

Deliverable 5.1

Evaluation Plan

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Abstract:	The report D5.1 presents the evaluation plan for the pilots. The report lists all the different elements that will be taken into consideration during the evaluation process. The report also explains and aims to guide partners on evaluating their pilot based on their specific conditions (e.g. duration of pilot, subject field, learning objectives etc.).
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List of Abbreviations

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

<i>Abbreviation</i>	<i>Description</i>
GBL	Game-based learning
GEM	Game based learning Evaluation Model
LA	Learning Analytics
LMS	Learning Management System
PBL	Problem-Based Learning
WP	Work Package

Executive Summary

The FLIP2G project aims to establish a Knowledge Alliance between higher education institutions, schools and private companies that will boost skills development and introduce novel, data-driven approaches to education and training. The consolidation of all efforts will provide a transnational set of results, as follows:

- a new pedagogical method that combines PBL and flipped classroom with game-based learning (FLIP2G educational approach)
- a gaming platform that supports PBL-enhanced flipped classroom processes, adaptive pathways and educational data recording
- learning designs for higher education, schools and business that support the FLIP2G paradigm
- Learning Analytics (LA) features that produce informative insights on learning process.

The above results aim to produce engaging pedagogical models and novel technologies that can foster motivation, generate adaptive learning pathways and allow self-directed learning in education and training.

The aim of this WP is to evaluate the effectiveness of the project's results in improving education and training through a PBL-enhanced flipped classroom model and an engaging environment with gaming and artificial intelligence elements. This WP will also assess the usage of LA tools in monitoring and guiding learners' progress throughout their learning experience.

Evaluations will consist of the collection, analysis and interpretation of information about all the results (e.g. learning methods and practices, platform, gaming elements). The method that will be followed will support a broad, multidimensional analysis of learning effectiveness, appropriateness and usability cost effectiveness.

Moreover, WP5 will incorporate LA, which will provide visualization and statistical information regarding the education and training process and will significantly contribute to the drawing of conclusions. The formative results along with the interim LA information will provide constant feedback to the consortium and allow pilots that may start later on to accordingly adjust their courses.

The report D5.1 presents the evaluation plan for the pilots. The report lists all the different elements that will be taken into consideration during the evaluation process. The report also explains and aims to guide partners on evaluating their pilot based on their specific conditions (e.g. duration of pilot, subject field, learning objectives etc.).

1.1 Scope

The present document is the Deliverable 5.1 “Evaluation plan” (henceforth referred to as D5.1) of the FLIP2G project. The main objective of D5.1 is to present all preparatory work carried out in order to develop a high-quality evaluation plan for assessing the pilots’ and the project’s results’ effectiveness.

1.2 Audience

The intended audience for this document is the FLIP2G consortium, the European Commission, and the public interested in evaluating learning experiences.

1.3 Structure

The structure of the document is as follows:

- Section 2 presents the methodology followed in order to evaluation all FLIP2G results and the performance of learners during the pilots.
- Section 3 presents evaluation methodologies that have been identified in the literature regarding Game Based Learning (GBL).
- Section 4 presents literature studied regarding qualitative data and how this will fit into the FLIP2G pilots.
- Section 5 presents the FLIP2G evaluation plan, covering the main axes, i.e. pedagogy, technology and performance.
- Section 6 concludes on the evaluation plan.

2 Methodology

The main goal of this report is to present an evaluation plan that will support the evaluation of the project results towards future exploitation by all interested stakeholders and of the project pilots towards validating the added value of the project's results.

Towards this end, we carried out an initial literature review on existing frameworks that support evaluation of learning via gaming environments. We examined all elements and concepts that are usually assessed and identified the most relevant concepts for FLIP2G.

We also carried out a review of the literature in regard to qualitative data analysis processes and investigated what data we can gather and assess within FLIP2G.

[pedagogy and technology]

The FLIP2G evaluation plan is built upon four three axes, as shown in Figure 1.

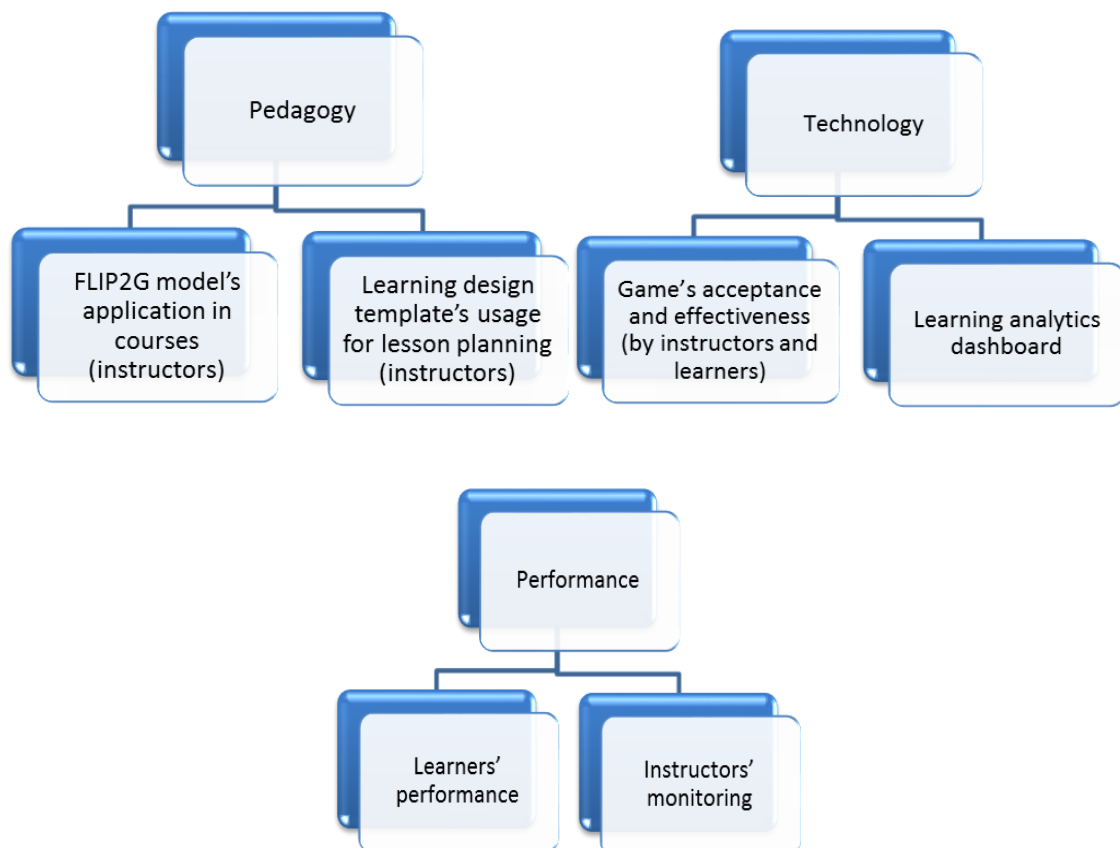


Figure 1 FLIP2G evaluation plan axes

FLIP2G evaluation: Pedagogy

The pedagogical aspect of the FLIP2G project results should be thoroughly evaluated. This will ensure that the results can be applied in the project pilots as well as by all future educators of all education levels and subject matters. Pedagogical results include:

- FLIP2G learning model
- FLIP2G learning designs

Instructors of the pilots will have to reflect on how they applied the FLIP2G model and how they designed their respective courses and assess their efficiency to plan and execute their courses.

FLIP2G evaluation: Technology

The technological results of the FLIP2G project will include the following two aspects:

- Game's acceptance and effectiveness (by instructors and learners)
- LA tools added value (by instructors and learners)

The interaction and experience of both instructors and learners with the gaming platform will be evaluated using multiple methods, depending on each pilot (e.g. interviews, focus groups, questionnaires, reflection forms). Each component of the gaming platform's evaluation will help future improvement of the technology so that it allows other instructors and learners to have positive gaming experiences after the project ends.

The LA dashboard's features will also be assessed by both instructors and learners. This will allow us to investigate to what extent instructors were able to draw conclusions on learners' progress during the course and thus adapt the course accordingly. Additionally, we will identify whether learners were able to draw information from visiting their LA results and make decisions regarding their learning process based on these results.

FLIP2G evaluation: Performance

The performance aspect regards the learners' performance within the course using the FLIP2G approach, as well as the instructors' monitoring options to scaffold and guide learners in all the different stages of the course and pedagogical model.

2.1 Ethical issues

Considerations need to be taken regarding any ethical or privacy issues that regard the participation of learners in the pilots. Different types of education levels will be participating in the pilots i.e. primary, secondary, undergraduate, postgraduate and adult education.

This requires the consideration of consent forms signed by the participants that will be requested to answer a questionnaire or participate in any evaluation methodology. This also may require the documentation of the research to be carried out per pilot, the data that will be gathered during the research and the purpose for which the data will be used.

Each partner pilot should consult with their Ethics department and prepare all necessary documentation that will ensure that all evaluation results can be further used to draw conclusions, publish publications and properly exploit the project results for their mainstreaming after the project end.

3 Evaluation of technological axis

The present section presents four frameworks of the relevant literature that include information on which aspect of game-based learning (GBL) should be evaluated. Each framework takes into consideration a set of elements for evaluating the technology of games used for learning and suggests how these elements can be assessed.

The following sub-sections briefly describe each framework for consideration within the FLIP2G paradigm. We will aspire to cover the most prominent evaluation aspects for technology in learning within our evaluation plan in different ways (e.g. within quantitative questions, within reflection / focus groups questions) and report our findings in D5.2.

3.1 Elements for evaluation in GBL (Aubert et al., 2019)

Aubert et al. (2019) propose a list of concepts that are important during the assessment of GBL solutions. The concepts proposed are divided into three main categories, i.e.

1. Game design and technical aspects
2. People and processes
3. Purpose and outcomes.

Each category includes relevant elements that should be taken into consideration to ensure the development and re-design of successful game-based learning strategies. The authors base the framework they have designed on literature of relevant studies that focus on evaluating GBL approaches using theoretical work in order to understand why GBL benefits the learning experience for both educators and learners. The following sections provide a brief introduction on each framework category and its concepts.

3.1.1 Game design and technical aspects

The “Game design and technical aspects” category includes elements that focus on how the game can become more motivating and less technically complex for its users. More specifically, the concepts proposed are:

- Immersive experience: A game should include interactive elements and a world environment that will allow users / learners to get immersed in the learning process and get motivated to participate actively in all learning activities.
- Levity: Serious games are considered games that have a serious purpose other than entertaining. The balance between entertainment and learning should be maintained, so that learners remain engaged in the learning process while at the same time be attracted by the gamification aspects of the environment.

- Complexity: All elements and features included in the game should resemble the complexity existing in real world situations that are simulated within the environment. This reinforces learners' engagement in the game and their ability to relate to the game's features and scenario, as they can draw from their existing experiences when they navigate the virtual world.
- Game/motivation affordances: This feature includes all the different ways that learners / players receive acknowledgement and rewards for their achievements (e.g. badges, gadgets, scores, levels upgrade etc.) and the goals of the game and each game level that should be clear, accessible and easy to navigate.
- Action-consequence feedback: This feature regards all the different ways each action within the game can affect learners' performance and how these actions can be re-designed to better improve the learning experience.
- Flow experience: The challenges learners experience within the game should be in accordance to the skills that they need to master.

3.1.2 People and processes

The "People and processes" category includes elements that focus on who the main stakeholders are in a GBL experience, and how the processes covered can affect successful performances. More specifically, important features to be considered when assessing GBL are:

- Representation: A gaming environment should provide a wide variety of interests, heterogeneous personas representations, world simulation habits etc. in order to appeal and attract learners of diverse personalities.
- Level playing field: A gaming environment should be mindful of any power imbalance that might occur between the participants, e.g. by including accessible for all world arenas, equal scoring or rewards etc.
- Open-endedness: Learners should be aware that in a game there is no pre-defined ending; each player can navigate through the environment based on their answers and performance in the different gaming elements and they might not have the same experience as other participants.
- Internalization of motivation: The provision of multiple and different levels of challenges that should be apparent throughout the entire game in order to maintain players' interest and motivation to continue playing and learning.
- Reflection / transformative learning: Players should have the opportunity to reflect on their gaming experience, and assess the different elements and features they encounter in the environment, in order to ensure that they can objectively provide feedback that can improve and transform the game to better fit their goals.

- Emotional involvement: A gaming environment should be mindful of the level in which it affects players' emotional and physical engagement towards completing the game.

3.1.3 Purpose and outcomes

The final category proposed by Aubert et al. (2019) regards the purpose of the game and the different outcomes that can affect players' positive attitude towards playing again. Such elements are as follows:

- Shared understanding of facts: This element assesses to which extent a gaming environment allows players to understand the different aspects of the subject matter being taught.
- Shared understanding of values: This element assesses to which extent a game allows players to understand the variety of societal and ecological values that are apparent in the environment.
- Commitment to solution finding: The game should be able to motivate learners in finding solutions not only to complete the game's tasks but also to facilitate in real-world problems, e.g. by simulating existing problems that can be solved through their suggestions.
- Social capital: This element regards the ability of a game to form social connections between the participants and a sense of social responsibility that participants will later put into practice to improve and make a difference in their society.
- Sense of ownership: This element regards the ability of a game to create a sense of ownership to the players, both on the individual and on a group level.
- Transference of learning: Learners' experience within a game should allow them to form learning schemas that they can transfer from a gaming environment to real world problems.

Based on the above framework, the combination of the suggested elements that should be assessed within a GBL strategy allows for the constant re-design of the learning process towards improving the learning experiences for all learners.

3.2 Evaluation framework for GBL (Tahir et al., 2018)

The work carried out by Tahir et al. (2018) aimed to accumulate and categorize the different elements that are usually included in educational games. The authors have studied different relevant work of educational games design, delivery and evaluation, and use four main conceptual levels to structure features for easier GBL evaluation. The following sub-sections provide a brief overview of the main layers and their concepts.

3.2.1 Learning / Pedagogical

The pedagogical layer regards features within an educational game that promote and help teaching and learning. These features are divided into four main categories as follows:

- **Learning objective.** Clear learning objectives in educational games should be formed in such a way that they exploit learners' prior knowledge and reinforce their ability to transfer the knowledge they learn within the game into their real-world settings.
- **Learning strategies.** The learning strategy that will be used for the course design and delivery should take into consideration different learning styles, use existing models and learning theories (e.g. Problem based learning, inquiry based learning etc.) and include a wide variety of learning activities in these contexts.
- **Learning content.** The learning content should be included within the game and be accessible by all participants in an easy and comprehensive way. Additionally, scaffolding features are important for the gradual comprehension of the material (e.g. hints, different difficulty levels etc.).
- **Learning outcome.** Educational games should promote knowledge and skills enhancement, as well as improved performance in interim and final assessments.

3.2.2 Game factors

The game factors category includes features within an educational game that stimulate the learners' engagement and gamification elements (e.g. avatars, gadgets, levels, points etc.). Such features include:

- **Game definition.** The game goals and rules should be visible and clear to all players before they begin their gaming experience. If the rules or any features change during the gameplay, all players should be informed accordingly.
- **Game narrative.** The narrative of the game should include a variety of different players and an engaging storyline that will maintain their interest and increase their motivation to complete the game's layers. Ideally, the narrative should simulate real-world contexts and the subject matter of the course.
- **Game mechanics.** The game should provide different ways players can interact within the game and control the game's elements.
- **Game resources.** It is important that all players can access the game's tutorial and any help / support available when they experience problems in using the game. Other resources that should be available include different rewards to increase motivation.
- **Game aesthetics.** Multimedia and visualization features included in educational games should be easy to use, user-friendly, attractive and not detract players' focus from learning.

- Game play. Challenge and a clear gaming strategy should be available so that players are constantly engaged in the learning process. The pace of each game level should be easy to follow, allow players to absorb and understand the learning content while at the same time enjoying the play aspect of the game. Finally, feedback is also important so that the game can interact with the players when necessary (e.g. praise when answers are correct, hints when scaffolding is needed, statistics with player's performance and progress etc.).

3.2.3 Affective cognitive reactions

The affective cognitive reactions category regards the different emotions and attitudes that learners experience in their interactions with the game. The different categories include:

- Enjoyment. Players' enjoyment in the learning process is an essential part of the course's success and improved performance. This can be achieved through interesting and entertaining immersive learning activities, ongoing feedback that encourages players' progress, social interactions with other players, knowledge improvement etc.
- Engagement. Players' active engagement in the game should be encouraged through challenging learning activities and tasks that they have to complete, clear objectives they have to achieve and ongoing interest in the game's storyline and narrative.
- Motivation. Players' motivation to complete all game's tasks can be enhanced with the provision of activities and materials that are relevant to the subject matter being taught, increase their sense of satisfactory learning and grab their attention.
- Flow. The flow of the game should allow feedback from the environment and from its players, interactions amongst the players and constant rewards for achievements.

3.2.4 Usability

The Usability category regards the extent to which a game is easy to use by the players so that they can achieve their educational goals. This includes features like the game's user interface, the ability for participants to learn and understand the taught materials, and the satisfaction they gain by completing tasks within the game.

Game usability can be achieved through the provision of different user control features, so that players can have different ways in interacting and controlling the system, easy navigation across the different levels and comprehensible error presentation for when something goes wrong with the technical aspect of the environment.

Additionally, consistency in the way the game is designed and played without major changes that have not been communicated to the participants or hinder participants' satisfaction within the game is important for its usability.

Finally, the provision of help and support by technicians and instructors whenever needed can improve a game's usability.

3.2.5 User

The User category takes into consideration all the different characteristics of the users the educational game is designed for. This will make it easier for evaluators of the game to assess to which extent the game managed to accommodate the specific features of its target group. For example, different learning profiles with different cognitive needs might require other gamification elements, learning material modes, learning activities etc.

To this end, a game's design and delivery should provide materials and learning activities that can accommodate the different learning styles that may exist within a classroom, i.e. videos, podcasts, slides, practical examples etc. Additionally, balance should be maintained between mental workload and knowledge improvement; instructors should not overwhelm learners with information and assignments within a game so that learners can have time and absorb the knowledge taught while at the same time enjoy the learning experience.

3.2.6 Environment

The last category in the model proposed by Tahir et al. (2018) regards the actual gaming environment, i.e. the technical features and structure as well as the context for which the game was designed and developed.

There are many different technology types and languages that are currently being used to develop gaming platforms (e.g. Unity, Unreal Engine, Solar 2D, BuildBox etc.), and each environment should take into consideration and meet the technical requirements and specifications that regard the specific context for which the game will be used. For example, a gaming platform that will be used in a University course for programming with a maximum of 40 students who will log in once a week for a maximum of one hour in the game requires much less technical resources than a platform used by a company that trains future pilots, which will have flight simulation features, will be used for multiple hours every day by hundreds of users, will require a significant amount of complex graphical development and resources to make sure that the simulators work as they should and minimum to no technical issues occur.

3.3 Game based learning evaluation (GEM) model (Oprins et al., 2015)

The GEM model described in the research work carried out by Oprins et al. (2015) provides the main features that should be measured and assessed in validation research for GBL practice. The authors have studied existing models for evaluating learning with focus on using serious games for education, and have designed a model that encompasses the most important features for GBL validation. The framework includes three main variable categories, i.e. Input, Process and Output, that can be measured in GBL.

Input regards the characteristics of the game as well as actual content that is included for education.

Process regards the learning experience of the participants, their enjoyment and knowledge comprehension within the game as well as their performance in the different game tasks.

Output regards the learning outcomes and the feedback / reflection of the participants on their learning experience.

With these three variables as the horizontal axis of the model, Oprins et al. (2018) divided the main validation features into three main categories, i.e. Learning environment, Learner and Environmental influences. Each feature is described in the following sub-sections.

3.3.1 Learning environment

The learning environment category covers the design features and indicators that can be assessed for GBL. Such indicators include:

- Game world. The game world reflects the context of the game, i.e. the narrative participants have to follow, the different levels of the game, the personas players can use, the navigations they have to follow, the different roles they can undertake etc.
- Action language. Action language regards the different ways players can interact with the platform and with other participants, i.e. the usability of the game.
- Challenge. The challenge indicator regards the problem or problems that players have to solve within the game. In GBL this also regards the learning content and activities they have to learn and complete. The challenge a player faces should be balanced, i.e. not so difficult that it hinders their ability and motivation to continue but also not so easy that they do not gain any additional knowledge or skills in their gameplay.
- Social interaction. Interactions between participants and participants and instructors should be allowed and made easy within the game, in order to promote collaboration, brainstorming and productive competition.
- Rules and goals. When clear learning goals and playing rules are provided to the learners beforehand, participants are more aware of what is expected of them and what they need to achieve; therefore, they tend to enjoy the gaming experience more.

- Control. Players often enjoy having control of their interactions within the game instead of simply following pre-defined steps. This increases their sense of power and motivation to keep playing, and can be achieved by allowing them to co-design certain features in the game, to make decisions on their paths in the different world levels, to change their personas etc.
- Feedback. Provision of feedback is essential for maintaining and enhancing players' satisfaction in the game. Such feedback can include scores of performance, hints for difficult topics, individual or group performance statistics, direct effects on actions etc.

3.3.2 Learner

The Learner category regards the different personal features of the participants, learning indicators that will validate their comprehension levels and the learning outcomes they have obtained from the game. More specifically:

- Personal features. Features such as prior knowledge, learning styles and cognitive capacity should be taken into consideration during game design and delivery.
- Learning indicators. Levels of motivation and engagement should be measured within the game so that instructors can adapt the environment accordingly when necessary. It is also important for participants to maintain a level of self-directness by having some control within the game and a sense of satisfaction by reducing their mental effort when they complete learning activities.
- Learning outcomes. The knowledge, skills and attitudes learners gain from the game should align with the initially set learning objectives and should be easy to transfer to other domains in the future.

3.3.3 Environmental influences

This category regards any factors outside of the learning environment that can influence and affect players' interaction and attitude towards the game. This can include any personal circumstances for a player or organizational environment issues. A recent and prominent example of this category is the COVID-19 worldwide pandemic, that has altered the way learning is carried out since 2020 and significantly affects the tools, mediums and contents being used for education.

4 Evaluation of pedagogical and performances axes

This section aims to provide an overview of the different methodologies available that describe how different types of data can be used to evaluate the learning process and learning experiences of learners. These methodologies can pinpoint how FLIP2G evaluation of the pedagogical outputs and learners' performance can be carried out. i.e. which methods to use and which data to take into consideration towards forming our evaluation plan.

Within the context of the FLIP2G project, the main source of investigation in the pilot project is the data generated by the gaming platform and processed through the LA system attached to the platform. However, within the context of some targeted pilot plans, there is also an argument to supplement the quantitative data with qualitative data relevant to the project.

There is precedent in using mixed methods and qualitative data to support or complement research into online educational activities, including use of LA.

The purpose of this section will be the following:

- Type of data gathering that could be relevant for the purposes of FLIP2G
- Propositions for qualitative data analysis that could be relevant for FLIP2G

4.1 Type of data

We can consider a variety of data for the FLIP2G project, both quantitative and qualitative, for analysis purposes.

Quantitative data in FLIP2G is generated through students' interactions with the gaming platform. The most important. As we can read in D3.3, the LA are based on online interactions such as frequency of connection, time spent during the game sessions, score during each session. Individual pilots might also use quantitative data from their own LMS (such as Moodle), and final results to the semester's evaluations.

Quantitative data can also be generated through targeted questionnaires based on students' preferences for activities in-class and interactions. We intend to look into students' self-reported opinions of the pedagogical model, regarding the pre-class preparation, activities in-class, and conduit of activities and projects through a whole semester.

Qualitative data can simply proceed from conducting online alternate activities for face-to-face interactions (interviews in particular). They can also include a variety of online activities and options (observation of online site, virtual ethnography, email, chat and instant message, discussion groups, or electronic forums (Lobe and al., 2020). Furthermore, qualitative data can also be elicited in our evaluation questionnaires via open-ended questions. Using the typology elaborated by Salmons (2017), we will focus on two types of specific qualitative data. The first one is extant data, based on the observation of interactions, whether on line or in the classroom. The second will be elicited data, gathered through open questions in questionnaires or interviews.

4.2 Qualitative data for the FLIP2G project

In e-learning a frequent use of qualitative data, which appears relevant within the confines of this project, is self-reported user satisfaction via questionnaires, evaluated either by Likert scales or open-ended questions. This approach appears in many studies owing to its facility of implementation, not always necessitating a control group, while allowing reflection on the user's experience (e.g. Lei et al., 2017; Lau et al., 2018). Junus et al. (2015) used for their research a more elaborated form of user self-reported satisfaction by employing the e-learning usability framework developed by Zaharias and Poylymenakou (2009). Said model associates criteria pertaining to usability on the one hand and instructional design on the other, to establish conclusions regarding the user final experience (in terms of motivation, learnability, and accessibility).

Another relevant data gathering approach for the project lies in semi-structured interviews. This approach balances interviews with a prepared framework of questions or discussion topics, completed by follow-up over the interview. For the purpose of the project we consider semi-structured interviews to be the most relevant approach since its balanced structure offers the most flexibility for a range of themes already defined in line with the project (learner motivation, flexibility of learning, self-directed learning experiences, challenges, etc.) Examples of models of semi-structured interviews include for example:

- Guided open-ended interviews, where researchers work from an 'interview guide' of topics, but without a precise wording in advance (Kvale, 2007).
- Responsive interviewing in which the main questions are set but the researcher elaborates the follow-up on his or her own (Rubin & Rubin, 2012)
- The three-interview structure, a more extensive model based on three themes (life history, experience, meaning making) arched over several interviews (Seidman, 2006)

In conclusion, there are many examples of qualitative analysis used in mixed methods approaches, among others in combination with LA, and there is also potential to exploit them during the FLIP2G pilot plan to ensure a better documentation of the learning process. While a one on one translation of the aforementioned methods is not possible in itself, we intend to use them as a basis to design our own questionnaires and interview models.

5 FLIP2G evaluation plan

The following Section demonstrates an evaluation plan to be followed by the FLIP2G partners. The evaluation plan took into consideration the types of data collection methods and types of data documented in the research done in Section 4 for the pedagogical axis, as well as the features in GBL that are usually evaluated based on Section 3 for the technological axis.

Each part of the evaluation plan covers a specific evaluation axis and aims to guide instructors, learners and future researchers during educational research and pedagogical model application.

5.1 FLIP2G Evaluation axis: Pedagogy

Within the Pedagogy evaluation axis, the FLIP2G learning model will be evaluated by the pilots' instructors, external evaluators and learners, while the learning design process will be evaluated by the instructors and external evaluators.

Table 1 Evaluation elements of FLIP2G pedagogy

Evaluation concept	Evaluation technique	Evaluation actors	Evaluation team	Evaluation mode	Evaluation data
4 stages of learning model	Reflection Questionnaire	Pilot instructors External evaluators Learners	Pilot organizer WP5 leader	Online	Reflection answers Questionnaire answers
PBL axis	Reflection Questionnaire	Pilot instructors External evaluators Learners	Pilot organizer WP5 leader	Online	Reflection answers Questionnaire answers
Flipped classroom axis	Reflection Questionnaire	Pilot instructors External evaluators Learners	Pilot organizer WP5 leader	Online	Reflection answers Questionnaire answers
Course design	Reflection	Pilot	Pilot organizer	Online	Reflection

		instructors	WP5 leader		answers
		External evaluators			

We propose two different evaluation techniques, based on the preferences of each pilot and of each actor. In regard to instructors, we will follow the reflection technique, as we would prefer more in depth analysis of their thinking process and we hope to derive numerous meaningful insights from their reflection remarks. Also, the number of instructors is limited, so a quantitative approach using questionnaires will not provide any added value. The same applies to any external evaluator that will assess the project results.

The reflection questions are available in a Google Forms form¹ for online dissemination to instructors, and in text form for any instructors that want to document their remarks offline.

¹ <https://forms.gle/MbAEGiCpUhWXKRGW7>

Reflection remarks on FLIPG pedagogy - Instructors

Form description

Please provide some initial information, such as: Pilot organization, educational level, name of course, number of students. *

Long-answer text

Did you have any previous experience in your courses with flipped classroom, PBL and gaming? *
If yes, please provide some examples.

Long-answer text

Did you apply the Concept exploration phase in your pilot? If not, why? If yes, what was your

educational goal?

Long-answer text

How did you design your Concept exploration phase for your course? Please provide examples of activities, data generated, and interventions made based on LA.

Long-answer text

Did you incorporate any of the PBL stages within the Concept exploration phase of your course? *
If no, why? If yes, please explain.

Long-answer text

How did you plan to engage with / intervene with your learners in order to adapt the course during the Concept exploration phase? *

The text version of the reflection questions regarding the pedagogical axis is available below.

Reflection remarks on FLIPG pedagogy - Instructors

Please provide some initial information, such as: Pilot organization, educational level, name of course, number of learners.

Did you have any previous experience in your courses with flipped classroom, PBL and gaming? If yes, please provide some examples.

Did you apply the Concept exploration phase in your pilot? If not, why? If yes, what was your educational goal?

How did you design your Concept exploration phase for your course? Please provide examples of activities, data generated, and interventions made based on LA.

Did you incorporate any of the PBL stages within the Concept exploration phase of your course? If no, why? If yes, please explain.

How did you plan to engage with / intervene with your learners in order to adapt the course during the Concept exploration phase?

Did you apply the Meaning making phase in your pilot? If not, why? If yes, what was your educational goal?

How did you design the Meaning making phase for your course? Please provide examples of activities, data generated, and interventions made based on LA.

Did you incorporate any of the PBL stages within the Meaning making phase of your course? If no, why? If yes, please explain.

How did you plan to engage with / intervene with your learners in order to adapt the course during the Concept exploration phase?

Did you apply the Demonstration and Application phase in your pilot? If not, why? If yes, what was your educational goal?

How did you design the Demonstration and Application phase for your course? Please provide examples of activities, data generated, and interventions made based on LA.

Did you incorporate any of the PBL stages within the Demonstration and Application phase of your course? If no, why? If yes, please explain.

How did you plan to engage with / intervene with your learners in order to adapt the course during the Demonstration and application phase?

Did you apply the Experiential engagement phase in your pilot? If not, why? If yes, what was your educational goal?

How did you design the Experiential engagement phase for your course? Please provide examples of activities, data generated, and interventions made based on LA.

Did you incorporate any of the PBL stages within the Experiential engagement phase of your course? If no, why? If yes, please explain.

How did you plan to engage with / intervene with your learners in order to adapt the course during the Experimental engagement phase?

In regard to the learners, we will include both reflection and questionnaires, as we are hoping to draw different types of information from them compared to the instructors, which can be done with both techniques. For example, it might be easier for some pilots to use questionnaire for their learners due to their large number, since it would be difficult to decode all reflection answers into evaluation results, whereas for some pilots, reflection might suit best for their learners.

Following, the evaluation plan includes a set of questions for learners to answer before participating in a FLIP2G-based course². These questions aim to identify learners' prior experiences with learning and learning strategies. This way, we can determine the level in which the course's participants are acquainted with participatory learning experiences and how this will affect their later responses to the evaluation questions after they have participated in the course.

These pre-course questions regarding pedagogy include:

Please fill you name

Please provide your age range

- ☐ 18 to 24

² <https://forms.gle/2vcdBdM1WN7YSDCZA>

- ☐ 25 to 29
- ☐ 30 to 34
- ☐ 35 to 39
- ☐ 40 to 44
- ☐ 45 to 49
- ☐ 50 to 54
- ☐ 55 to 59
- ☐ Over 60

What are your personal learning goals from the course (i.e. what would you like to learn)?

Please select the statements that reflect your preferred way of learning (you can choose more than one answer). Most of the time, I ...

- ☐ prefer to study alone.
- ☐ enjoy competing.
- ☐ create a mental picture of what I study.
- ☐ prefer to study with other learners.
- ☐ compete to get the highest grade.
- ☐ create a mental picture of what I see.
- ☐ learn better when someone represents information in a pictorial (e.g., picture, flowchart) way.
- ☐ learn practical tasks better than theoretical ones.
- ☐ learn better when I study with other learners.
- ☐ compete with other learners.
- ☐ create a mental picture of what I read.
- ☐ learn better when someone uses visual aids (e.g., whiteboard, power point) to represent a subject.
- ☐ learn better when I am involved in a task.
- ☐ focus more on the details of a subject.

- ☐ consider the details of a subject more than its whole.
- ☐ learn better when I watch an educational program.
- ☐ learn better when I watch a demonstration.
- ☐ create a mental picture of what I hear.
- ☐ remember the details of a subject.
- ☐ learn better when I study alone.
- ☐ remember specific details of subjects.
- ☐ learn better when studying practical, job-related, subjects.

Did the majority of the courses you have enrolled in provide you with ways to actively participate within the classroom (e.g. present your ideas, work with your classmates towards a goal, solve problems, develop prototypes, search for information)? If yes, what types of participation have you been involved in? If no, how was the majority of your classes structured?

Were you ever given material to read at home before you discuss the specific topic in the classroom? If yes, please elaborate. If no, please relay some examples on when and how you usually read the material taught.

In previous courses, were you able to practice knowledge that you have learned beforehand during class hours? If yes, please provide some examples. If no, please provide examples on how you usually practice your knowledge in other classes.

Do you believe that in your previous courses you were able to gain skills such as problem solving, critical thinking, communication of ideas, leadership, work group etc. If yes, please provide such examples. If no, please explain why.

The evaluation plan also includes reflection questions for learners that have participated in the pilot courses designed using the FLIP2G pedagogical model and the FLIP2G learning design template. These questions aim to allow learners of any level to reflect on their learning experience and provide remarks that might give us insight into how the model can be improved to increase learner satisfaction and positive inclination.

The reflection questions are available online as a Google form or offline for usage:

Now that the course is over, what are your first thoughts about the learning approach that was followed? Are they mostly positive or negative? If positive, what comes to mind specifically? Similar with negative?

What was the most interesting moments about a) working in groups, b) studying the majority of the subject first at home c) trying to solve problems by applying what you were taught in practical exercises. Please provide information about all three.

What was the most challenging moments about a) working in groups, b) studying the majority of the subject first at home c) trying to solve problems by applying what you were taught in practical exercises. Please provide information about all three.

Do you prefer the more traditional courses where lectures are taught during class and your participation and engagement is minimum or this new type of participatory learning experience? Please elaborate on the reasons for your preference.

The questionnaire questions are provided below and are also available in a Google form³ for easy documentation and answer retrieval.

Please fill in your name.

Please provide your age range

- ☐ 18 to 24
- ☐ 25 to 29
- ☐ 30 to 34
- ☐ 35 to 39
- ☐ 40 to 44
- ☐ 45 to 49
- ☐ 50 to 54
- ☐ 55 to 59
- ☐ Over 60

Did you think that studying the majority of the learning material from home helped you...
[learn the subjects at your own pace.]

3

https://docs.google.com/forms/d/e/1FAIpQLSdZLIgBJ5FxDs1kQ8MQdNVSfsBsdRkByGFGnq_qR5LbJrHQw/viewform?usp=sf_link

[make notes on concepts that were confusing to ask the teacher in class.] [understand the material better.] [search additional resources (links, videos, articles) to gain more information on the subject.] [draw from your past knowledge when trying to understand a concept.]
Did you find studying the material at home and not participating in traditional lectures ☐ Very challenging ☐ Challenging ☐ Neither challenging nor helpful ☐ Helpful ☐ Very helpful
Do you find practicing the knowledge you learned in the classroom ☐ Very challenging ☐ Challenging ☐ Neither challenging nor helpful ☐ Helpful ☐ Very helpful
Do you find applying the knowledge you learned in a proposed solution and demonstrating it ☐ Very challenging ☐ Challenging ☐ Neither challenging nor helpful ☐ Helpful ☐ Very helpful
Were you able to interact more with your teacher and ask questions about the material compared to other more traditional courses? ☐ Yes ☐ No ☐ Maybe
If you answered yes in the previous question, please provide some examples. If you answered no, please explain why not.
Did you enjoy working in group compared to working individually on assignments? ☐ Yes ☐ No ☐ Maybe
Please elaborate on your previous answer regarding work group.
Did you find trying to solve problems by applying what you were taught in practical exercises ☐ Very challenging ☐ Challenging ☐ Neither challenging nor helpful ☐ Helpful ☐ Very helpful
What types of activities did you participate in while exploring concepts of the subject matter? ☐ Reading slides provided by the teacher ☐ Reading slides / files / articles I searched on my own

☐ Viewing videos provided by the teacher ☐ Viewing videos I searched on my own ☐ Playing a game ☐ Discussing with my classmates ☐ Discussing with my teacher ☐ Other...
What types of activities did you participate in while understanding the different concepts of the subject matter? ☐ Reading slides provided by the teacher ☐ Reading slides / files / articles I searched on my own ☐ Viewing videos provided by the teacher ☐ Viewing videos I searched on my own ☐ Playing a game ☐ Discussing with my classmates ☐ Discussing with my teacher ☐ Presenting my ideas / understanding to classmates and teacher ☐ Practicing the knowledge learned with assignments ☐ Other...
Did you find it easy to apply what you learned in a proposed solution and demonstrate it? ☐ Yes ☐ No ☐ Maybe
What types of activities did you participate in while demonstrating and applying the subject matter? ☐ Reading slides provided by the teacher ☐ Reading slides / files / articles I searched on my own ☐ Viewing videos provided by the teacher ☐ Viewing videos I searched on my own ☐ Playing a game ☐ Discussing with my classmates ☐ Discussing with my teacher ☐ Presenting my ideas / understanding to classmates and teacher ☐ Practicing the knowledge learned with assignments ☐ Other...
What types of activities did you participate in while you explored further on the subject matter? ☐ Playing a game ☐ Reflecting on the knowledge learned and the solution presented ☐ Discussing with my teacher ☐ Improving on my prototype / system / solution ☐ Presenting my reflections to classmates and teacher ☐ Reporting my experience ☐ Other...

5.2 FLIP2G Evaluation axis: Technology

The evaluation of the Technological axis regards two aspects, i.e. the gaming environment and the LA dashboard. The gaming environment consists of two parts, i.e. the launched game that is played by the learners and the teachers' dashboard, where teachers structure their courses, register their learners, set up their quizzes and launch their lessons.

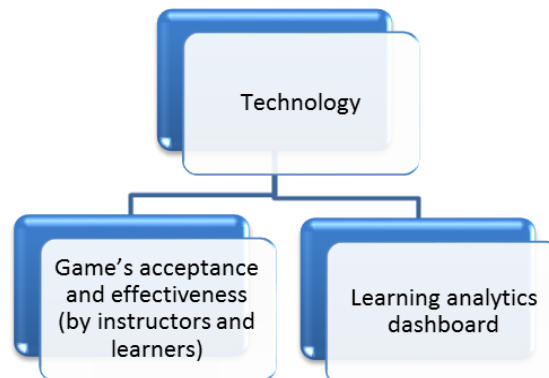


Figure 2 FLIP2G Technology evaluation

Table 2 Evaluation concepts matrix

Evaluation concept	Evaluation technique	Evaluation actors	Evaluation team	Evaluation mode	Evaluation data
Gaming environment	Questionnaire Reflection remarks	Pilot instructors External evaluators	WP5 leader Partner pilots	Online	Reflection based on GBL evaluation frameworks Questions' answers
Teacher dashboard	Reflection remarks from instructors	Pilot instructors	WP5 leader Pilots instructors	Online	Reflection
LA dashboard	Questionnaire Reflection remarks from	Pilot instructors	WP5 leader	Online	Questions' answers

	instructors	Learners			Reflection
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A few questions included in the pre-pilot questionnaire regard learners' prior gaming experience and technology usage during learning. This way, we aim to identify if previous extensive interaction with gaming platforms or other tools for learning and collaboration have affected the respective learners' learning experience and satisfaction from the pilot.

What is your experience with playing online/video games? *

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I like playing online/video games	☐	☐	☐	☐	☐
I often play online/video games	☐	☐	☐	☐	☐
Compared to people of my age, I play a lot of online/video games	☐	☐	☐	☐	☐
I would describe myself as a gamer	☐	☐	☐	☐	☐
I play different types of online/video games	☐	☐	☐	☐	☐

What types of tools have you used in previous courses to help with your learning experience? *

- ☐ Moodle
- ☐ Other e-learning platform
- ☐ Facebook
- ☐ Twitter
- ☐ Project management tool
- ☐ Co-writing tool (e.g. Google docs, Google sheets)
- ☐ Discussion tool (e.g. forums, chats)
- ☐ Quiz tools
- ☐ Game
- ☐ Other: _____

Please provide some more examples on the tools you mentioned in the previous questions, and add any examples of tools you have used and were not available in the question. *

Your answer

In your previous courses, were you given ongoing feedback on your progress (e.g. remarks from your teacher on where you could improve, engagement score, percentage of right / wrong questions answered in quizzes etc.)? If yes, please provide some examples. If no, please elaborate on what type of feedback you believe would be useful to you during the semester for improving your performance. *

Your answer

Gaming environment

Once learners have completed the pilot course, they are provided with a questionnaire that was designed based on the concepts for evaluation included in the most commonly used evaluation frameworks identified from literature and described in Section 3 of this report. These questions aim to give us a better idea of how learners interacted with the game and what were their remarks.

We grouped the most commonly featured aspects, as mentioned in relevant work as to what we aim to assess. These aspects regard:

- user experience
- user satisfaction
- motivation
- gamification
- goals

Reflection questions are also available for a more in depth analysis of the learners' experience.

Tell us about the overall experience with the game. Was it positive or negative? Why?
What features of the game did you use? How often did you login in the game and for what purpose?
What did you feel was interesting and lacking about the game?
Were there any technical issues while using the game? Did the technical issues prevent you from enjoying the gaming experience?
Would you be interested in playing an enhanced version of this game? What do you think would make the game better?
Did you playing the game affect your performance in any positive or negative way? Please explain.
Did you find the quiz part of the game motivating for you to test your knowledge? What would change about the quiz process and what would you keep?
Did you find the material access easy in the game for you to read? What would change about the material access process and what would you keep?

Teacher dashboard

The teacher dashboard is an important interface, as all teachers have to learn how to navigate through the different menus, create new students, maintain the correct tags, create questions and quizzes, add materials, create courses, start sessions etc. We aim to retrieve reflection notes from the pilot teachers on their interactions with the dashboard. The reflection questions are:

What was your overall experience with the teacher dashboard? Positive, negative? Why?
Please let us know what the most positive feature of the teacher dashboard was and which the most negative. Provide some examples.
Did you find the teacher dashboard user friendly?
Did you manage to add students from the Students menu? Did you encounter any issues?

Did you manage to create questions in the Questions menu? Did you encounter any issues?
Did you manage to create quizzes in the Quiz menu? Did you encounter any issues?
Did you manage to add learning content from the teacher dashboard? Did you encounter any issues?
Did you manage to set up courses and sessions in the teacher dashboard? Did you encounter any issues?
What improvements do you think could add value to the teacher dashboard?

LA dashboard

The LA dashboard aims to allow teachers and learners to reflect on the course's progress and make adaptations to the course and learning experience in order to improve the LA results towards better learner performances. The reflection questions for teachers are presented as follows:

What was your overall experience with the LA dashboard? Positive, negative? Why?
Please let us know what the most positive feature of the LA dashboard was and which the most negative. Provide some examples.
Did you find the LA dashboard user friendly?
Did you manage to make sense of your learners' progress using the LA dashboard?
Which LA graphs did you find more useful and which more challenging to understand?
Were you able to adapt your course based on information you gained from the LA dashboard? Please provide examples.
What additional features would you want to see in the LA dashboard?

The reflection questions for learners are presented as follows:

What was your overall experience with the LA dashboard? Positive, negative? Why?
Please let us know what the most positive feature of the LA dashboard was and which the most negative. Provide some examples.
Did you find the LA dashboard user friendly?
Did you manage to make sense of your progress using the LA dashboard?
Which LA graphs did you find more useful and which more challenging to understand?
What additional features would you want to see in the LA dashboard?

5.3 FLIP2G evaluation axis: Learner performance & experience evaluation

The last aspect of evaluation regards the performance and experience of learners during the FIP2G-designed courses, as shown in Figure 3.

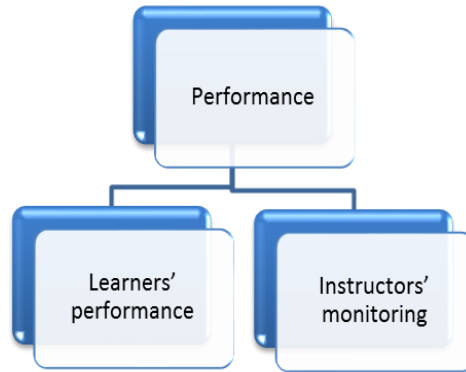


Figure 3 FLIP2G Performance and experience evaluation

Table 3 Evaluation elements for FLIP2G performance

Evaluation concept	Evaluation technique	Evaluation actors	Evaluation team	Evaluation mode	Evaluation data
Learners' performance & Instructors' monitoring	LA dashboard visualizations	Pilot instructors Learners	WP5 leader Pilot partners	Online	Engagement Navigation paths Material views Times of quiz efforts
	Grades	Pilot instructors Learners	WP5 leader Pilot partners	Online Offline	Quiz answers within the game Assignment grades Final grades
	Questionnaire	Pilot instructors	WP5 leader Pilot partners	Online	Questions' answers

		Learners			
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Specific considerations will be taken for the different ways we should approach the retrieval of evaluation feedback from primary and secondary education learners. We will consider more attractive and user friendly approaches for evaluation data.

Do you believe you were able to properly explore all concepts taught in the course by reading the material provided? Please elaborate.

Do you believe you were able to properly make sense of the knowledge taught in such a depth that you would be able to apply this knowledge in different contexts? Please elaborate.

Do you believe you were able to properly demonstrate and apply the knowledge learned through practical experimentation and implementation of problem solving tasks? Please elaborate.

Do you believe you were able to properly reflect on your experience and adjust your learning accordingly for this and any future courses? Please elaborate.

6 Conclusion

The evaluation plan proposed in this report aims to cover a variety of axes that should be assessed within the FLIP2G project's context. The evaluation plan can also be used by any instructor that will apply the FLIP2G project's outputs in the future and can be extended / adapted to fit any requirements.

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