanism, where 50% of the grade comes from the final examination, and the other 50% is divided between 10% of the quiz answers and 40% of the group assignments' grading. Additional elements that affect students' grades are the in-class discussions and their presentation skills. All lectures were carried out through the Zoom software.

Table 11. Basic information about the course "e-Government"

Target Group	Subject	Time/Duration	Overall Objective	Number of learning activities	Success metrics
☒ Undergraduate university students ☐ Postgraduate university students ☐ Secondary education students ☐ Primary education students ☐ Professionals	e-Government e-Participation	13 weekly lectures	Learn about e-Government, Open Government Data and Linked Open Data	40 learning activities in total, including lectures, weekly quizzes, group and individual assignments and weekly problems to solve	Assignment marks Final exams

5.1.1 Learning Design for Pilot 1

Pilot 1 was the first design of a UOM course based on the FLIP2G pedagogical model. The objective of the e-Government course is that students understand the role and capabilities of Information

Systems and technologies when applied in Public Administration. Students who complete this course gain the following knowledge and skills:

Knowledge:

- What technologies can be used in public administration, with emphasis on semantic web and linked data (knowledge graphs, chatbots)
- e-government strategies and policies
- open government data
- e-government processes and services
- semantic web technologies and linked data
- electronic participation and usage of social media in public administration
- chatbots and Artificial Intelligence in the public sector.

Skills:

- develop simple web applications using REST APIs technologies and semantic web technologies
- use chatbots for executing electronic public services

We endeavoured to take into consideration all different elements of the pedagogical model and apply them into adapting the e-Government course accordingly. Towards this end, the weekly lectures included a different topic and contained educational material on the topic, a weekly quiz for assessing the level of understanding and tasks on the group assignments. These lectures were structured as follows:

Table 12. Study structure of e-Government – 1st iteration

Lecture	*Topics covered*	*Online tools/platforms used in the lecture*
Introduction to e-government	e-government challenges and opportunities e-government definition and polices open government data and Sir Tim Berners Lee stars interoperability	Debategraph (https://debategraph.org/Stream.aspx?nid=61932&iv=05&sh=y) Data.gov.gr (https://data.gov.gr/)
e-government policies	European polices Greek policies e-government action plans	Chart creations (https://digital-agenda-data.eu/datasets/digital_agenda_sco

		reboard_key_indicators/visualizations) Chart creations (https://ec.europa.eu/eurostat)
Public service provision and CPSV	Public administration and public services Public services in Greece Models and phases of public services CPSV template	
One-stop government and Interoperability	Citizens and public administration Online one-stop government Interoperability Integrated public service governance	Cartography Tool (CarTool)
e-participation	e-participation principles e-participation phases social media in politics	OpenGov.gr forums Mind-mapping tool
Open government data	Open data culture Open data principles Cleaning open data Publishing open data Open data repositories and licenses	CKAN open-source data catalog Socrata cloud-based SaaS Open Data catalog platform
Open data publication	API REST API Web services, JSON API call from Chrome API call with Java	Eclipse IDE for Java coding Postman Chrome add-on Diavgeia.gov.gr portal
Resource Description Framework (RDF)	RDF introduction URI RDF ontologies and vocabularies Turtle language	
SPARQL	SPARQL introduction Basic commands	http://data.dai.uom.gr:8890/sparql RDF store

	Queries with SPARQL SPARQL examples and practice	
Chatbots	e-government systems and human-computer interaction Chatbots introduction Chatbots messages Chatbots creation tools	Amazon Lex https://aws.amazon.com/lex/ Dialogflow (Google) https://dialogflow.com/ IBM Watson https://www.ibm.com/watson/how-to-build-a-chatbot Luis (Microsoft) https://www.luis.ai/home Wit.ai (Facebook) https://wit.ai/ Rasa X (https://rasa.com/)
Advanced technologies and e-government	Cloud computing Internet of Things Smart Cities Artificial Intelligence	

During the **concept exploration phase** of the PBL pedagogical model, students could access from several repositories the learning materials mentioned above. Students could login to the gaming environment or the university's e-learning platform and download the materials for the upcoming week's subject matter. Each material provided a wide variety of introductory knowledge with the main concepts and principles for e-government, systems and technologies used within public administration, advanced technologies such as chatbots and AI etc.

The UOM teacher designated sessions of discussions with student groups while they were trying to understand the concepts taught. Each student could also post a question in the e-learning forum or send an e-mail to the teacher with clarifications needed on what the concepts they were reading meant and if they needed extra material resources.

A reflection of students' progress during concept exploration regarded the monitoring of the accessed materials through the gaming environment and the e-learning platform, as well as any reflection remarks provided by the students in different means (e.g. forum, quiz answers, e-mails etc.).

The UOM teacher proceeded to interventions whenever he noticed students would not read the suggested reading materials or would give the wrong answers to the quiz questions in a way it was obvious they had not understood the concepts correctly. Intervention mechanisms included

additional materials, correcting of misconceptions, and discussions on why they understood the material incorrectly.

For the **meaning making phase** of the pedagogical model, students were initially required to complete different group assignments that corresponded to the weekly lecture's learning content. Towards this end, each student had to understand in depth the materials they read, answer the respective quizzes within the game individually, and then collaborate with their group members to complete and upload the assignment in the e-learning platform.

In total, three group assignments and one individual assignment were designed, as follows:

- 1st group assignment: Create a presentation that you would present to a public authority in order to promote the design and construction of a mobile app that will help disabled people have access to public service processes and workflows.
- 2nd group assignment: Create a diagram using the CPSV template to model the public service process of issuing a public transportation card to disabled people by public authorities. Describe all the different concepts and flows that are included within the public service process. Create a BPMN diagram to show the business processes' workflow.
- 3rd group assignment: Study the API provided by the Greece's Transparency Program initiative (Diavgeia), create 3 different API class calls and enrich them with additional code so that they post different kinds of open data.

Students were able to answer more in-depth quiz questions within the game, and had access to the teacher for questions and clarifications while they were trying to make sense of the learning content, through the e-learning forum and emails. Students were also able to reflect on their experience in making sense the knowledge taught and read and creating their own knowledge, through discussions within the classroom and using the online forum. The UOM teacher provided hints and additional assistance in the form of materials or adapted assignments objectives when students encountered difficulties in applying what they have read.

For the **Demonstration and application** phase of the model, student groups carried out the designed group and individual assignments and prepared respective reports detailing their learning process and results. Students also prepared presentation slides to present in the classroom and demonstrate their work. An example of such a presentation is shown in Figure 17.

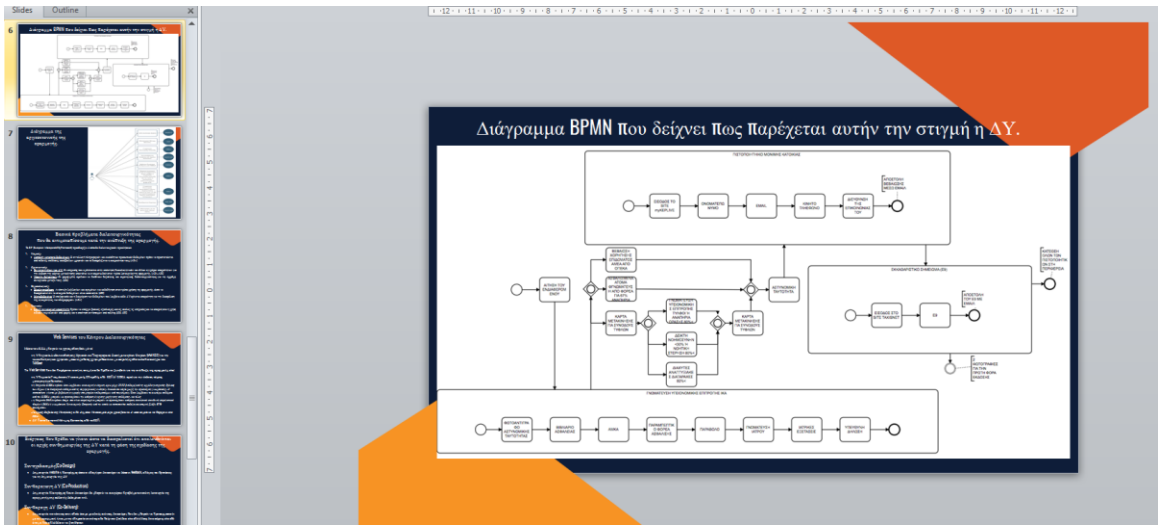


Figure 17. Demonstration example for e-government

The students could send questions on the way they tried to apply the knowledge taught in their assignment tasks and the UOM teacher was able to scaffold their work by pointing out ways they could improve their ongoing progress. Discussions within the classroom also helped students interact with each other, the teacher and other group members in brainstorming different ways to complete the assignments.

The group presentations via Zoom were the most common way students could show their weekly progress, receive constructive comments on how they can improve their work and discuss any identified difficulties, challenges or interesting findings. The UOM teacher was able to correct the work done before the final assignments' deadline by providing feedback on the quality of their progress and results.

During the final phase of the FLIP2G pedagogical model, i.e. **Experiential engagement,** students prepared and submitted reports as well as the final versions of their presentations, which included their reflections on a) their group work, the way they collaborated and how they organized their workload, and b) their results, how they applied the knowledge they were taught, why they made the decisions they did, and what were the lessons learnt.

5.1.2 Delivery of Pilot 1

Pilot 1 ran fully online due to the Covid-19 restrictions that were in place in Greece during the fall semester of 2020. To this end, the course used both the FLIP2G gaming environment and the university's e-learning platform to help students with all the communication, information sharing, and assessments that had to be carried out online. In total, 74 students were enrolled in the course. However, due to the fact that it was the first semester that classes were carried out online, many students had trouble following the course and dropped out throughout the semester.

It is also worth mentioning that, due to the online nature of the course, many students used their personal PC / laptops and home wifi connections to log in to the class and to the FLIP2G game. The majority of the students also had returned back to their home cities or villages, where the internet had many connections issues, due to the heavy workload of the wifi network, since all the students at different levels of education (i.e. primary, secondary, higher education) had to login online for their classes. This also contributed largely to a major drop out from the usage of the FLIP2G game due to its heavy graphics, and the UOM teacher had to also create the course quizzes in the university's e-learning platform.

Figure 18 shows the analytics dashboard of the university's e-learning platform, where students of the course logged in to read course announcements and access the learning materials and the course's quizzes, when they were unable to access the gaming environment.

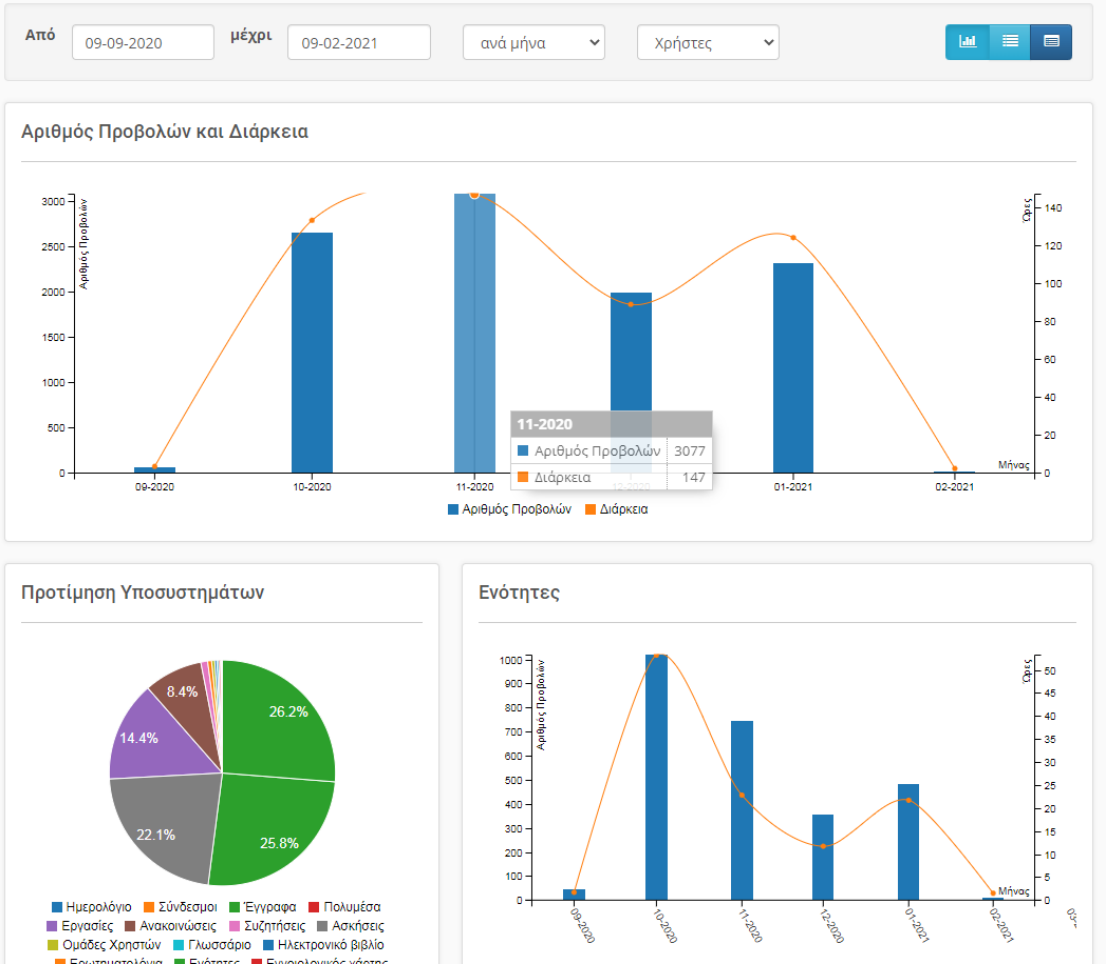


Figure 18. Pilot 1 e-government learning analytics

Co-funded by the Erasmus+ Programme of the European Union

In the analytics of the game, as shown in Figure 19, the teacher of the course could see which questions were challenging for most students, so that these were discussed during the in-class sessions.

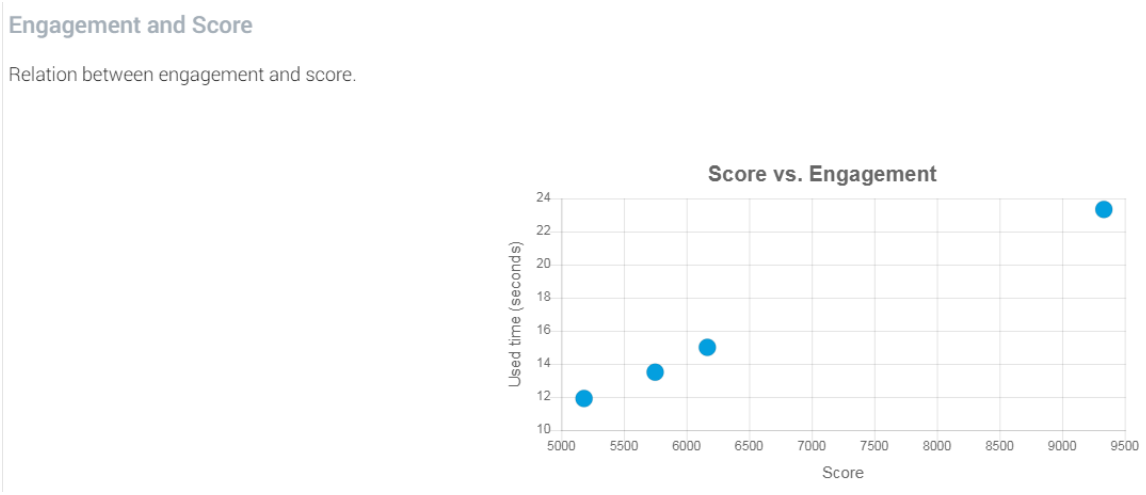


Figure 19. Engagement and score dashboard for e-Government course

Figure 20 shows the average score evolution for all students who participated in each session. This overview helped to identify the sessions that were perceived as more difficult by the students.

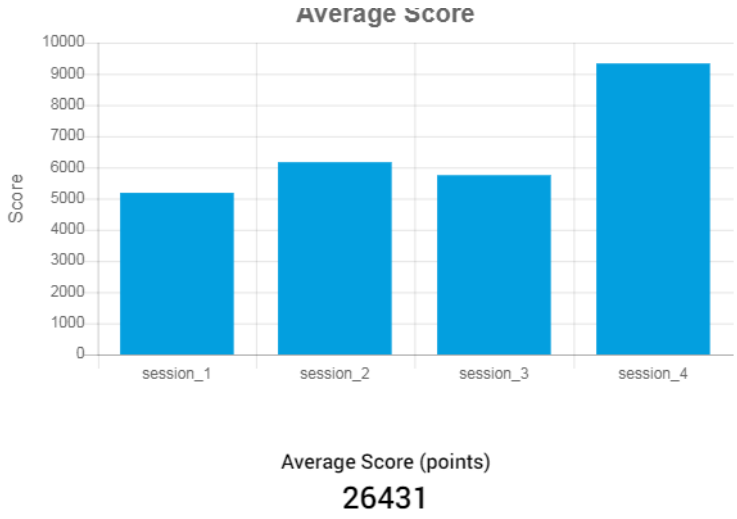
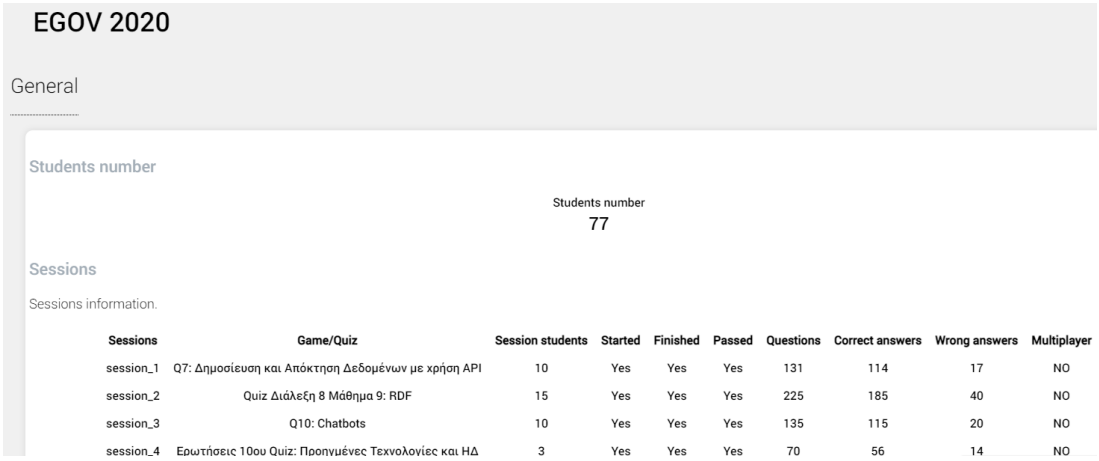


Figure 20. Score evolution for the e-Government course



EGOV 2020

General

Students number

Students number
77

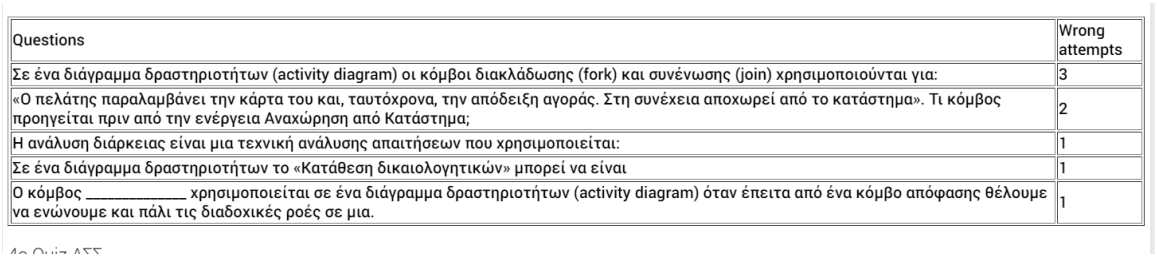
Sessions

Sessions information.

Sessions	Game/Quiz	Session students	Started	Finished	Passed	Questions	Correct answers	Wrong answers	Multiplayer
session_1	Q7: Δημοσίευση και Απόκτηση Δεδομένων με χρήση API	10	Yes	Yes	Yes	131	114	17	NO
session_2	Quiz Διάλεξη 8 Μάθημα 9: RDF	15	Yes	Yes	Yes	225	185	40	NO
session_3	Q10: Chatbots	10	Yes	Yes	Yes	135	115	20	NO
session_4	Ερωτήσεις 10ου Quiz: Προηγμένες Τεχνολογίες και ΗΔ	3	Yes	Yes	Yes	70	56	14	NO

Figure 21. Number of students who participated in each session

The UOM teacher consulted the FLIP2G analytics dashboards as well as students' answers from the quizzes in order to make adaptations in each weekly lecture (see Figure 22).



Questions	Wrong attempts
Σε ένα διάγραμμα δραστηριοτήτων (activity diagram) οι κόμβοι διακλάδωσης (fork) και συνένωσης (join) χρησιμοποιούνται για:	3
«Ο πελάτης παραλαμβάνει την κάρτα του και, ταυτόχρονα, την απόδειξη αγοράς. Στη συνέχεια αποχωρεί από το κατάστημα». Τι κόμβος προηγείται πριν από την ενέργεια Αναχώρηση από Κατάστημα;	2
Η ανάλυση διάρκειας είναι μια τεχνική ανάλυσης απαιτήσεων που χρησιμοποιείται:	1
Σε ένα διάγραμμα δραστηριοτήτων το «Κατάθεση δικαιολογητικών» μπορεί να είναι	1
Ο κόμβος _____ χρησιμοποιείται σε ένα διάγραμμα δραστηριοτήτων (activity diagram) όταν έπειτα από ένα κόμβο απόφασης θέλουμε να ενώνουμε και πάλι τις διαδοχικές ροές σε μια.	1

Figure 22. Frequency of wrong attempts in questions of a Quiz

For example, the answers that were incorrectly selected by a significant number of students were discussed inside the classroom, in order to identify the cause of the misconceptions, and the correct answers were provided.

5.2 Pilot 2 – Advanced Information Systems

The second pilot for UOM used the Advanced Information Systems course, which is elective and runs during the 8th semester for the Applied Informatics programme. In total, 8 students were enrolled during the spring semester 2021. During this course, students learn about innovative information systems in order to solve business problems and exploit new opportunities for achieving competitive advantage.

The aforementioned topics were taught using the FLIP2G model, where students could access the game and the UOM's e-learning platform and read the provided materials before class. Each lecture was available in PDF format with a set of slides that contain in depth learning content for the course's topics.

5.2.1 Learning Design for Pilot 2

The objective of the Advanced Information Systems course is that students understand the usage and importance of advanced information systems for solving business problems and exploiting new opportunities that achieve competitive advantage. The focus of this year's course was the ERP SAP S/4 HANA system.

By completing this course, students are able to understand the role and capabilities of implementing Information Systems in the Public Sector, use e-Government and e-Participation applications, and develop simple applications based on linked open government data.

The course runs for 13 weekly 3-hour lectures, where lectures include:

- Brief presentation of the learning materials that students have already accessed and read
- Quiz with questions from the learning materials using the FLIP2G gaming environment
- Assignment presentations from student groups and discussion

The course assessment is carried out through a 50% - 50% grading mechanism, where 50% of the grade comes from the final examination, and the other 50% is divided between 10% of the quiz answers and 40% of the group assignments' grading. Additional elements that affect students' grade are the in-class discussions and their presentation skills.

Table 13. Basic information about the course "Advanced Information Systems"

Target Group	Subject	Time/Duration	Overall Objective	Learning activities	Success metrics
☒ Undergraduate university students ☐ Postgraduate university students ☐ Secondary education students ☐ Primary education students ☐ Professionals	ERP SAP S/4 HANA	13 weekly lectures	Learn about the different modules of the ERP SAP S/4 HANA system (MM, SD, FI, HR)	29 learning activities (10 learning materials 3 case studies 5 activities for SD 8 activities for Fiori 3 group assignments (SD, MM, PP))	Assignment marks Final exams

The course was re-designed based on the FLIP2G pedagogical model, as it was previously carried out in a traditional setting, where the teacher delivered lectures and students participated in their final exams.

Table 14. Study structure of Advanced Information Systems

Lecture	*Topics covered*	*Online tools/platforms used in the lecture*
SAP Introduction	SAP – The Intelligent Enterprise Fast Facts about SAP S/4HANA Innovation & Simplification SAP FIORI Transition to SAP S/4HANA	
Case study	Case study of Global Bike Group	SAP Global Bikes study
Fiori exploration	SAP Fiori Launchpad (FLP) Fiori app example - Sales Order Edit Launchpad Fiori Apps	SAP Fiori
Workshop for Fiori	Fiori exercises	SAP Fiori
SAP Sales and Distribution	Sales Shipping and Transportation Billing Credit Management Foreign Trade	SAP Fiori

For the **Concept exploration phase** of the pedagogical model**,** students were able to access the learning materials from the e-learning platform supported by the university. Each week, the teacher would upload the weekly lecture and students could study the material before the course.

Teacher-student interaction was carried out directly through chats or emails, where students could post questions about the materials they read or ask for additional content and clarifications. A reflection of students' progress during concept exploration regarded the monitoring of the accessed materials through the e-learning platform, as well as any reflection remarks provided by the students in different means (e.g. class discussions, e-mails etc.).

Finally, intervention mechanisms during concept exploration included the provision of additional materials, and discussions with students where they did not access the content from the e-learning platform.

During the **Meaning making phase,** students were required to form small groups of two. Each group would be assigned with studying a specific ERP SAP module from MM, SD or PP. The learning material includes slides with guidelines and lecture notes. Groups had to also participate in learning activities such as lab exercises within the classroom and case studies investigation and problem solving to make sense of each module's characteristics.

Students were able to answer more in-depth quiz questions once they started to read the materials of each module more thoroughly and research the provided case studies. They were also able to reflect on their experience in making sense the knowledge taught and read and creating their own knowledge, through discussions within the classroom and emails. Students also used online social media accounts to communicate with each other and with the teacher.

The teacher provided additional assistance in the form of materials (lecture notes in English and more information on the case studies) when students encountered difficulties in applying what they have read.

During the **Demonstration and application phase,** student groups carried out the group assignments for their SAP modules and prepared presentations and reports detailing their learning process and results. Students also demonstrated their work in the classroom, acting as teachers for their assigned module, as the other students had studied other SAP modules, as shown in Figure 23.

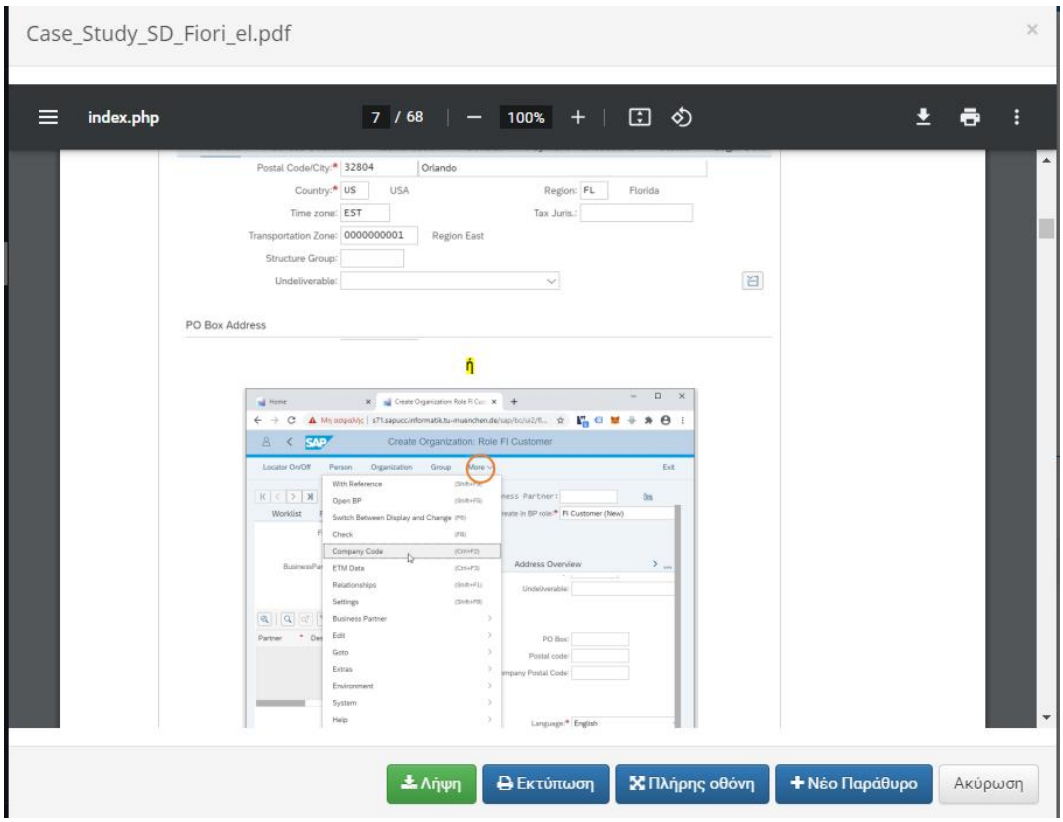


Figure 23. Example of work demonstration by the student groups on SAP practice

Students were able to discuss any questions they had with the teacher within the classroom or through email regarding different features of the SAP modules. The group presentations within the classroom were the most common way students could show their weekly progress, receive any constructive comments on how they can improve their work and discuss any identified difficulties, challenges or interesting findings. The teacher was able to correct the work done before the final assignments' deadline by providing feedback on the quality of their progress and results.

Finally, in the **Experiential engagement phase,** students prepared their reports as well as the final versions of their presentations.

5.2.2 Delivery of Pilot 2

Pilot 2 ran fully online due to the Covid-19 restrictions that were in place in Greece during the fall semester of 2020. The course was carried out mainly without the usage of the educational game, as the pilot was carried out in the beginning of the game's launch and the students were experiencing problems with the interface. The reason for this was the fact that students participated for the first time in online courses from their homes due to the country's lockdown, and used their personal computers and internet networks to participate in the courses. This resulted in overload problems and students were not able to log on to the game and complete the quizzes.

In total, 25 students were enrolled in the course. However, due to the fact that it was the first semester classes were carried out online, many students had trouble following the course and dropped out throughout the semester.

It is also worth mentioning that, due to the online nature of the course, many students used their personal PC / laptops and home wifi connections to log in to the class and to the FLIP2G game, which resulted in the challenges described in the previous pilot. This contributed largely to a major drop out from the uage of the FLIP2G game due to its heavy graphics, and the UOM teacher had to also create the course quizzes in the university's e-learning platform.

5.3 Pilot 3 – Innovative e-Business Systems

The 3rd pilot was carried out for the Innovative e-Business Systems, which runs in the 2nd semester of the postgraduate programme of the Applied Informatics Department. The main goal of the course is for students to understand the importance of innovative technologies and how they can be used to solve business problems and achieve competitive advantage.

5.3.1 Learning Design for Pilot 3

Students who complete this course gain the following knowledge and skills:

Knowledge:

- Technologies and capabilities of Content Management Systems.
- Technologies and capabilities of CRM (Customer Relationship Management) and ERP systems.
- Technologies and capabilities of Data Visualization Systems
- Technologies and capabilities of Business Intelligent Systems

Skills and competences:

- Usage of technologies from each of the aforementioned categories
- Solving business problems and exploit opportunities through innovative e-business systems

Table 15. Basic information about the course "Innovative –Business Systems"

Target Group	Subject	Time/Duration	Overall Objective	Learning activities	Success metrics
☐ Undergraduate university students	Information systems CRM CMS	13 weekly lectures	Learn about the different innovative information	48 learning activities (13 learning materials	Assignment marks Final exams

☒ Postgraduate university students ☐ Secondary education students ☐ Primary education students ☐ Professionals	ERP BI AI and chatbots		systems	6 lab session cases 25 activities in group and individual assignments 4 quizzes	

Towards this end, a mix of theoretical lectures and lab sessions were carried out. The theory focused on the different types of systems, while the lab sessions demonstrated real examples and good practices of each category. Students were able to practice using the systems individually and then perform assigned tasks as a group to complete their problem-solving assignments. The topics covered in each session are shown in Table 16.

Table 16. Study structure of Innovative e-business Systems

Lecture	*Topics covered*	*Online tools/platforms used in the lecture*
Information systems	What is information Business processes Information systems	
Business systems	Theory on CMS	Lab session on Wordpress
Business systems	Theory on CRM	Lab session on Salesforce
Business systems	Theory on ERP	Lab session on SAP S/4 HANA
Business systems	Theory on project management and collaboration	Lab session on Trello software
Business Process	Theory on business process flows BPMN language and concepts	Lab session on Signavio software

Modelling		
(Social) Data Visualization Systems	What is data visualization Types of visualizations Types of data for visualizations	Lab session on Tableau software
Business intelligence	Business intelligence Machine learning	Lab session on Rapidminer BI
AI and chatbots	Theory on AI AI opportunities and case studies Chatbots (frameworks, principles, examples)	Lab session on Rasa X framework

Students were divided into groups of 5, and each group had to perform a semester assignment, with one interim and one final presentation and report. Students were also required to perform individual assignments for practicing on the SAP S/4 HANA system. Each group also had to use social media to communicate their findings and share comments and reflections. The social media used included LinkedIn and Twitter.

During the **concept exploration phase** of the PBL pedagogical model, students could access the learning content from the university's e-learning platform and the gaming environment. Students were also provided with external additional links with information that was useful for their understanding of the theory. Each student could also post a question in the e-learning forum or send an e-mail to the teacher with any clarifications needed on the meaning of the concepts, and if they needed extra material resources. The teacher could monitor whether students had accessed the learning content based on the analytics provided by the platforms used.

Students were able to explore the general concepts of what is a CRM, ERP, BI and CMS system, understand their differences and objectives to improve the business sector. Each student was responsible for gaining the required knowledge and making sense of the content provided.

For the **meaning making and demonstration and exploration phases** of the pedagogical model, students were initially required to complete one group assignment that included practice with each information systems they were taught in the weekly lectures and lab sessions. Towards this end, each student had to understand in depth the materials they read, answer the respective quizzes within the game individually, and then collaborate with their group members to complete and upload the assignment in the e-learning platform. The group assignment included:

- Creation of a company profile (name, objective, company logo, vision statement).

- Launch company website using Wordpress (upload template, logo, create at least 5 pages, add widgets and menus).
- Create a company account on Saleforce CRM (add products, contacts, create purchase quote, order).
- Design a business process workflow on Signavio based on the scenario provided.
- Create different visualizations on Tableau using large amounts of datasets.
- Use Rapidminer to employ the clustering algorithm to datasets and create clustering visualizations.

Students also had to perform two individual assignments with the following examples of learning activities:

- Exploration and practice on SAP Fiori with the SD module
    - Create customers
    - Create sale orders
    - Create invoices
- Social media exploration (Twitter and Linkedin)
    - Create accounts on Twitter and LInkedin
    - Follow other accounts relative to the course's topics
    - Post tweets using specific hashtags
    - Connect on Linkedin with groups and institutions relevant to the course's topics
    - Use and assess an existing chatbot
    - Demonstrate and report how digital transformation will look like in the future

Students were able to reflect on their experience in making sense the knowledge taught and read and creating their own knowledge, through discussions within the classroom and using the online forum. The UOM teacher provided hints and additional assistance in the form of materials or adapted assignments objectives when students encountered difficulties in applying what they have read.

The group presentations were the most common way students could show their weekly progress, receive any constructive comments on how they can improve their work and discuss any identified difficulties, challenges or interesting findings. The UOM teacher was able to correct the work done before the final assignments' deadline by providing feedback on the quality of their progress and results.

During the final phase of the FLIP2G pedagogical model, i.e. **Experiential engagement,** students prepared and submitted reports as well as the final versions of their presentations, which included their reflections on a) their group work, the way they collaborated and how they organized their workload, and b) their results, how they applied the knowledge they were taught, why they made the decisions they did and what were the lessons learnt.

5.3.2 Delivery for Pilot 3

Like the other two pilots, Pilot 3 ran fully online due to the Covid-19 restrictions that were in place in Greece during the Spring semester of 2021. The course was carried out using the university's e-learning platform and the FLIP2G gaming environment. In total, 18 students were enrolled in the course. However, as students again experienced connection time-out issues with the game, some students completed the course's quizzes in the gaming environment, and some used the e-learning platform.

Based on Figure 24 and Figure 25, the majority of the students gave mostly correct answers rather than wrong answers, showing a very good performance by all students in each session.


All Courses | Καινοτόμα Συστήματα η-Επιχειρείν course | Καινοτόμα Συστήματα η-Επιχειρείν Students | Guide

Students number
18

Sessions

Sessions information.

Sessions	Game/Quiz	Session students	Started	Finished	Passed	Questions	Correct answers	Wrong answers
session_1	1ο Quiz ΚΣΗΕ	9	Yes	No	Yes	133	102	31
session_2	2ο Quiz ΚΣΗΕ	8	Yes	No	Yes	117	94	23
session_3	3ο Quiz ΚΣΗΕ	5	Yes	No	Yes	118	85	33
session_4	4ο Quiz ΚΣΗΕ	6	Yes	No	Yes	181	112	69

Figure 24. Quiz sessions for students in "Innovative e-business systems"

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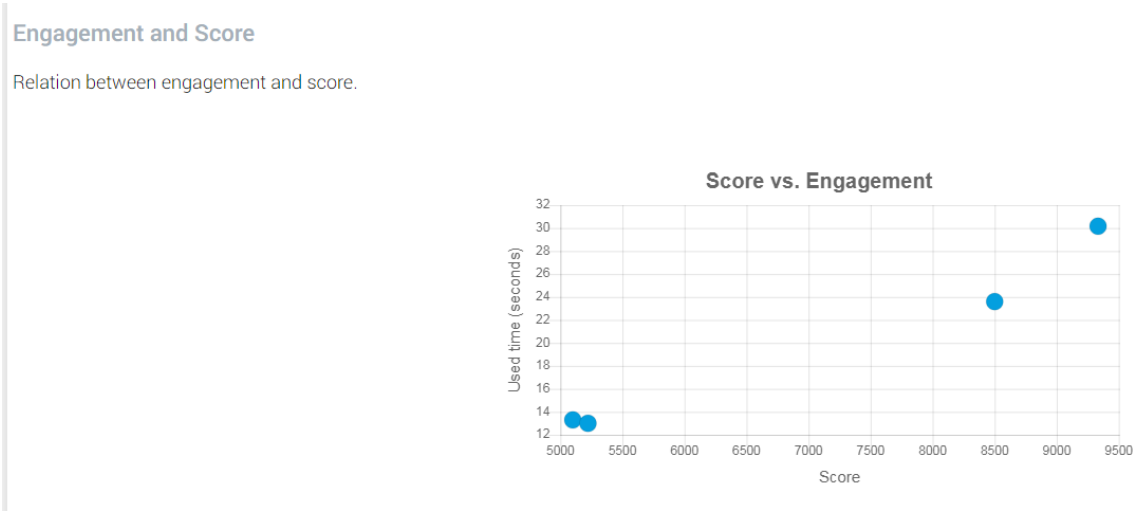
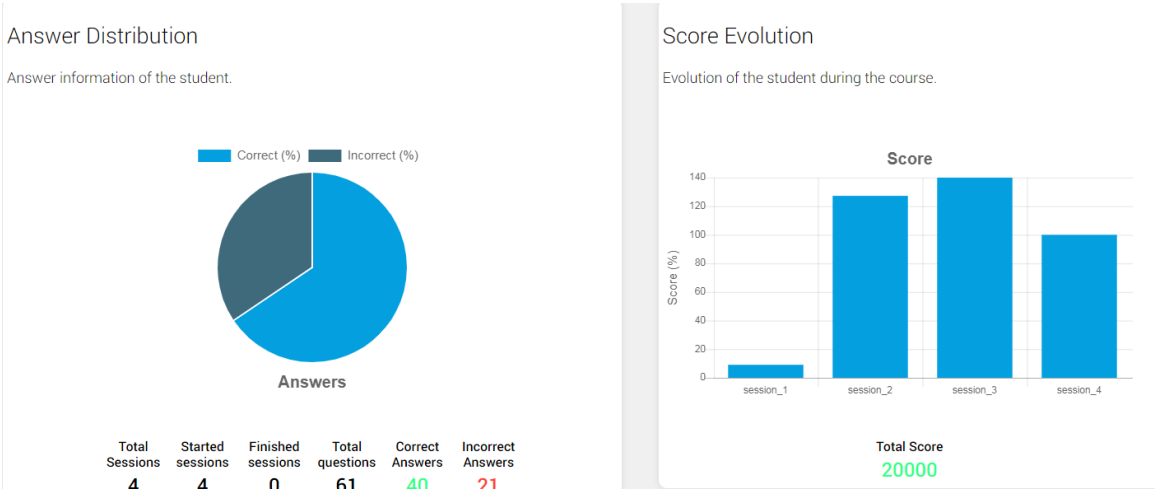


Figure 25. engagement score for "Innovative e-business systems"

The UOM teacher checked the wrong answers provided by the students and was able to adapt the course by providing more information on the misconceptions identified for each topic, as shown in Figure 26.



Wrong Answers

Wrong answers from student.

1ο Quiz ΚΣΗΕ

Questions	Wrong attempts

2ο Quiz ΚΣΗΕ

Questions	Wrong attempts
Θεωρείστε την περίπτωση ενός βιβλιοπωλείου. Ποιο είδος ΠΣ παραγγέλνει αυτόματα από τους προμηθευτές όταν το απόθεμα πέσει κάτω από ένα προκαθορισμένο όριο;	2
Όταν μία επιχείρηση χρησιμοποιεί ένα λογισμικό ως υπηρεσία είναι απαραίτητο να έχει εγκατεστημένη υποδομή ΠΤ	1
Σε μία άδεια χρήσης λογισμικού με μεταφορά πνευματικών δικαιωμάτων – copyright:	1
Θεωρείστε την περίπτωση ενός καταστήματος επίπλων. Ποιο είναι το είδος ΠΣ που επιτρέπει την χρήση μαθηματικών μοντέλων για την πρόβλεψη των πωλήσεων επίπλων ανά μήνα για το επόμενο τρίμηνο;	1
Θεωρείστε την περίπτωση ενός καταστήματος επίπλων. Η επιχείρηση θέλει να δημιουργεί διαδικτυακές καμπάνιες με στόχο την προσέλκυση νέων δυνητικών πελατών στους οποίους θα κάνει προσφορές πωλήσεων για τα έπιπλά τους. Η πιο κατάλληλη επιλογή είναι:	1

3ο Quiz ΚΣΗΕ

Questions	Wrong attempts
Η απόφαση εάν μια επιχείρηση πρέπει να λειτουργήσει ένα νέο εργοστάσιο στην Κίνα είναι:	2
Σε μία αποθήκη δεδομένων έχουμε την πρόταση «Το 2006 στην Ελλάδα το ποσοστό ανεργίας των αντρών ήταν 4% ενώ των γυναικών ήταν 6.5%». Ποια είναι η μέτρηση;	1
Όλα τα ΠΣ χρησιμοποιούν σχεσιακές βάσεις δεδομένων για την αποθήκευση των δεδομένων τους.	1
Η χρήση ενός λογιστικού φύλλου για την επισκόπηση της κατανομής των πελατών μίας εταιρείας ανά περιοχή και ηλικιακό εύρος μπορεί να γίνει με την κατασκευή:	1
Έστω ότι μία εταιρεία θέλει να πάρει απόφαση για το πόσο να μειώσει την τιμή εάν θέλει να πουλήσει μία συγκεκριμένη ποσότητα προϊόντος. Η απόφαση θα ληφθεί πιο εύκολα με τη χρήση ενός λογιστικού φύλλου και την κατασκευή:	1

4ο Quiz ΚΣΗΕ

Questions	Wrong attempts
Η διερεύνηση του τι προϊόντα αγοράζει ένας πελάτης με βάση άλλα προϊόντα που έχει αγοράσει στο παρελθόν γίνεται με:	2
Η ομαδοποίηση ασθενειών σε διαφορετικές συστάδες με βάση κοινά χαρακτηριστικά πραγματοποιείται με:	2
Η αναγνώριση ενός tweet ως «θετικό» ή «αρνητικό» με βάση το περιεχόμενό του πραγματοποιείται με:	2
Ως test set στη μηχανική μάθηση που προβλέπει αποτελέσματα πολιτικών εκλογών ορίζουμε:	2

Figure 26. Analytics for "Innovative e-business systems" for intervention and adaptation

5.4 Pilot 4 - Information Systems Analysis and Design BSc

The 4th pilot was carried out for the "Information Systems Analysis and Design", a course that runs in the 4th semester of the undergraduate programme of the Applied Informatics Department. The main goal of the course is for students to develop skills, understand and apply modern methods on systems analysis and design using Unified Modeling Language (UML).

5.4.1 Learning Design for Pilot 4

Students who complete this course gain the following knowledge and skills:

Knowledge:

- Understand methodologies for systems analysis and design.
- Understand systems analysis using UML.
- Understand systems design using UML.

Skills and competences:

- Analyze and synthesize information for systems analysis and design.
- Use software for systems analysis and design that support UML (e.g. Visual Paradigm).

Table 17. Basic information about the course "Information Systems Analysis and Design"

Target Group	Subject	Time/Duration	Overall Objective	Learning activities	Success metrics
☒ Undergraduate university students ☐ Postgraduate university students ☐ Secondary education students ☐ Primary education students ☐ Professionals	Information systems Analysis of information systems Design of information systems Diagrams UML language UML software	13 weekly lectures	Learn about systems analysis and design	53 learning activities (14 learning materials 6 lab session with diagrams 20 activities in group assignment 13 quizzes	Assignment marks Final exams

Towards this end, a mix of theoretical lectures and lab sessions were carried out. The theory focused on the different types of systems, while the lab sessions demonstrated the design of different kinds of UML diagrams (sequence, use case, class etc.). Students were able to practice using the Visual Paradigm software and then perform assigned tasks as a group to complete their problem- solving assignment. The course structure is shown in Table 18.

Table 18. Study structure of Information Systems Analysis and Design

Lecture	*Topics covered*	*Online tools/platforms used in the lecture*
Systems Analysis and Design (SAD)	Introduction to SAD SAD phases (planning, analysis, design, implementation) Methodologies of systems development (e.g. waterfall, phased, extreme programming, SCRUM etc.). Case study	
Planning phase	Planning: Project Initiation System Request Planning: Project Initiation – Feasibility Study Planning: Project Initiation – Project Selection	
Business modelling	Business processes Business process modelling (BPM)	Activity diagrams in Visual Paradigm
Analysis request	Requirements identification and specification User stories, epics, product backlog	Use case stories - diagrams in Visual Paradigm
Use cases	Workflows Descriptions of use cases UI design based on ICONIX	Use case stories - diagrams in Visual Paradigm
Class diagrams	Domain models Class diagrams Introduction to object oriented logic	Class diagrams in Visual Paradigm
Class and object diagrams	Examples of creating class and object diagrams	Class and object diagrams in Visual Paradigm
Behaviour modelling –	Design principles Software layers	Sequence diagrams in Visual Paradigm

sequence diagrams	Software development principles and strategies Sequence diagrams theory and practice	
Analysis of class diagrams	Complex examples of class diagrams design	Class diagrams in Visual Paradigm
Systems implementation	Transition from UML to Java Java introduction Theory on UML diagrams transition to Java code	Eclipse IDE for Java

In total, 21 groups were formed, with 1 to 5 members, and each group had to perform a semester assignment, with one interim and one final report and presentation during the semester.

During the **concept exploration phase** of the PBL pedagogical model, students could access the learning content from the university's e-learning platform and the gaming environment. Students were able to explore the different types of diagrams used for systems analysis and design, understand what each diagram's objective is and how it can lead to the implementation of an integrated information system. Each group of students were able to explore the taught concepts by accessing the learning material and answering quiz questions in the gaming environment.

During the **meaning making phase**, students were required to practice with the Visual Paradigm software and design all the different types of UML diagrams. That way, they could make sense of each diagram so that they can apply it properly in their group assignment. Students were also able to reflect on the taught material by investigating an existing case study from the BioJam company and make decisions on the problems the company has and how they can be solved through the adoption of information systems. Each group had to perform the tasks in the group assignment. These tasks among others included:

- Create a system request
- Create a feasibility study
- Record business processes identified in the scenario
- Design models for two AS-IS business processes and two future improved business processes using UML activity diagrams
- Record user stories and epics and create product backlog
- Create use case UML diagram

Students then had to upload the interim report with the above tasks completed, and their reflection on their tasks and performances. The UOM teacher could then identify whether the students have properly understood the taught learning content and whether the course should be adapted so that students can correctly demonstrate their knowledge and skills in the next phase.

For the **demonstration and exploration phase**, each group had to perform the tasks in the second part of the group assignment. These tasks among others included:

- Create a two class and object diagrams
- Improve text descriptions of previous user stories
- Create sequence diagrams of the previous user stories
- Identify issues arising from the design of the aforementioned diagrams
- Implement the class diagrams in Java code
- Improve Java code with methods and commands that print data.

Students could discuss their progress within the lab sessions while practicing with each type of diagram and identify ways they could apply the diagram for their case study and company. Students also answered quiz questions in the gaming environment; when they had connection issues they used the e-learning platform.

5.4.2 Delivery for Pilot 4

Pilot 4 ran fully online like the other three pilots. In total, 225 students were enrolled in the course. However, as students again experienced connection time-out issues with the game, some students executed the course's quizzes in the gaming environment and some used the e-learning platform.

Based on Figure 27 and Figure 28, the majority of the students gave mostly correct answers rather than wrong answers, showing a high performance by all students in general. The first three quizzes showed significant misconceptions and wrong answers, so the teacher had to provide additional clarifications to the students.

Co-funded by the Erasmus+ Programme of the European Union

Students number

Students number
225

Sessions

Sessions information.

Sessions	Game/Quiz	Session students	Started	Finished	Passed	Questions	Correct answers	Wrong answers
session_1	1ο Quiz ΑΣΣ	82	Yes	Yes	Yes	423	262	161
session_2	2ο Quiz ΑΣΣ	101	Yes	Yes	Yes	985	512	473
session_3	3ο Quiz ΑΣΣ	58	Yes	Yes	Yes	1021	548	473
session_4	4ο Quiz ΑΣΣ	11	Yes	Yes	Yes	178	120	58
session_5	5ο Quiz ΑΣΣ	7	Yes	Yes	Yes	56	38	18
session_6	6ο Quiz ΑΣΣ	10	Yes	Yes	Yes	147	98	49
session_7	7ο Quizz ΑΣΣ	18	Yes	Yes	Yes	280	209	71
session_8	8ο Quiz ΑΣΣ	9	Yes	Yes	Yes	40	35	5
session_9	9ο Quiz ΑΣΣ	15	Yes	Yes	Yes	130	111	19
session_10	11ο Quiz ΑΣΣ	7	Yes	Yes	Yes	63	49	14
session_11	12ο Quizz ΑΣΣ	9	Yes	Yes	Yes	73	51	22
session_12	13ο Quizz ΑΣΣ	15	Yes	No	Yes	143	84	59

Figure 27. Quiz sessions for students in "Information Systems Analysis and Design"

Engagement and Score

Relation between engagement and score.

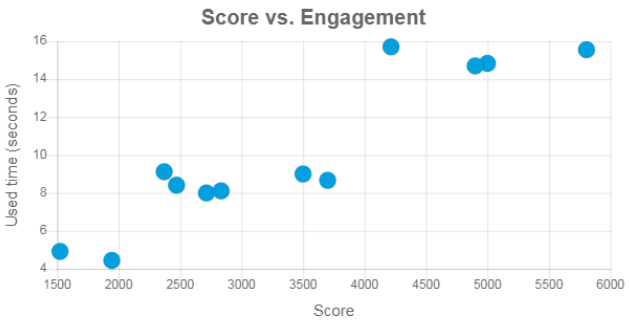


Figure 28. Engagement score for "Information Systems Analysis and Design"

The UOM teacher checked the wrong answers provided by the students and was able to adapt the course by providing more information on the misconceptions identified for each topic, as shown in Figure 29.

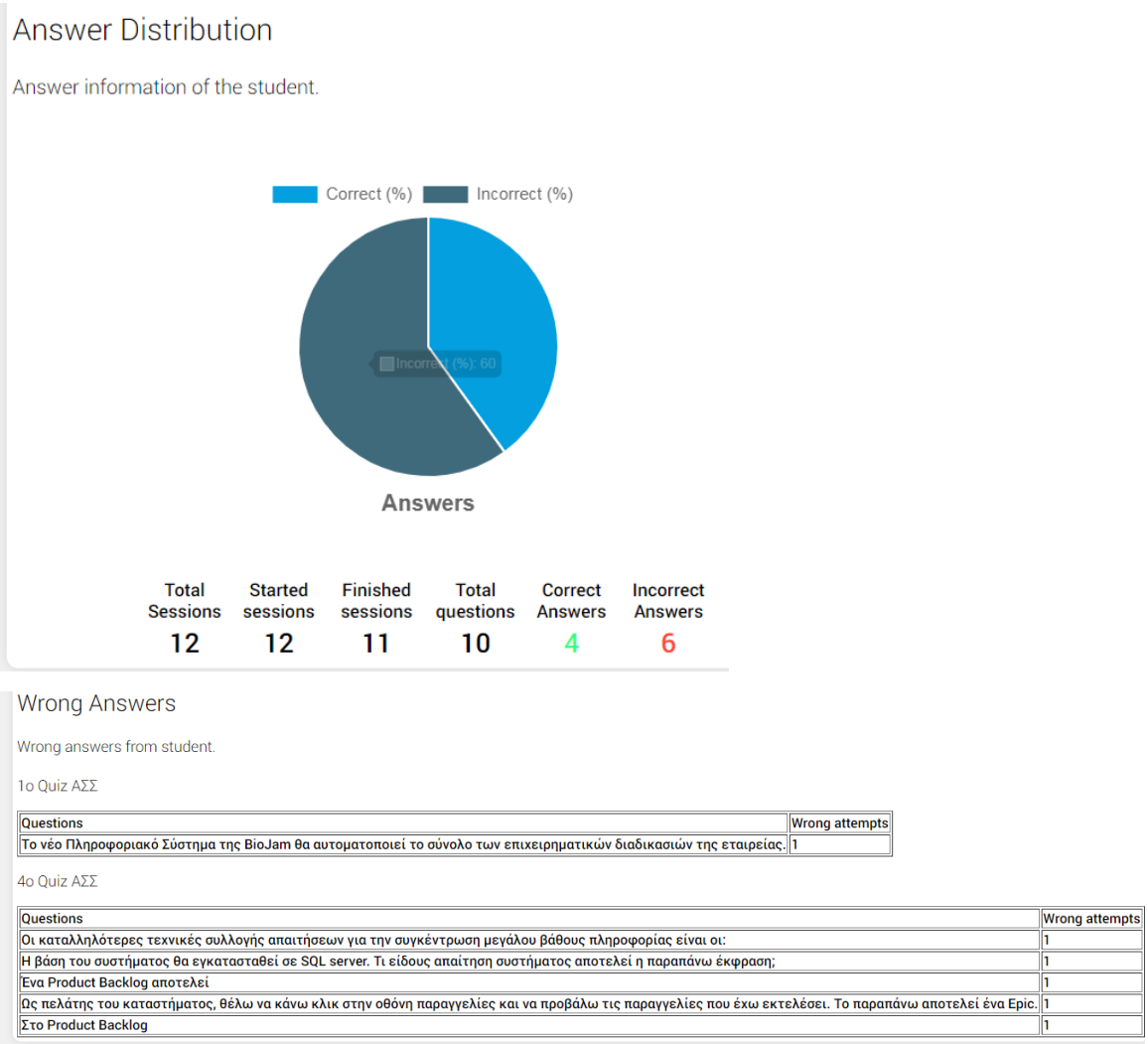


Figure 29. Analytics per student for "Information Systems Analysis and Design"

5.5 Pilot 5 – e-Government (2nd iteration)

The 5th pilot for UOM used again the e-Government course, which is elective and runs during the 7th semester of the Applied Informatics programme. The course ran for the 2nd year using the FLIP2G pedagogical paradigm and the gaming environment. During the 2nd iteration, lectures were carried out in the university premises, as lockdown has been lifted for the Fall semester 2021. In total, 115 students were enrolled in the e-learning platform and the gaming environment. The learning content and curriculum structure remained the same as the Fall 2020 semester's pilot, i.e. during this course, students learn about basic concepts regarding e-Government, Open Government Data and Linked Open Data, Provision of Public Information and Services, One-stop Government, Interoperability and e-Participation.

5.5.1 Learning design for Pilot 5

The main design principles remained the same as the Pilot 1, as students were satisfied with the pedagogical model and learning phases that they had to follow during the course. The gaming environment during this semester has been upgraded with new features and UI. The connection issues that were previously encountered were not apparent during the 5th pilot. This is due to the improved gaming environment and the fact that students could join the game from the university's computers.

5.5.2 Delivery for Pilot 5

The pilot was carried out from October 2021 until end of November 2021. In total, 111 students enrolled in the course, while approximately 34 to 36 students participated actively in the course sections, as shown in Figure 30.

Students number

Students number
111

Sessions

Sessions information.

Sessions	Game/Quiz	Session students	Started	Finished	Passed	Questions	Correct answers	Wrong answers
session_1	3o Quiz eGov 21-22	34	No	Yes	Yes	405	270	135
session_2	4o Quiz eGov 21-22	34	No	Yes	Yes	381	297	84
session_3	5o Quiz eGov 21-22	29	No	Yes	Yes	310	236	74
session_4	6o Quiz eGov 21-22	26	Yes	No	Yes	258	247	11

Figure 30. Sessions activity for eGov 21-22

Based on the learning analytics dashboard, students' performance seemed to improve after each session. The usage of the new game's feature with the scaffolding technique within the quizzes seemed to help their understanding of the material more compared to the more traditional quiz undertaking.

As Figure 31 and Figure 32 show, engagement was higher in the earlier sessions and lower as the sessions progressed. This way mostly due to the fact that students could finish the quiz more quickly using the scaffolding hints, and detect the correct answer for each question faster.

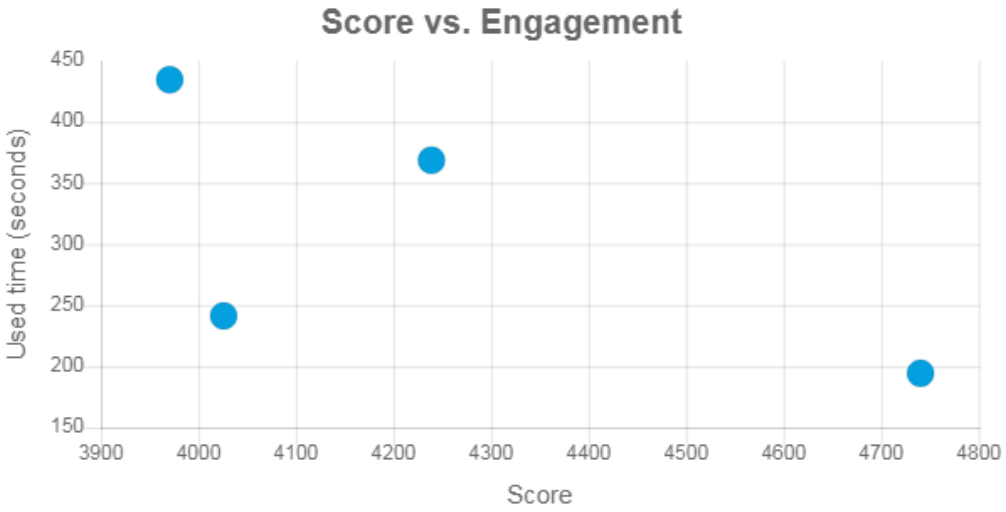


Figure 31. Score vs engagement analytics for eGov 21-22

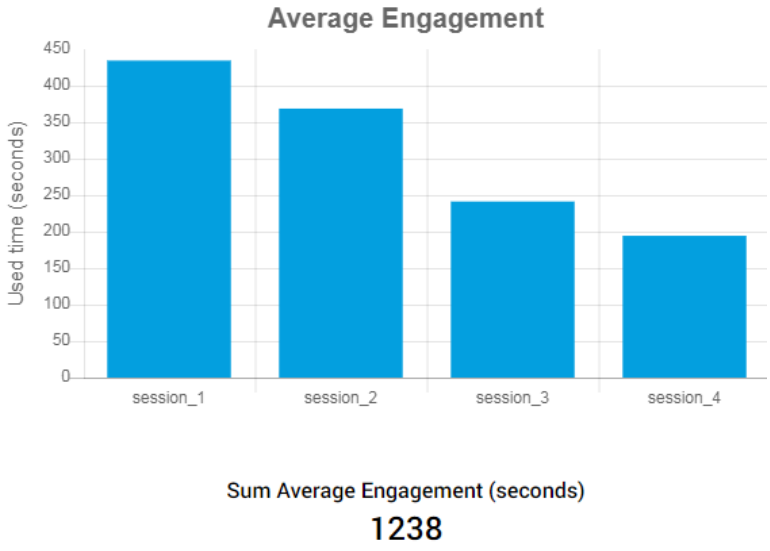


Figure 32. Average engagement for eGov 21-22

The course will continue to utilize the FLIP2G's results for the rest of the semester and for the new UOM courses for the spring semester 2022.

5.6 Pilot 6 – Information Systems Analysis and Design MSc

The 6th pilot for UOM used the Information Systems Analysis and Design course, which runs during the 2nd semester of the Interdepartmental Programme of Postgraduate Studies in Information Systems at UOM. The course ran using the FLIP2G pedagogical paradigm and the gaming environment. Lectures were carried out in the classroom, and students used a Moodle platform and the FLIP2G gaming environment for content access and quiz answers.

5.6.1 Learning design for Pilot 6

The main design principles remained the same as the Pilot 1, as students were satisfied with the pedagogical model and learning phases that they had to follow during the course. The gaming environment during this semester has been upgraded with new features and UI. Like in the case of the 5th pilot the connection issues that were previously encountered were not apparent during the 6th pilot.

Students who complete this course gain the following knowledge and skills:

Knowledge:

- Identify the main steps of a systems analysis and design process
- Understand the purpose and usage of the basic UML diagrams (activity, use case, sequence, object, class).

Skills and competences:

- Usage of Visual Paradigm for the creation of UML diagrams
- Collaborate and work together towards the development of software using good practices of project management
- Develop skills like problem and concept analysis and information synthesis
- Draft official technical reports and represent and communicate ideas to 3rd parties.

Table 19. Basic information about the course "Information Systems Analysis and Design MSc"

Target Group	Subject	Time/Duration	Overall Objective	Learning activities	Success metrics
☐ Undergraduate university students ☒ Postgraduate university	Information systems UML diagrams Visual Paradigm	13 weekly lectures	Learn about the analysis and design processes for information systems	38 learning activities (3 quizzes, 12 learning materials, 4 lab sessions, 1 case study, 9 presentations, 9	Assignment marks Final exams

students ☐Secondary education students ☐Primary education students ☐ Professionals				assignments	

Towards this end, a mix of theoretical lectures and lab sessions were carried out. The theory focused on the different types of UML diagrams, while the lab sessions demonstrated how each diagram can be designed and applied in real world settings, also using relevant software such as Visual Paradigm. Students were able to create different types of diagrams based on provided scenarios during the practical sessions in the classroom, and during their problem-solving assignment as groups. The structure of the course was as shown in Table 20.

Table 20. Study structure of MSc Information Systems Analysis and Design

Lecture	*Topics covered*	*Online tools/platforms used in the lecture*
Information systems	Phases of information systems analysis and design Methodologies for developing information systems	
Planning	Project initiation and management	
Analysis	Business modelling Activity diagrams	Visual paradigm – activity diagrams
Analysis	Requirements analysis Use case diagrams	Visual paradigm – use case diagrams
Analysis	Text descriptions in use case diagrams Interfaces of use case diagrams	
Object oriented paradigm	Introduction to object oriented thinking	
Analysis	Domain modelling	Visual paradigm – class diagrams

	Class diagrams	
Analysis	Object diagrams	Visual paradigm – object diagrams
Design	Design strategies Robustness analysis	
Design	Re-design of information systems Sequence diagrams	Visual paradigm – sequence diagrams
Design	Re-design class diagrams	Visual paradigms – class diagrams re-design
Implementation	UML and Java	Eclipse IDE

In total, 9 groups of 4 to 5 students were formed. Each group had to work together and complete the group assignment's tasks. Each week the groups presented their progress and discussed any issues that were identified in the classroom with the teacher.

The assessment of students was divided as follows:

- 40% group assignment (5% presentations, 10% interim submission, 25% final submission)
- 10% quizzes from the gaming environment
- 50% final exams

Students initially **explored all concepts** of the theory for the subject matter through the slides and links provided by the teacher (e.g. different phases of systems design and analysis), and thus they were able to **make sense** of the concepts taught through their practical experimentation with each diagram in the lab sessions within the classroom.

For the exploration and in depth understanding of the materials, students were given a case study and group assignment that they had to investigate, and where they had to analyze and design an information system based on the provided scenario shown in Figure 33.

ΜΕΤΑΠΤΥΧΙΑΚΟ ΠΡΟΓΡΑΜΜΑ ΣΤΑ ΠΛΗΡΟΦΟΡΙΑΚΑ ΣΥΣΤΗΜΑΤΑ
«ΑΝΑΛΥΣΗ και ΣΧΕΔΙΑΣΜΟΣ ΠΛΗΡΟΦΟΡΙΑΚΩΝ ΣΥΣΤΗΜΑΤΩΝ»
Ακαδημαϊκό Έτος 2021-2022
Διδάσκοντες: καθ. Κ. Ταραμπάνης, καθ. Ε. Ταμπούρης

Μελέτη Περίπτωσης:
Πληροφοριακό Σύστημα Κολυμβητηρίου «Δελφίνι»

Θεωρείστε πως είστε μια μικρή εταιρία πληροφορικής, με νεανικό προσωπικό, που αναλαμβάνει μικρά έως μεσαία έργα κυρίως δημιουργίας websites και e-shops. Η εταιρία δεν έχει αναλάβει ξανά έργο κατευθείαν με πελάτη. Τα έργα της έως τώρα ήταν υπό μορφή υπεργολαβίας άλλων μεγαλύτερων εταιριών. Η ομάδα σας επιθυμεί να αναλάβει το έργο της δημιουργίας ενός νέου ΠΣ για την επίλυση των προβλημάτων του Κολυμβητηρίου «Δελφίνι» που περιγράφεται παρακάτω.

Υπάρχουσα κατάσταση

Το κολυμβητήριο «Δελφίνι» απασχολεί 3 προπονητές και 4 υπαλλήλους στη γραμματεία. Έχει μερικές εκατοντάδες μέλη τα οποία κατατάσσονται σε 2 επίπεδα ανάλογα με τις ικανότητες τους στην κολύμβηση. Το 2ο επίπεδο είναι το αγωνιστικό και τα μέλη αυτού του επιπέδου πρέπει να έχουν «δελτίο αθλητή» ενώ λαμβάνουν μέρος και σε επίσημους αγώνες. Ο τρόπος λειτουργίας του κολυμβητηρίου (όπως δόθηκε από τον ιδιοκτήτη του κολυμβητηρίου) είναι χωρισμένος σε 4 βασικές περιοχές ως εξής:

1. Σχετικά με την εγγραφή νέου πελάτη

Με την εγγραφή στο κολυμβητήριο, κάθε πελάτης δίνει τα στοιχεία του, πληρώνει ένα εφάπαξ ποσό (κόστος εγγραφής) και λαμβάνει μια πλαστικοποιημένη κάρτα-μέλους. Η πληρωμή μπορεί να γίνει με μετρητά ή με τη χρήση πιστωτικής κάρτας (όχι όμως με συνδυασμό των δύο). Για την χρήση πιστωτικής κάρτας χρησιμοποιείται συσκευή POS που υπάρχει στο κολυμβητήριο και είναι συνδεδεμένη με το διατραπεζικό σύστημα ΔΙΑΣ. Εάν δεν υπάρχει επαρκές υπόλοιπο, ζητείται άλλη κάρτα ή μετρητά. Εδώ υπάρχουν προβλήματα που σχετίζονται με την απώλεια της κάρτας-μέλους των πελατών.

2. Σχετικά με την επιλογή προγράμματος

Κάθε νέος πελάτης κάνει ένα τεστ κολύμβησης (μετά από ραντεβού που κλείνει η γραμματεία) όπου αξιολογούνται οι ικανότητες του από ένα προπονητή. Με βάση αυτό κατατάσσεται σε ένα από τα 2 επίπεδα.

Για το επίπεδο 2, ο πελάτης θα πρέπει επίσης να είναι διατεθειμένος να εκδώσει δελτίο αθλητή. Για να γίνει αυτό, ο πελάτης προσκομίζει μια ψηφιακή φωτογραφία σε CD ή USB stick, πιστοποιητικό γέννησης, βεβαίωση από γιατρό και 20€. Τα δικαιολογητικά προωθούνται στην Ομοσπονδία με

Figure 33. Case study scenario for SAD 21-22 MSc

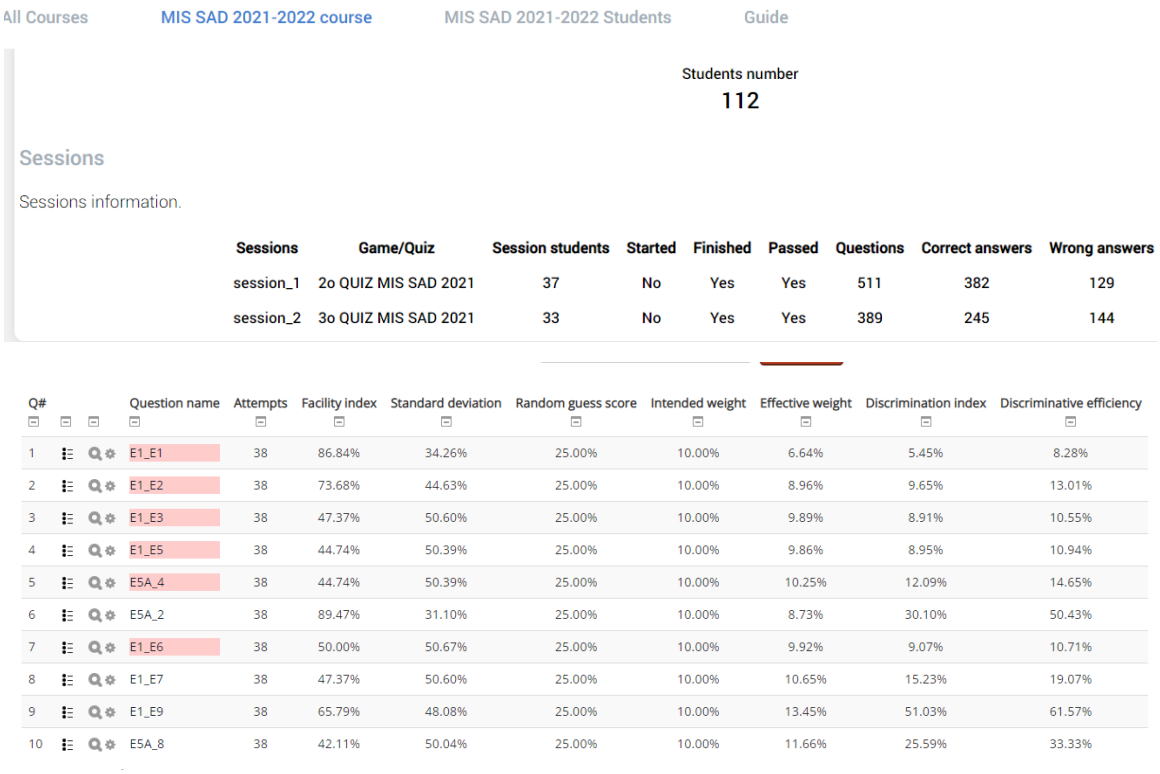
Each group was a part of a computer company that was assigned a project for the development of a new information system that will solve problems for a swimming venue named “Dolphin”. Towards this end, each group had to:

- Create a system request
- Create a feasibility study

Students then have to upload the interim report and present their work in the classroom. Outside of the context of the pilot, students will continue to utilize the FLIP2G model in order to finish their course until the end of the semester, when they will present the final assignment in the classroom.

5.6.2 Delivery for Pilot 6

The pilot was carried out from October 2021 until the end of November 2021. Due to technical issues and holidays, only two sessions of quizzes were carried out within the game, while the rest were continued in the Moodle learning platform of the course, as shown in Figure 34.



Sessions	Game/Quiz	Session students	Started	Finished	Passed	Questions	Correct answers	Wrong answers
session_1	2o QUIZ MIS SAD 2021	37	No	Yes	Yes	511	382	129
session_2	3o QUIZ MIS SAD 2021	33	No	Yes	Yes	389	245	144

Q#	Question name	Attempts	Facility index	Standard deviation	Random guess score	Intended weight	Effective weight	Discrimination index	Discriminative efficiency
1	E1_E1	38	86.84%	34.26%	25.00%	10.00%	6.64%	5.45%	8.28%
2	E1_E2	38	73.68%	44.63%	25.00%	10.00%	8.96%	9.65%	13.01%
3	E1_E3	38	47.37%	50.60%	25.00%	10.00%	9.89%	8.91%	10.55%
4	E1_E5	38	44.74%	50.39%	25.00%	10.00%	9.86%	8.95%	10.94%
5	E5A_4	38	44.74%	50.39%	25.00%	10.00%	10.25%	12.09%	14.65%
6	E5A_2	38	89.47%	31.10%	25.00%	10.00%	8.73%	30.10%	50.43%
7	E1_E6	38	50.00%	50.67%	25.00%	10.00%	9.92%	9.07%	10.71%
8	E1_E7	38	47.37%	50.60%	25.00%	10.00%	10.65%	15.23%	19.07%
9	E1_E9	38	65.79%	48.08%	25.00%	10.00%	13.45%	51.03%	61.57%
10	E5A_8	38	42.11%	50.04%	25.00%	10.00%	11.66%	25.59%	33.33%

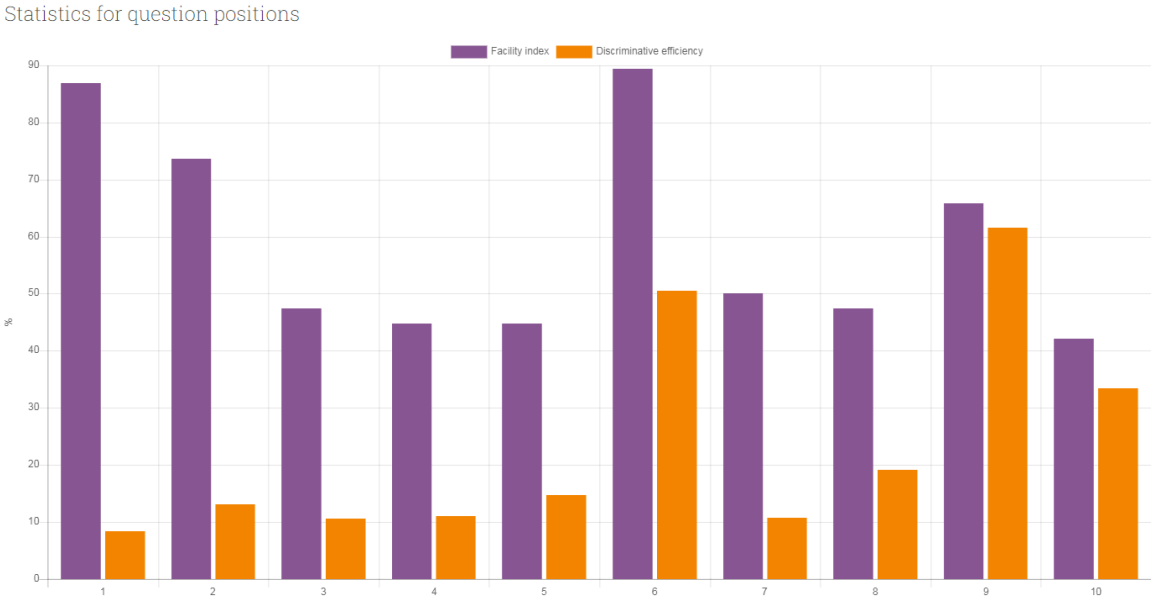


Figure 34. Statistics from FLIP2G gaming platform and Moodle platform

In total, 112 students enrolled in the course, while approximately 33 to 38 students participated actively in the quizzes. The new feature of the gaming platform that received positive comments from the students was the “Help” button, which removes one possible answer from the question while also reducing the total score for the question, as shown in Figure 35.

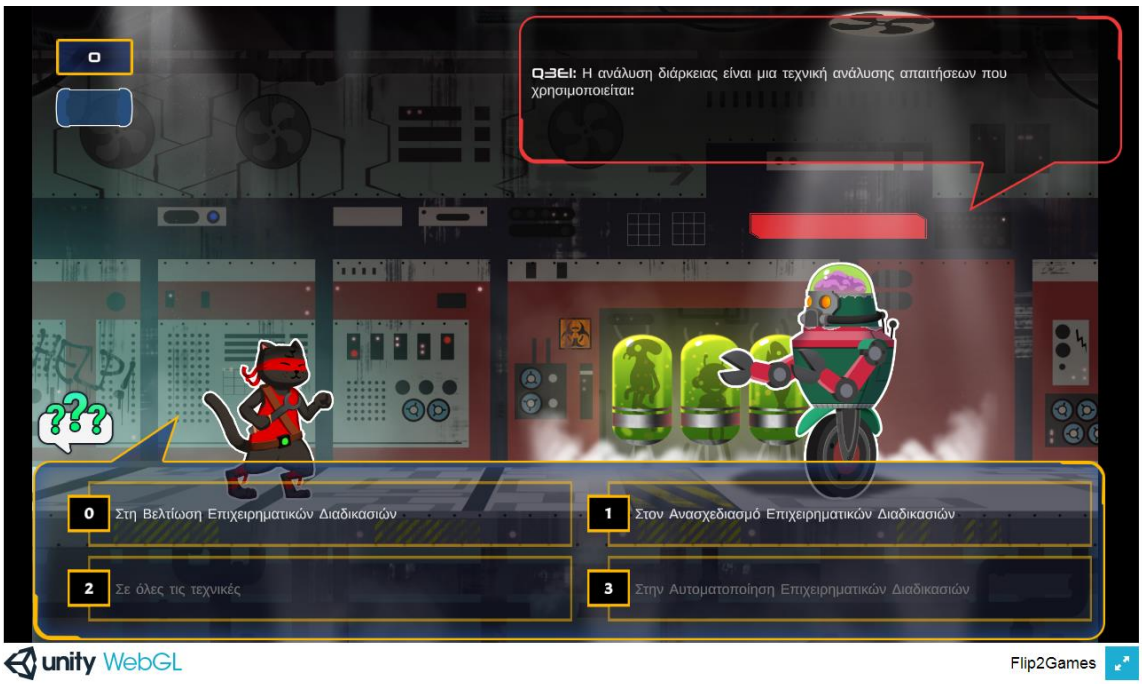


Figure 35. Scaffolding technique in FLIP2G game

This allowed students to adapt their understanding of the taught material, as they were given the choice of selecting between multiple possible answers and get a higher grade or reducing their grade but having fewer possiblities to get a question wrong.

The final steps of the course will be completed outside of the project's scope, but students will still follow the FLIP2G pedagogical model to demonstrate and reflect on the knowledge learned.

6 Mandoulides Schools

Mandoulides Schools carried out two pilots for primary and secondary education students, during the academic year 2021-2022. More specifically, Informatics and Maths courses for 6th grade and 9th grade were re-designed based on the FLIP2G pedagogical framework and included the gaming platform in their curriculum. It should be noted that flipped classroom is a well-known and practiced pedagogical strategy in Mandoulides Schools in secondary education grades, as teachers in maths, physics, biology and chemistry courses for 8th and 9th grade have been creating video lectures and uploading them in the school's Moodle e-learning platform. The inclusion of gamification and PBL however are new, as well as the combination of all these techniques through a holistic framework that guided the teachers in their courses' re-design.

6.1 Pilot 1 - Informatics

The 1st pilot ran in the Informatics course that is taught in 6th grade (primary education).

The pilot was carried out during the academic year 2021-2022 and the course material that was used for the pilot's learning activities focused on four main topics i.e. cyberbullying, personal data, spam/ phishing emails, web usage. The pilot was carried out within the classroom, since Greek schools were open and Covid-19 lockdown was lifted.

Table 21. Basic information about the course Informatics

Target Group	Subject	Time/Duration	Overall Objective	Number of learning activities	Success metrics
☐ Undergraduate university students ☐ Postgraduate university students ☐ Secondary education students ☒ Primary education students ☐	cyberbullying, personal data, spam/ phishing emails, web usage	12 weeks / 45 minute lectures	Understand the risks of the web regarding cyber bullying, personal data and spam emails	23 (10 learning contents, 4 game quizzes of 15 questions each, 4 hackathon runs, 5 learning activities (read materials, discuss and brainstorm, synthesize information, concept mapping)	Hackathons scores Gaming scores

Professionals					

6.1.1 Learning Design for Pilot 1

During this course, around 100 students aged 12 would participate for the first time in a class that was designed based on collaboration, gamification and problem solving. Students that complete this course should be able to achieve the following knowledge and skills.

Knowledge

- Basic informatics concepts (computer components, what a programming language is, algorithmic logic)
- Understand basic knowledge about the Web
- Learn basic information about cyber-bullying
- Learn basic information about privacy and personal data on the Web

Skills

- Analyse complex tasks in individual simpler projects
- Choose the appropriate ICT tools for implementation of the work
- Use various ICT tools effectively to complete their work
- Select, organize and sort information.
- Compose, create and transform information and material
- Apply evaluation criteria on sources and information and present and communicate ideas.

The layout of the course is available in Table 22.

Table 22. Study structure of Informatics

Lecture	*Topics covered*	*Online tools/platforms used in the lecture*
Introduction to cyberbullying	what is cyberbullying ways to act for victims of cyberbullying	Moodle e-learning platform Hackathon website (https://hackathlon.eu/) Gaming environment
Introduction to	What type of data is considered personal	Moodle e-learning platform

personal data	What types of data should we reveal online Behaviour in social media	Hackathon website (https://hackathlon.eu/) Gaming environment
Introduction to spam – phishing – chain emails	What kind of email is considered spam How to recognize spam / chain emails How to avoid phishing	Moodle e-learning platform Hackathon website (https://hackathlon.eu/) Gaming environment
Introduction to web usage	Basic concepts of the Web What types of websites should students use What are the dangers of the Web	Moodle e-learning platform Hackathon website (https://hackathlon.eu/) Gaming environment

For each topic, students had to log-in on the school's e-learning platform and access the learning content that they could view/read on their own time. The learning material contained valuable information about the very important issues of cyberbullying and personal data security on the Web, especially for students in primary and secondary education.

Once students were familiar with the topic, they had to run the hackathlon that was launched with activities on the topic. This way, students could make sense and explore more in depth the knowledge they had gained on their own, using an innovative and engaging platform.

Students were then led to the gaming platform, where they had to perform quizzes for each topic and demonstrate their knowledge and skills inside the classroom by discussing their performances with the teacher and reflecting on why some of their answers were wrong. The pilot's assessment was a combination of progress in the course's activities and tools and performance in the final exams.

6.1.2 Delivery for Pilot 1

The pilot's session on cyberbullying ran for approximately two months and followed the FLIP2G pedagogical model, where students collaborated in searching for information related to cyberbullying individually and in groups, in order to understand the concept. Afterwards, students had to make sense of the information they collected by discussing their findings in the classroom with each other and with the teacher.

They used the FLIP2G game to answer questions on the main concepts they learned (Figure 36), and then demonstrated this knowledge in the classroom through a set of assignments.

Figure 36. Delivery of pilot sessions on Cyberbullying, Safety on the Web, and Internet Usage

During the sessions, and after the students had read the material on the subject, they logged in on the game and answered the questions of the relevant quiz. Based on the analytics of the game (Figure 37), it seems that the majority of the students got a high score in the quiz.

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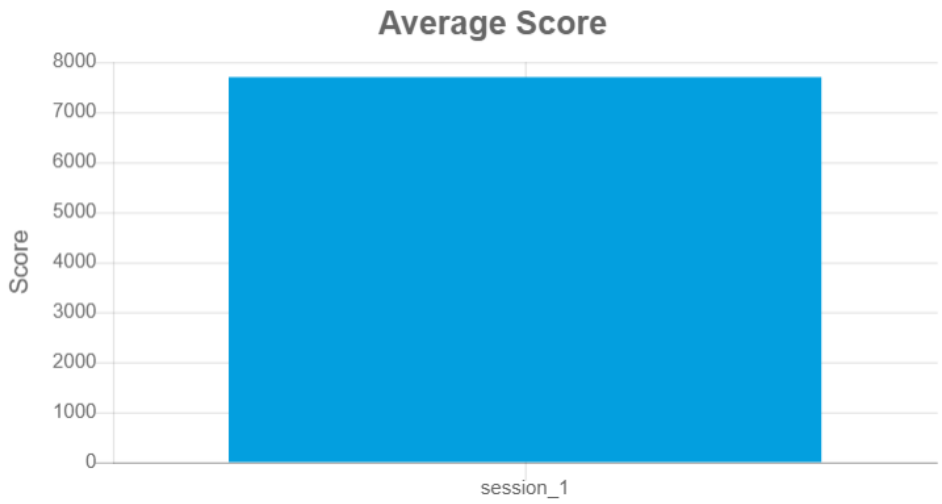
Sessions information.

Sessions	Game/Quiz	Session students	Started	Finished	Passed	Questions	Correct answers	Wrong answers
session_1	Quiz 1 - Hackathlon	22	Yes	Yes	Yes	785	594	191



Average Score (points)

7699

Figure 37. Average score for Informatics session

Examples of students' analytics are shown in Figure 38. For the sessions that have run so far, the top student has answered correctly 80% of the questions (84 out of 105) and received a grade of 8.4 out of 10.

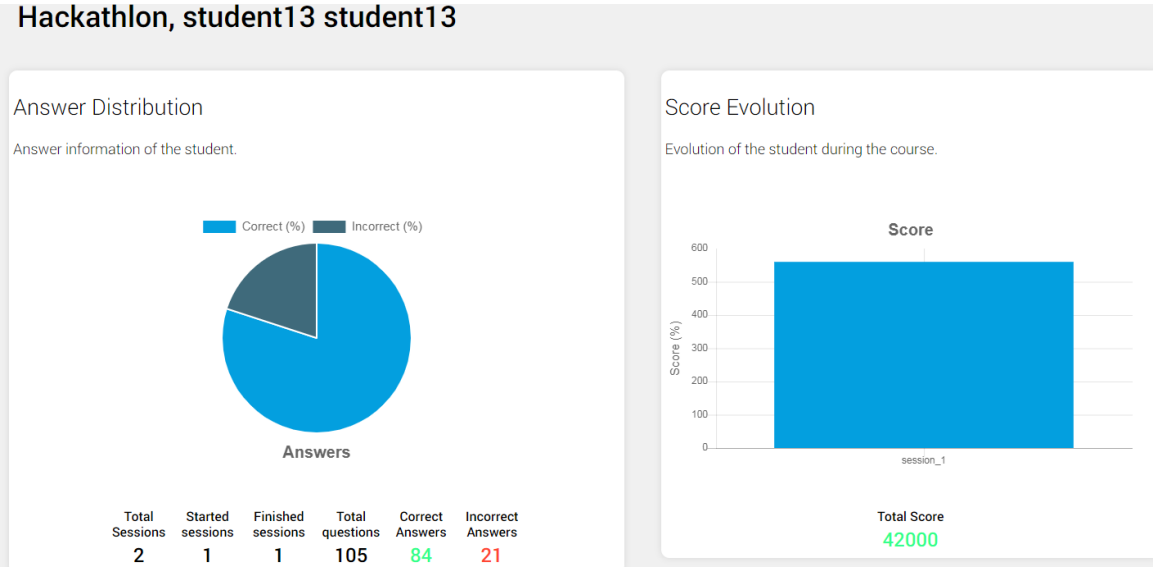


Figure 38. Statistics analysis of the student with the highest score

Figure 39 shows that the student's engagement in the game was approximately 10 to 11 minutes. This shows that the student had to really think about the questions and the answers and search relevant content on their own to find and provide the correct answer.

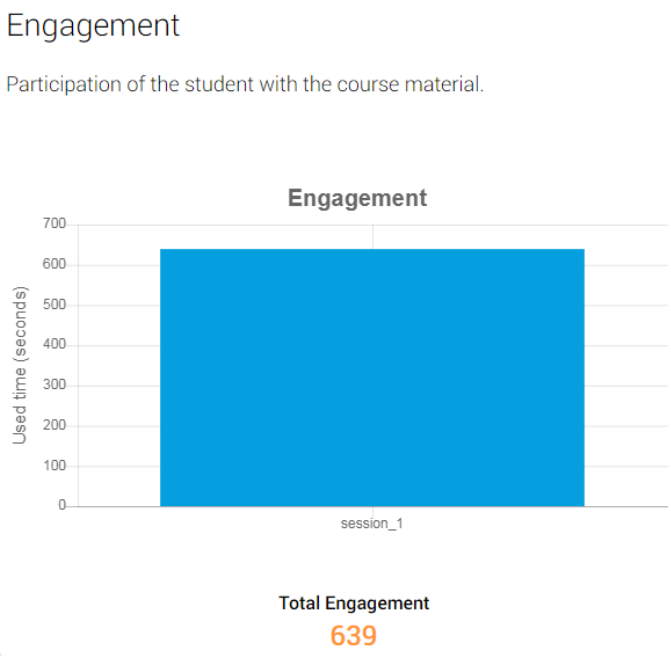


Figure 39. Student engagement in game session

The pilot will continue to run for the entire academic year, where students will learn more in depth information on the topics of cyberbullying and internet safety by following the FLIP2G model.

6.2 Pilot 2 – Hackathlon for Maths

The 2nd pilot ran in the Mathematics course that is taught in 8th and 9th grade (secondary education). Similar to the 1st pilot, Pilot 2 was carried out in the classroom for 12 weeks during the academic year 2021-2022. The application of the FLIP2G outcomes in the Mathematics course focused on the topics of Excel and advanced Excel for mathematical purposes. Table 23 provides some basic information about the course.

Table 23. Basic information about the course Mathematics

Target Group	Subject	Time/Duration	Overall Objective	Number of learning activities	Success metrics
☐ Undergraduate university students ☐ Postgraduate university students ☒ Secondary education students ☐ Primary education students ☐ Professionals	Advanced excel features	12 weeks / 45-minute lectures	Familiarize students with advanced features and processes in excel that could help them with solving maths-based problems	20 (8 files of learning material, 4 hackathlons, 4 gaming quizzes, 4 problems to solve)	Hackathlon scores Gaming quizzes scores

6.2.1 Learning Design for Pilot 2

Approximately 100 students aged 14 and 15 participated in the course. Students that complete this course should be able to achieve the following knowledge and skills.

Knowledge

- Basic Excel concepts (worksheet, data types, rows, columns, cells)
- Basic functions (sum, average, min, max, using = to perform simple mathematical equations)
- Data transformation / cleaning in Excel
- Advanced functions (subgroup, vlookup, what-if, pivot table)
- Create charts / graphs

Skills

- Make decisions on what formula / function to use based on available data
- Properly clean and transform data for mathematical processing
- Create valuable dashboards with graphs based on available data

The layout of the course that concerns the topics mentioned is available in Table 24.

Table 24. Study structure of Mathematics

Lecture	*Topics covered*	*Online tools/platforms used in the lecture*
Basic Excel concepts	Excel layout (rows, columns, cells) Data types (number, text, dates, decimals)	Moodle e-learning platform Hackathon website (https://hackathlon.eu/) Gaming environment Microsoft Excel
Excel functions	Different excel functions (sum, average, min, max etc.)	Moodle e-learning platform Hackathon website (https://hackathlon.eu/) Gaming environment Microsoft Excel
Excel functions (2)	Vlookup What-if analysis Pivot table	Moodle e-learning platform Hackathon website (https://hackathlon.eu/)

	Subgroup Conditional formatting	Gaming environment Microsoft Excel
Charts/ graphs	Different charts types Different visualizations in a chart Layout of a chart	Moodle e-learning platform Hackathon website (https://hackathlon.eu/) Gaming environment Microsoft Excel

The learning content was available on the Moodle e-learning platform. Students could download it on their school's individual laptops and access the material on their own pace.

Similar to the Informatics pilot, once students were familiar with the topic, they completed the hackathlon that was based on activities on the topic. This way, students could make sense and explore more in depth the knowledge they had gained on their own. Students were then led to the gaming platform, where they had to complete quizzes for each topic and demonstrate their knowledge and skills inside the classroom by discussing their performances with the teacher and reflecting on why some of their answers were wrong. The pilot's assessment was a combination of the progress in the course's activities and tools and the performance in the final exams.

6.2.2 Delivery for Pilot 2

The pilot ran using the FLIP2G model, where students collaborated to solve different maths problems using Excel and its more advanced formulas. Students were taught the different Excel formulas and logged in on the game to test their knowledge and get feedback (Figure 40) before they applied it in the given problems.

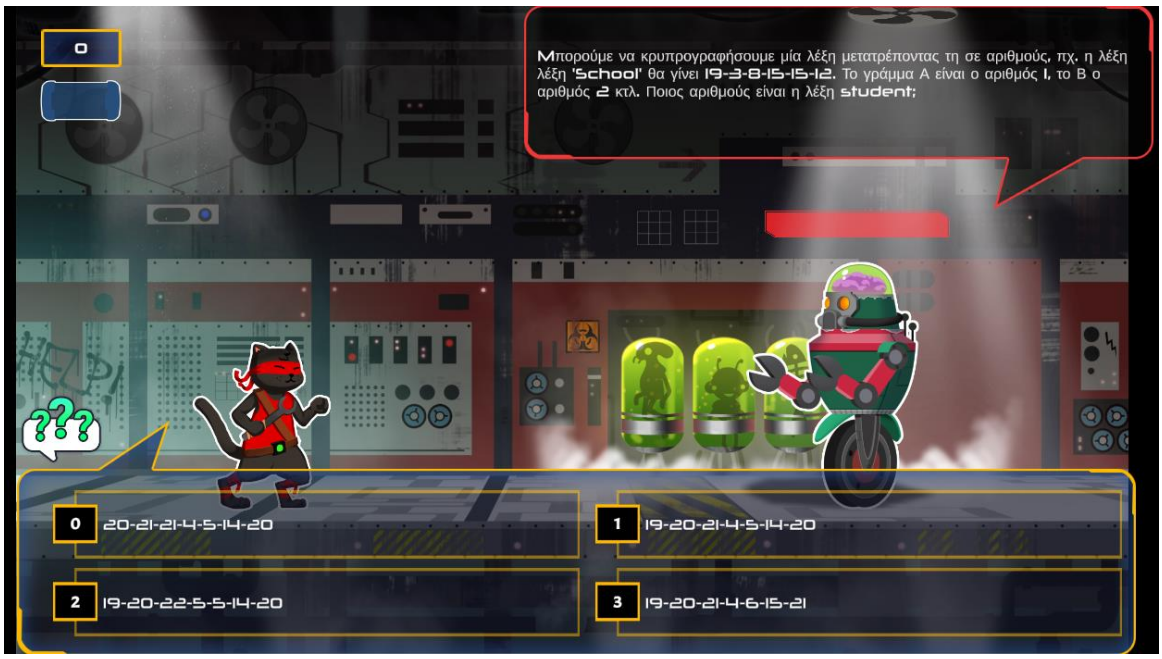


Figure 40. Pilot sessions for advanced Excel formulas

The pilot will keep running even after the project will end, and students will continue to use the project's results in order to solve the problems given by the Mandoulides schools' teacher.

7 Revheim School

Revheim school ran the same pilot on three parallel classes on the ninth grade in lower secondary school. The pilot was used in the area of social sciences to teach about imperialism over the course of two weeks. Due to the Covid-19 restrictions and a difference in the plans for each class, the iterations were spread over the course of the second semester with their numbers matching the order in which they were held. It was originally planned to use it on four different classes, but the last one had to be cancelled due to a teachers' strike in Norway, which happened in the middle of the third iteration and left too little time to start and finish the fourth one.

7.1 Pilot 1 - Imperialism

When the pilot started at Revheim, it was initially supposed to include four classes on the same grade which would total around 100 pupils. Due to the aforementioned strike, the third iteration had to be paused halfway through, but it continued where we left off after the strike. The first iteration took place from the 25.03.21 to 16.04.21 with the easter holiday in the middle of it. Followed by the second one starting 26.04.21 and ending on the 12.05.21. The third one took place 18.05.21 but did not end before 11.06.21 due to the strike.

The pupils for this pilot had to explore Imperialism in their social sciences classes over the span of two weeks (Table 25). They had to examine the time period known as imperialism and consequently, learn about colonialism, how the industrial revolution sped up the process of imperialism and colonialism, the spread of western civilisation, slavery and both the short- and long-term consequences of imperialism. After learning about the period and using different tools in the process, they had to deliver a presentation in front of the class, where they could discuss a question from the period to show that they could apply the knowledge they had gained to more open questions related to the topic.

Table 25. Basic information about the course Imperialism

Target Group	Subject	Time/Duration	Overall Objective	Success metrics
☐Undergraduate university students ☐Postgraduate university students ☒Secondary education students ☐Primary education students ☐Professionals	Imperialism	2 weeks	For pupils to learn about the imperialist time period and enable the pupils to reflect upon the underlying reasons for the imperialist expansion and how it affects the world today.	Students need to be able to use history to explain and discuss how events after this time period has unfolded. This means that the presentation should include elements of discussion and not just presentation of a time period.

Co-funded by the Erasmus+ Programme of the European Union

7.1.1 Learning Design for Pilot 1

The learning design for the pilot had to be based on the national curriculum for social sciences. This is quite broad and does not contain any specifics on what subject it is supposed to be about or any specific grade other than from 8th to 10th grade lower secondary. This means that the teacher has a lot of freedom when choosing a topic to study, but also that the learning design has to be tangible.

Our learning goals for the course are taken from the national curriculum for social sciences which states that the students after the tenth grade should be able to:

- Use didactical methods and digital resources in their own investigations and be able to present their findings with the use of digital tools, whilst discussing the validity and relevance of their findings.
- Draft how different periods of the past, e.g. events and groups, have been affecting people's actions and attitudes to this day.
- Reflect upon how people who have been fighting for changes in society have been affected by geography and historical contexts.

Since the national curriculum goals are quite broad a teacher needs to be selective in what topic they want to cover in order to approach the goals. This gives teachers in Norway the ability to choose topics they are interested in, or feel are of most value for the pupils. In order to meet these curriculum goals, the teachers wanted the pupils to learn about the Imperialism time period so that they are able to understand why the world we live in today is the way it is. This time period puts the Industrial Revolution into context and also helps build and understanding about what led to World War I. We also wanted the students to actively engage with the course material via different tools and to raise an awareness on how they learn in this process. Prior to this, the teacher has often been dominant in the learning of new material, but the flipped classroom setting that the FLIP2G model employs helped the teaching to be more student oriented. Digital tools are frequently used in our school when we research a topic, work with tasks, and do revisions. However, self-reflection on the use of it is less common. The FLIP2G learning analytics made this step easy to communicate to the pupils, as it enables the teacher to see what parts of the topic are difficult to grasp. The last two curriculum goals are focused on reflection and in order to do this, it requires some knowledge and basic understanding of the topic first.

The learning activities planned for this subject were:

- Selected YouTube videos on the subject as homework to study the topic beforehand. The students are asked to write down keywords from the video and write also some questions, if something was difficult to understand (pre-class activity).

- The students come to the class and discuss what they know before they play the FLIP2G game to test their understanding of the learning material (in-class activity).
- They are given a set of keywords about the period that the students are supposed to write about, so they grasp the important things about the time period. They then study the topic by reading their history books, selecting articles from the Web, and creating a working document where they write notes, questions and answers in order to get a better understanding of the topic. They work in pairs or on their own. The FLIP2G quiz is repeated to see if they remember the basics, but a few more advanced questions based on the keywords are asked as well (in-class activity).
- After exploring the subject on their own, the teacher delivers a presentation about the subject to summarize everything, and based on the results from the FLIP2G session, they put extra emphasis on things that are unclear (in-class activity).
- The students are asked to read through the presentation and their notes as homework and pick out a part of Imperialism they want to make a presentation about (after-class activity).
- As part of the application stage, they produce a short presentation on a specific subject related to Imperialism and work with it both in-class and as part of their homework. This can be recorded or presented in front of the class.
- After everyone has delivered their presentation, the students will need to complete a new FLIP2G quiz, which now includes questions from the presentations, along with questions from the previous quizzes. The LA from this last one gives a good look into which questions are difficult and what part of the subject they need to re-read at home before the next subject (In-class/post-class activity).

7.1.2 Delivery for Pilot 1

As explained in the beginning, due to Covid-19, national holidays, and a teachers' strike, the pilot did not run consistently in all classes. The learning design remained the same for all three classes, without making any changes. The only difference was that for the third iteration of the pilot, there was a pause in the middle of it due to the strike. The most impactful thing for the pilot was Covid-19. It meant that a lot of pupils were at home at various times when they had flu-like symptoms and therefore had to do some of the in-class activities at home. However, most students were able to finish their presentations and work with the project as expected. Luckily, we were able to use the school for our classes and it impacted the project minimally, since we did not need to run everything online.

There were problems with the LA dashboard towards the end of the semester and IT did not have the capacity to look at it. When a new upgrade to the FLIP2G dashboard became available, the IT

department made an error, which resulted in the loss of data, so screenshots from the LA dashboards and the like are not in this report for Revheim Skole.

In the concept exploration stage, the students had to watch a video on imperialism, coupled with writing keywords on things they did not understand from the video as their homework. They wrote the notes in Google Classroom, so that the teacher could see who did their homework and who did not. In class, they were placed into groups where they explained to each other what they understood from the topic. After completing their homework and the in-class group discussions, they were given different online sources besides their textbook on the subject. They worked with this to learn more about the topic, both at home and in class. After they had explored it themselves, they were given a short quiz on key points from the time period to evaluate if they had learned the most fundamental things. The feedback from this was then used by the teacher to help students who had not understood everything by providing extra focus on the points that were difficult in a smaller group. The teacher noted that most of the pupils that did poorly on the first FLIP2G session also had not watched the video or taken notes as they were supposed to. This happened in all three iterations with at least 2-3 pupils per class.

In the meaning making stage they were given keywords and a working document in class where they wrote down explanations for the keywords, along with relevant information they found interesting. They then wrote some of their own reflections on the things they had found in the working document. We then used the game FLIP2G to see if their retention of the basic concepts was prominent and if they had picked up on some of the more advanced concepts. Some of the more advanced concepts were difficult for the students, so the learning analytics provided excellent feedback on which topics and concepts the pupils struggled with. This was then included in the next presentation for the class. After the presentation, and as the course progressed, the students started working on creating their own questions for a quiz. Several of these questions were then used in a FLIP2G session to see if there was an improvement in the previous questions and if they understood the subject thoroughly enough to create and answer their own questions.

With concept exploration and meaning making stages completed, the students were then tasked with creating an oral presentation about key concepts from the time period of Imperialism. They had to present their findings and answer the questions they had made in the first task in the concept exploration and meaning making stages. This fused both the demonstration and application stages with the experiential engagement stage. After everyone had their presentation, the FLIP2G quiz included some questions from the students' presentations to check whether they had learned anything from the other students. The learning analytics provided a satisfactory result, as the students had retained much of the knowledge in the topics they had gone through, and provided pointers to the ones who needed to work a bit extra on it at home. In a normal class there are always those who get everything right and get high grades, those who get an average score, and those whose score is below average. The students reported that the FLIP2G quizzes were easier than

normal tasks that they used to complete, but the ones who did not get everything right, did not always want the reminder that they needed to work more with the subject.

The FLIP2G was not used to give any students a grade, but the presentation they prepared and the process of working with the project were evaluated by the teacher. They were given feedback on how they had worked on the topic and how the teacher perceived their engagement. The FLIP2G game made possible for the teacher to give this feedback, as the learning analytics showed what the different students struggled with.

8 Conclusions

Overall, the FLIP2G model and platforms have been tested by the project's educational partners in various settings:

- Educational levels/target groups: primary education students, secondary education students, undergraduate university students, postgraduate university students, degree apprenticeship students
- Delivery format: lectures, workshops, hackathon, school classes; online, face-to-face teaching, or blended
- Delivery pattern: weekly sessions, block teaching
- Duration: from one week (for block teaching) to a whole semester (13 weeks)
- Subjects: business, programming, information systems, mathematics, social sciences, computer science
- Size of classes: from small classes (e.g. around 8 students) to large classes (e.g. around 100 students)
- Assessment type: coursework, exams, presentations, reports; groupwork and/or individual assessment
- National educational systems: Danish, Greek, UK, and Norwegian

Despite the differences among the pilots, there seems to be an agreement among the instructors regarding the benefits and challenges of applying the FLIP2G challenges. In general, the instructors have mentioned that the FLIP2G game allowed their students to test their understanding of the concepts discussed in class and them to identify challenging topics that need further explanation. The learning analytics dashboard enabled them to evaluate the performance of their students and provide further guidance/support to the students that needed it the most. Of course, the pilots did not run without any challenges. External factors (e.g. the pandemic, IT failure, strikes etc.) have intervened with the delivery of the pilots and these are issues that others educators that want to use the FLIP2G outcomes in their teaching may face. We hope that by discussing in detail the circumstances under which our pilots ran and by providing examples of how we used the FLIP2G model/platforms, we will motivate other educators to try them.

References

CMI. (2017). *Chartered Manager Degree Apprenticeship Assessment Plan.* https://www.managers.org.uk/~/media/Files/PDF/Chartered_Manager_Degree_Apprenticeship_Assessment_Plan.pdf