From Developers to Players: Exploring the Dual Impact of Game-Based Learning on Student Engagement, Learning and Skill Development

Abstract

This paper explores the implementation of Game-Based Learning (GBL) in higher education, with a particular focus on the dual role of students as developers and players of educational games. In particular, the study investigates the extent to which GBL leverages intrinsic motivation, fosters engagement, consolidates prior knowledge, and cultivates essential 21st-century skills in undergraduate students that designed, developed, and played interactive digital gamebooks on STEM disciplines. A mixed method based on surveys and focus groups was leveraged to assess the diverse learning outcomes and the educational impact of the project. Findings show that the GBL approach significantly increased student engagement, fostered deeper learning in IT-related skills, and provided valuable experiences in competences such as project management and teamwork. However, the integration of advanced academic content in Mathematics and Statistics was perceived as less effective, posing challenges to knowledge acquisition and consolidation. This study concludes that while GBL is highly effective in promoting motivation and skill development, further refinement is needed to align content complexity with learning objectives.

1. DIGITAL NATIVES AND NEW EDUCATIONAL APPROACHES

Digital native students who are growing up in an interconnected, multi-tasking and rapidly changing environment have been shown to have different neurological characteristics and behaviors compared to previous generations (Prensky & Berry, 2001; Small & Vorgon, 2008; Murillo, 2021; Wang et al., 2022). To date, maintaining students' motivation throughout the learning process is one of the main issues across various disciplines of higher education (Hartt et al., 2020). The new generation of learners is difficult to engage, as they tend to be more active and autonomous than before by seeking out information, tools and feedback from multiple sources, and by constructing their own knowledge, rather than being considered passive recipients from their instructors.

Nowadays, educators recognize the need to redesign pedagogical practices that engage digital natives leveraging primarily on their intrinsic motivation (Thurston, 2018; Radovan & Radovan, 2024). In recent years, traditional modes of teaching, such as frontal lectures, have given way to active and experiential learning methodologies that, by involving students in the first person, promote diverse (e.g., cognitive, social and emotional) abilities while enhancing deep learning (Hartt et al., 2020). These methods, encompassing a wide range of educational practices, exhibit explicit objectives and involve real-world tasks (Brown, 2000; Frand, 2000; Oblinger, 2003), providing students with many opportunities, such as reflecting firsthand on the content of a subject, fostering interaction with other learners, and promoting the development of collaborative knowledge building skills (Tham & Tham, 2012).

The use of games in educational contexts is one of these innovative practices in the form of collaborative experience. Game-based learning (GBL) has been acknowledged by scholars as a promising solution in higher education (Liu et al., 2011; Belova & Zowada, 2020; Hartt et al., 2020;

Cabrera-Solano, 2022) and has been increasingly adopted by faculty members to motivate higher education students and improve their learning performance across diverse disciplines (Hays, 2007; Sung & Hwang, 2013; Watson et al., 2013).

The present paper deals with the implementation in higher education of a GBL practice based on digital non-linear and interactive storytelling, with the with the purpose of investigating to what extent GBL leverages students' intrinsic motivation to foster engagement and interest in the subjects, consolidates prior knowledge and facilitates the development of new knowledge and skills.

In the following sections, this paper aims to: (i) overview the recent literature on GBL (ii) explore different theories underlying this methodology and present a possible theoretical framework for the purpose of the study; (iii) describe the design, implementation and use of gamebooks by students of a private university in the dual role of developers and players; and (iv) discuss the main learning outcomes obtained through a pilot course.

2. THEORETICAL BACKGROUND

2.1 Game-Based Learning

The term 'game-based learning' (GBL) has a broad meaning that refers to the use of games designed for learning purposes (Aydin & Cakir, 2022). The main purpose of these games, whether on digital support or not, is to promote the active participation of learners and facilitate learning by including challenges, rewards, interaction and feedback (Alsawaier, 2018). Examples of GBL activities include educational videos (i.e. videos used as an educational resource), simulations, digital games, quizzes and crossword puzzles (Tham & Tham, 2012). The diffusion of games for educational purposes in the digital format has been possible due to the adoption of ICT tools in

education as well as to the increasing acknowledgement of the importance of playing in learning. These games are designed with the aim of supporting learning by identifying a balance between educational and entertainment purposes. They are generally characterized by activities, rules and constraints that replicate those of the real world, to immerse the player in a challenging and verisimilar environment (Ariffin et al., 2014). Digital GBL solutions can enable reflective, experiential, and intriguing learning environments (Bygstad et al., 2022), affecting students' emotions and providing them with a memorable learning experience (J¨a¨ask¨ & Aaltonen, 2022). Depending on the type of task for which they train, they can be classified as skills and procedures learning games, action games, role-playing games and strategy games (Hays, 2007).

GBL is not limited to lower educational levels but has emerged to be useful even at universities. As such, it is an attractive and interesting area of research which is still limited in terms of outcomes (Greipl et al., 2020).

GBL differs from gamification: whereas the former is based on games or game-like environments with a focus on a certain learning activity, gamification consists in the integration or addition of game-design elements, game mechanics or game thinking in non-game contexts (Plass et al., 2015; Al-Azawi et al., 2016; Ha et al., 2020). In other words, GBL uses games as part of the learning process while gamification turns the learning process into a game (Al-Azawi et al., 2016).

2.2 The impact of GBL in education

In the past decade, a growing number of empirical studies have been conducted to explore GBL effectiveness in various domains of education such as STEM subjects (Wouters et al., 2013; Hung et al., 2014; Muntean et al., 2019; Troussas et al., 2020; Zhao et al., 2022; Wang et al., 2022; Trinh et al., 2023). When compared to traditional methods, it has been shown that GBL can lead to interesting learning outcomes (Wouters et al., 2013; Freeman et al., 2014; Boyle et al., 2016):

(i) First, being an inherent aspect of human social behavior, gameplay has the potential to serve as a motivational tool for students (Prensky, 2001; Felicia, 2010; Plass et al., 2015): it provides an enjoyable social experience, encourages a feeling of independence and capability and engages learners both emotionally and cognitively (Huizinga & Schendel, 2002; Karriker & Aaron, 2014; Hartt et al., 2020). This notion is grounded in Self-Determination Theory (SDT), according to which inner motivation is fostered by the three psychological needs of autonomy (i.e. the need to feel in control of one's own actions and decisions), competence (i.e. the need to feel effective and capable of achieving desired outcomes) and relatedness (the need to feel connected to others and to experience meaningful relationships) (Deci & Ryan, 1985). When intrinsic motivation is triggered in the first place and eventually but not necessarily integrated with extrinsic motivational components such as grades or rewards, learners are spurred on to actively engage in the designated activities (Hartt et al., 2020).

(ii) Second, many studies denote GBL as an effective learning methodology that foster students' deep learning, facilitating the acquisition, consolidation and retention of knowledge (Squire, 2011; Ariffin et al., 2014; Eastwood & Sadler, 2013; Al-Azawi et al., 2016; J̈aïaskï̈a et al., 2022). GBL facilitates knowledge acquisition by creating an interactive environment where students can engage with the content and take an active role in the educational activity (González-González & Navarro-Adelantado, 2021; Trinh et al., 2023). Games often require students to apply what they have learned repeatedly, a factor that, as Roediger and Butler (2011) explain, strengthens long-term memory through the testing effect. Finally, knowledge retention is also enhanced through GBL because it leverages both repetition and the emotional engagement associated with gameplay (Plass et al., 2015).

(iii) Third, GBL has been shown to promote skills' development (Prensky, 2001; Hornik & Thornburg 2010; Qian & Clark, 2016; Al-Azawi et al., 2016; Echao & Romero, 2017; Pellas & Vosinakis, 2018; J̈aäskk̈a et al., 2022; Bakhsh et al., 2022). Qian & Clark (2016) have defined the 21st century skills as a wide range of competences ranging from learning and innovation (i.e., critical thinking, problem solving, creativity, collaboration and communication) to information, media and technology. Educational games are believed to influence the development of these competences, not only during the plays itself, but also during both their design and development (Qian & Clark, 2016). The latter two stages often require the development of a strategy, a leadership style, and social interactions, as they require participants to diverge, trade, and mediate among each other to produce an effective educational game (Mcdonald, 2001; Karriker & Aaron, 2014; Schrier et al., 2024). This leaves space to synergetic learning and facilitates teamwork as the ability to collaborate effectively and efficiently towards the achievement of a common goal (Boyatzis 2009; Ku et al., 2013), on which engagement itself is grounded (Ryan et al., 2006). Moreover, the collective development of gamebooks requires learners to handle a challenge and find a common solution to a problem (Chiong, 2010), therefore contributing to the development of creativity, communication (Qian & Clark, 2016), critical thinking and problem-solving abilities (Malone & Lepper, 1987; Chee & Lee, 2009; Salas & Piccolo, 2009; Al-Azawi et al., 2016). Last and foremost, when students participate in the process of designing and developing an educational game in the digital format, they also experience a complex task of project management, which refers to a combination of competences far beyond the technical skills (PMI, 2017). The organization of workflow and the compliance with internal and external deadlines enable the enhancement of leadership, strategic and business management skills as well as experiential reflective learning through "learning by

doing", which are deemed essential competences of project management (Ramazani & Jergeas, 2015; Cicmil & Gaggiotti, 2018) and are requested in organizations.

Despite the potential of GBL to increase motivation, stimulate learning, and develop higher-order skills, the effectiveness of these games has been mainly investigated for students playing games, with very little investigation for students developing the same games. In other words, further investigations on how GBL affects learning, motivation and 21st century skills development in the dual role of player and developer are recommended.

3. RESEARCH PURPOSE

As highlighted in the previous section, while GBL has been extensively studied, there remains a gap in understanding its full potential in the learning process, especially in contexts where students engage in roles beyond pure participation.

To explore more deeply the potential of GBL in fostering intrinsic motivation and enhancing the learning process and outcomes, a dedicated learning project has been designed involving students not only as learners but also as creators within the GBL environment. The dual role played by students, serving simultaneously as developers and players, provides a unique dimension to our study. It allows us to observe and analyze the impacts of GBL from a holistic perspective, considering both the process of game creation and the experience of game-based learning. This duality adds a layer of complexity to the traditional GBL approach, enriching the learning experience and offering deeper insights into both the efficacy and the dynamics of game-based education.

3.1 The context of the study: the learning project ImpaRa

The learning project, named “ImpaRa” (in Italian “Imparare Raccontando”, “Learning by storytelling”), consisted in the design, implementation and use of 11 gamebooks by 34 volunteers first-year Management Engineering undergraduates at an Italian university, during a period of approximately four months (February 2023 – May 2023).

The project was characterized by three sequential macro-phases:

(i) Macro-phase 1: design and implementation by participants (developer students) of interactive, web-playable non-linear stories within which to embed appropriate problems of Mathematics, Statistics, and Informatics;

(ii) Macro-phase 2: experimentation of the stories developed in macro-phase 1, at a time when all first-year students of the Management Engineering degree course (player students) were involved;

(iii) Macro-phase 3: collection of opinions on the experience, both of developer students and player students, followed by the analysis and the critical synthesis of data;

The game developers were coordinated by four team leaders (i.e., two full-professors, a lecturer and a research fellow), all of them teaching the subjects targeted by the project. The students participating to this project were rewarded with up to 5 points (out of 30, the maximum grade at Italian universities).

Students’ training was an essential aspect for the development of the game and was guaranteed throughout the duration of the project. Before the starting of macro-phase 1, students were trained both on the use of Twine, and on storytelling. During macro-phase 1, from mid-March to mid-May, students were mentored and facilitated by two young faculty members who acted as

project team leaders. Two progress meetings were scheduled to review both the content and technical-informatics issues.

The gamebooks developed by students consist in non-linear, interactive, web-playable stories based on role-playing dynamics. Each gamebook was implemented using Twine, a free, open-source software system, which provides a high-quality nonlinear story development and use experience without the cost of purchasing licenses. Twine provides a different developing framework, from which Harlowe was selected for its simplicity.

The gamebook narrative, typically in the fantasy or detective genre, is in the second singular person. The story proceeds in a branching and nonlinear way, so that it is not possible to read pages in their numerical order. The text alternates with evocative pictures of immersive and captivating scenarios of the setting, divided into various sections. At the end of each chapter, players are asked to solve a problem to continue their adventure. These challenges require disciplinary skills in Data Science; more than one solution is correct, with different solutions leading to different paths, in the realistic logic that the same problem can be solved in multiple ways. If playing in groups, students can interact with each other for the identification of a common solution and develop social skills. Once they received instant feedback on the correctness of the solution, the players were directed to the next challenge, based on the answer provided.

3.2 Research Objectives

The literature indicates that GBL fosters a sense of competence and emotional involvement making learning enjoyable and engaging, (Felicia, 2010; Hartt et al., 2020); it consolidates prior knowledge and promotes deep learning (Squire, 2011; Eastwood & Sadler, 2013; Al-Azawi et al., 2016); it cultivates higher-order skills like critical thinking, problem-solving, creativity, and collaboration through social interaction and teamwork (Qian & Clark, 2016; Boyatzis, 2009); and,

additionally, it develops new competences including project management, leadership, and strategic business management through game design and development processes (PMI, 2017; Ramazani & Jergeas, 2015; Cicmil & Gaggiotti, 2018).

On the basis of this evidence, the gamebooks were designed and implemented with the purposes of investigating to what extent GBL:

(i) Leverages intrinsic motivation to foster engagement and interest in the subjects (for both developers and players);

(ii) Consolidates prior knowledge acquired during the year through the courses of Mathematical Analysis, Experimental Data Analysis and Statistics and Informatics (for both developers and players);

(iii) Cultivates higher-order skills demanded by the workplace in the 21st century (for developers, only);

(iv) Develops new IT-related knowledge and skills related to the use of Twine (for developers, only).

The achievement of these objectives served as the basis of the gamebooks' design and was subsequently evaluated through assessment questionnaires that were administered to the students who participated in the game, both as developers and as players, to measure learning motivation and effectiveness.

4. METHODS

In order to gain a deep and comprehensive understanding of the effectiveness of the GBL approach on students' motivation and learning outcomes, two separate analyses were conducted for the purpose of the study.

The achievement of the objectives from (i) to (iv) was evaluated: first, through two different web-based assessment questionnaires that were administered to the students who participated in the game, respectively as developers and as players, at the end of the courses (June); secondly, through three focus groups that were conducted by one of the researchers with 3 up to 6 developer students who volunteered to take part in this further investigation in the following months (October and November).

The semi-structured questionnaire for developers consisted in 16 questions aimed at investigating: the students' interest and engagement in developing the gamebook, the major challenges encountered, the main takeaways in terms of higher-order skills development, and the perceived effectiveness on their learning outcomes (i.e., consolidation of prior knowledge and acquisition of new competences related to the IT)

The semi-structured questionnaire for players consisted in 8 questions aimed at investigating, on the one hand, the quality of gamebooks in terms of storytelling, disciplinary content, IT and graphic implementation and, on the other hand, the perceived effectiveness on their learning outcomes (i.e., consolidation of prior knowledge acquired during the year and increase of interest in the subjects' content).

Focus groups in the form of "informal discussions among selected individuals about specific topics" (Beck et al. 1986) were conducted to obtain perceptions about the overall project (Kreuger, 1998). In particular, 12 broad and open-ended questions were derived from both questionnaires and further articulated to deepen the students' experiences both as developers and as players and to assess the overall perceived effectiveness of the project.

4.1 Participants

The participants to this project were first-year students of the bachelor's degree in Management Engineering attending the same courses of mathematics, statistics, and computer science in the university under study. Among the 34 students involved in the innovation project, 29 attended the final event in June and took part in the initial analyses through questionnaires, resulting in a response rate of approximately 85% of the total population.

Out of these 29 respondents, 13 volunteered to participate in further analyses conducted through focus groups during the months of October and November, representing approximately 45% of the total population.

4.2 Data Collection and Analysis

Prior to both the distribution of questionnaires and the conduction of focus groups, the researcher requested honest responses by guaranteeing anonymity and confidentiality for all participants and by ensuring that any sensitive information would not be disclosed.

With regards to questionnaires, two URLs were provided to participants, containing the form for developers and the form for players, respectively. Both questionnaires were completed within the end of the event. This approach enabled the electronic collection of data, leading to effective data entry and integration, as well as time reduction. Data were analyzed by one of the researchers and then revised by a second researcher to achieve better accuracy. The surveys are available in the additional material of the paper.

With regards to focus groups, all discussions were recorded with prior consent of participants and then transcribed for a more accurate analysis of data. An approach of theoretical coding was

adopted to attribute explicit “codes” for the generation of themes and sub-themes, which allowed to capture the essence of observations and to gain meaningful insights (Boyatzis, 1998; Onwuegbuzie et al., 2009). Also in this case, the analysis of data was first performed by a researcher and then refined by a second researcher.

4.3 Data Validity, Reliability and Triangulation

Data validity pertains to the accuracy of data measurement, while reliability denotes the consistency of the research approach across various researchers and projects (Gibbs et al., 2007; Creswell & Plano Clark, 2018).

The students completed the questionnaires immediately after the end of the project, this allowing them to recall the information easily, given the short window of elapsed time.

Although the questionnaires may have been completed with some pressure, as students were asked to do so by their supervisors, they provided the basis for a further investigation, which was conducted in the following months through focus groups and helped gain better insights on the topic. The time window between the quantitative and the qualitative analysis allowed to assess whether the students’ perception of the overall usefulness and effectiveness of the project as well as the positive work dynamics eventually emerged through the questionnaires were confirmed.

In the quantitative analysis, there was no direct intervention of the researchers that might have influenced the responses of participants. In the qualitative analysis, the intervention of the researcher (i.e., moderator) was limited to ensuring the achievement of the research objectives.

Data triangulation, namely a research process involving multiple individuals, data sources and methods that allow to gain a deeper understanding of the subject, was ensured: first, by corroborating the quantitative analyses based on questionnaires with the qualitative analysis deriving from the focus groups; second, by always including a second researcher to review the

analysis of data; third, by investigating the phenomenon at different times with respect to the end of the project.

5. RESULTS

5.1 Quantitative Analysis

In this section, we present a statistical analysis of data obtained from two distinct questionnaires: one related to the experience evaluation and the other related to the stories' peer-to-peer evaluation. Although the analysis yields valuable insights, it is crucial to acknowledge its limitations. The sample size is notably small, rendering the analysis less robust. This limitation in data volume is attributable to the experimental setting: the project, being an innovative venture within a small university context, involved only a limited number of student participants. Consequently, the analysis should be interpreted as providing initial evidence to be confirmed through the focus groups, rather than a foundation for independent conclusions.

5.1.1 Developing Experience Questionnaire

The questionnaire, designed to evaluate the experiencers' perceptions, was administered to students immediately following the event's conclusion but prior to the public disclosure of the results, as a strategy intended to mitigate potential biases. It comprised two types of questions: quantitative evaluation of specific features via scoring, and qualitative feedback through open-ended questions.

Participants rated motivation and six other key items, each of them standing for a skill or a set of knowledge that was supposed to be stimulated by the participation to the project: creativity,

teamwork, project management, statistics, mathematics, and IT related skills (the details about the questions can be found in the supplementary materials). The questionnaire utilized a six-point scale for item evaluation, ranging from 1 (the related skill did not increase at all) to 6 (the related skill increased a lot), with specifics detailed in Table 1 of Appendix A. The aggregated results of this evaluation are concisely presented in Table 2 and in Figure 1.

Table 2: mean and standard deviation of the items collected in the developing experience questionnaire

Figure 1: frequency distribution of the items collected in the developing experience questionnaire

The central value of the employed rating scale was set at 3.5. Table 2 revealed that the mean score for nearly all evaluated items surpassed this midpoint, indicating a generally positive perception of the didactic experience. Notably, only the evaluation of mathematical skills approximated this central value, suggesting a more nuanced participant response in this specific area. This overall trend implies a positive impact of participation in such educational experiences. The observed effect was particularly pronounced in the areas of project management and teamwork. These skills are intuitively enhanced in a group work setting, where participants are required to collaborate towards a deliverable within a set deadline, involving several intermediate stages. Considering that the participants were first-year engineering students, this activity likely represented their initial exposure to university-level group and project work, offering substantial learning opportunities. Similarly, the presence of a high score regarding critical thinking can be derived from two elements: the youth of the students, who have not yet been exposed to many problem-solving tasks with needs it; and the quality of the experience, which results in properly designed.

Conversely, the questionnaire indicated lower scores in the core academic domains the students were expected to strengthen: statistics and mathematics. This suggests that knowledge

consolidation in these areas was perceived as less effective compared to the acquisition of other skills. The disparity may stem from the actual sensation of learning. In project work and teamwork, the continuous, intense experience of collaborating and striving to meet deadlines dominates the learning process. During the development of a software-based game book, the feeling of improving IT related skills is pervasive during the whole implementation process. In contrast, the application of statistics and mathematics, while crucial, occupies only a fraction of the activity time. Consequently, even though there is a certain process of knowledge consolidation occurring, it is perceived to a lesser extent.

Figure 2. frequency distribution of the items related to motivation collected in the developing experience questionnaire

Figure 3, scatter plot of the two motivation items employed in the survey

Motivation, being a highly multifaceted and subjective concept that would require a separate theoretical framework, has been measured in the present study with two questions, as a proxy of the students' level of engagement and satisfaction towards the project.

In order to ensure the accurate identification of motivation, two different metrics were utilized. The histograms in Figure 2, like those previously presented, exhibit a left-skewed distribution, indicating that the majority of participants exhibited high motivation on both questions used for measurement. Figure 3 illustrates that the two metrics are consistent with each other, given that they grow together. A point is denser when multiple observations are present, which can occur because integer values were used in the questionnaire.

The open-ended question in the questionnaire solicited participants to freely identify three positive aspects of their project involvement, aiming to capture their spontaneous perceptions without guiding their responses. The diverse array of responses, indicative of their individual experiences and priorities, is systematically presented in Table 3 and Figure 4.

Table 3: occurrences of the features appearing in the open-ended question of the developing experience questionnaire.

Figure 4: share of the answers in which a feature occurs in the question regarding the positive elements of the developing experience. Given that they were ask up to three features per answer, the sum exceed the unit.

The distribution of positive elements identified by the students, as extracted by researchers from the open-ended responses, follows a Pareto-like pattern. Notably, 75% of the occurrences were concentrated within the first 25% of the categories. This significant clustering indicates a high degree of consensus among students regarding the positive aspects of the project, suggesting that its objectives and benefits were perceived consistently and unambiguously by the majority of participants. This uniformity in perception highlights the project's clear scope and its impact on the students' learning experience.

This further analysis serves a dual purpose: firstly, it corroborates certain findings obtained from the closed-ended questions, thereby reinforcing their validity. Secondly, it unveils additional insights that were not discernible through the closed-ended questions alone.

The confirmatory aspect of the analysis is evident in specific elements: teamwork, coding (representative of IT-related skills), and creativity rank among the top three positions. This alignment strongly reinforces the previously depicted perceptions, with regards with the consistency in participants' views regarding these key aspects of the project experience.

Additionally, the open-ended responses reveal three elements not previously identified in the closed-ended questions.

First, over 20% of the students specifically mentioned the application of disciplinary topics in developing challenges as a positive element. This indicates that while the average perception of specific topic learning was not overwhelmingly strong, a notable minority of students experienced

a significant impact. This divergence suggests variability in how different students perceive and value the integration of theoretical knowledge into practical challenges.

Secondly, the concepts of 'success' (completion and achievement in tasks) and 'challenge' (the difficulty level of the game) emerged from the responses. These elements can be linked to motivation, an aspect not explicitly measured in the closed questions. This finding prompts further investigation into the role of motivation in such projects. Specifically, it raises questions about whether motivation drives student participation in voluntary projects, whether participation in these projects enhances motivation, or if both dynamics coexist. Understanding this interplay is crucial, as it could significantly influence the design and appeal of similar future educational initiatives.

Thirdly, the aspect of critical thinking, though mentioned by only two students, still emerged in the analysis. This suggests that while critical thinking played a role, it was perceived as a less prominent element. Considering the project's primary focus on enhancing creativity rather than direct problem-solving, this outcome aligns with expectations, indicating that critical thinking was not a primary perceived benefit in an ingenuity context.

5.1.2 Playing Experience Questionnaire

The second questionnaire focused on players peer-evaluating each story as players, not as developers. While analyzing story quality is not essential for assessing the learning effects of the design and implementation process, it is informative to determine whether the stories were positively or negatively received, as the quality of the book games produced can cast doubt on the actual development of the targeted skills, regardless of the students' self-reported perceptions. If

the end product is poorly received, it could challenge the notion that the educational objectives were effectively met.

A total of 11 stories were developed, each by a different group of the aforementioned student participants. These stories collectively garnered 86 evaluations, averaging 7.82 evaluations per story. While the gameplay experience was collaborative, the evaluation process was individualized, acknowledging the importance of personal experience and perception in the assessment. Each questionnaire was administered immediately after the completion of each game-story, capturing the immediate, raw responses of the players. This approach had its merits and drawbacks. On the positive side, it ensured that the initial, most impactful impressions were recorded, which is vital in determining if the story's level was perceived as adequately engaging by the students. However, this method introduced an asymmetry in the judgment process; stories played later were evaluated against a benchmark set by earlier stories, which the first stories did not have. Despite this, the emphasis was on capturing the overall impression rather than conducting a rigorous statistical analysis, that the low numerosity of evaluation per story would not permit to conduct anyway.

Table 4: mean and standard deviation of the features identified by the playing experience questionnaire

Figure 5: frequency distribution of the features identified by the playing experience questionnaire

Similar to the previous questionnaire, each story underwent evaluation through a scoring system ranging from 1 to 6, where 1 indicated a very low score and 6 a very high score for specific features of the story.

Figure 5 illustrates the distribution of scores for each specific feature evaluated across the stories, while Table 4 consolidates these results. Importantly, both the chart and the table represent statistics from all 86 evaluations, rather than the mean scores for each individual story.

Observations reveal that the mean distribution score for each feature exceeds 4, indicating a predominantly positive assessment from the students. This suggests that the overall quality of the educational activity's output was, on average, sufficiently high. Additionally, the distributions exhibit a left-skewed tendency across some features, which implies a frequent occurrence of highly-rated plots, writing styles and disciplinary content. This trend potentially confirms that the project effectively fostered students' creativity and their ability to articulate and express generated ideas. Such an outcome highlights the project's role not only in enhancing technical skills but also in developing students' creative and communicative competencies.

Moreover, the high mean value and skewed distribution observed in the disciplinary content evaluations suggest that the specific competences targeted by the project were effectively utilized in developing most of the book game. This indicates that, although not every student may have learned these subjects during the project, they were able to apply them successfully in this context, meaning that there could have consolidate their knowledge regarding them.

Lastly, the notable score in implementation, although the lowest among all categories yet still above 4, corroborates the enhancement of IT skills through the project. Given that Twine was a novel tool for all participants, the high-quality implementation of the book games implies effective learning and skill acquisition. This outcome suggests that the project successfully facilitated the development of new IT competencies among the students, as evidenced by their ability to proficiently use an unfamiliar technology in a practical application.

5.2 Qualitative Analyses

In this section, we present a qualitative analysis of data based on three focus groups conducted with a small portion of students with the aim of corroborating the results of the questionnaires and gaining valuable insights.

Each focus group lasted from 90 to 120 minutes. The first one involved 3 students, the second one involved 4 students and the last one involved 6 students. A moderator (i.e. a researcher) allowed the facilitation of open and uninhibited dialogue (Powell & Single, 1996) throughout all sessions. 12 open-ended questions were designed for the discussion guide, but, where appropriate, the moderator tried to be receptive to relevant issues raised by participants that had not been previously prepared and encouraged equal participation among all members.

This methodology allowed to explore a specific set of issues regarding the participants' views and experiences on the project and to assess their overall satisfaction.

5.2.1 Main Themes Identified

RQ1: How would you evaluate the project experience as a developer?

Nearly all participants stated that developing a gamebook was a positive and interesting educational experience, although it resulted quite complex and challenging, especially because it took place during a very busy exam period and required a lot of time and efforts.

In general, the project itself did not seem to significantly impact the learning of math and statistics, mostly because the challenges included in the game were simple, but it was certainly more useful for computer science since it required learning to use a software from scratch (i.e., Twine).

Moreover, it helped students learn to organize themselves and better manage an intense workload and the group dynamics.

Below are some of the most significant statements:

- *"It was truly a learning experience because it was the first one to be long-term; it taught us how to manage the team and organize the work"*
- *"it was great but it was characterized by many challenges because of the constant changes in progress and the difficulty in turning an idea into practice"*
- *"I would describe it as a challenging experience but one to treasure, especially for future group works"*

RQ2: How would you evaluate the project experience as a player?

The final in-class event where students were asked to play the gamebooks of their peers was found by some of them to be useful as it was seen as an opportunity to compare their work with that of others.

Most participants, however, reported that it could have been handled differently. Two important sub-themes mentioned here were the lack of time and the noise in the classroom, which prevented students from focusing on the stories and giving their peers more reasoned feedback. The challenges of math and statistics presented in the gamebooks emerged to be simple in most cases, and, when not, they were unrelated to the story and therefore less attractive. These different perspectives are presented with the statements below:

- *"We played with a critical eye having also developed a gamebook; it allowed us to make a few more considerations on our project"*

- *"It was not the right place because there was confusion. Also, we had not enough time, so the stories were often read very quickly or even skipped to get to the challenges, which were easy in the end"*

RQ3: Have you enjoyed developing a gamebook?

All but two students enjoyed developing a gamebook, especially because it was an optional project that they voluntarily pursued, as reported in the following lines:

- *"It was interesting to join and successfully complete a university project that was not mandatory"*
- *"It was a creative project that turned out to be very different from those typically developed during the degree program"*

Overall, the part of designing the game played the biggest role in improving the students' motivation rather than simply playing the game, as already highlighted in the literature by Divjac and Tomic (2011). Qualitative analyses also showed that, when investigating the overall satisfaction and commitment to the project, these were related to elements of intrinsic motivation. In most cases, students said they were satisfied with the implementation of the gamebooks because of their interest and curiosity about the nature of the project itself, the challenge to themselves to be able to complete what they had started, and, finally, the sense of self-determination and self-actualization that they had developed along the way.

RQ4: Has your approach and/or interest in the subjects (i.e. statistics, mathematics and computer science) changed? If yes, how?

Everyone agreed on the fact that the project was too short to trigger a change in approach or to increase interest in the subjects involved, especially with regards to mathematics and statistics. A

different argument emerged for computer science, as learning how to use a new software (i.e. Twine) greatly affected students' motivation.

- *"This initiative gave us the opportunity to independently manage a 360-degree information technology project"*
- *"It was really inspiring to understand the language of machines and what is behind them"*

RQ5: Did the project provide you a better understanding of the content of these subjects (i.e. statistics, mathematics and computer science)? If yes, in what way?

With respect to mathematics and statistics, the project did not help consolidate prior knowledge acquired during the year, expect for one student. The challenges related to these two subjects that were included in the game were considered to be simple as they were initially designed for high-school students; on a general basis, they did not require a further review of the courses' program.

With respect to computer science, a somehow different perception emerged among students. Some of them stated that the project allowed to consolidate computer skills related to the use of Python of the previous semester; others perceived Twine as a completely different software, to the point that they talked about acquiring new skills and content.

- *"This project enabled us to bring mathematics and statistics into a more playful and enjoyable context by means of leveraging on information technology, but the challenges had to be easy and therefore resulted not very stimulating"*
- *"Learning how to use Twine was a natural evolution from previous training on Pyton"*
- *"Within this period, I feel I have learned new computer science content"*

RQ6: How was the teamwork experience like and what did it allow you to learn?

Team dynamics proved to be partially positive, in the end. In general, they helped students understand how to manage a collective project and divide tasks according to skills and personal interest. In most cases, they also increased the sense of personal responsibility towards the group, taking away a consistent amount of time from exams preparation. However, some respondents pointed out two major challenges: having to take on the work of others in case of free-riding by one or more team members, and managing the repeated slowdowns due to the re-subdivision of tasks, which came out to be uneven throughout the project due to an initial lack of information.

- *"The group experience was satisfactory despite the moments of disagreement, which always required to discuss in person"*
- *“Group dynamics were sometimes complicated due to the lack of commitment by one of the team members”*
- *“The implementation of the story on Twine, which I initially wanted to take on alone, constituted the bulk of the project and later required a further division of roles”*

RQ7: How do you evaluate the experience of managing a deadline project and what are the major difficulties you have encountered?

The main aspects emerged in this case were the usefulness of the project in terms of good time management and proper organization of the workload, especially considering the exams period, and the difficulties arisen due to the negligence of some individuals in providing their contribution. Some also mentioned that the project supervisors provided useful timing guidelines to manage the workload.

- *“I learned how to manage a project and carry out many things at the same time”*
- *“Several times during the project, I felt like I couldn't make it, but the organization of workload and the timing schedule were crucial to move forward”*

- *"At the beginning, we had some difficulties in dividing the work among us, because there was no communication with a team member"*

RQ8: How difficult was it to choose the disciplinary content for the challenges included in the stories?

According to all participants, choosing the disciplinary content for the challenges and connecting it to the story with meaning proved to be one of the biggest challenges. The eligible topics were limited, also considering that the stories were supposed to be aimed at high-school students. A group started with the story and then tried to insert the challenges, but soon realized that they had to do the opposite: so, starting with the challenges and then building the plot around them.

- *"It was limiting to include challenges that were not decontextualized from the story but, at the same time, were not trivial"*
- *"We had to include similar challenges several time because of the limited repertoire of choices"*

RQ9: Did you enjoy devising the story from scratch and developing it into the form of a gamebook?

Creativity came out to be a central aspect in fueling students' engagement. Most respondents stated that the fact of developing a story from scratch and with few constraints in the plot was of particular interest. Only three students admitted that they were not very inventive and leveraged on a tool of generative artificial intelligence (i.e. Chat GPT and autoGPT) to receive support regarding some critical junctures and the mode of exposure.

- *"It was nice to design different paths throughout the story and give room for creativity, especially in the context of Engineering"*

- *“The part of creativity was not limited to a single individual, as there was a continuous interaction among the team members with plenty of contributions from different sides”*
- *“In developing the plot, Chat GPT helped ground the general idea and refine some issues”*

RQ10: Is there anything else that you feel to have learned from the project and group work that you didn't learn from books or classes?

The only aspect emerged besides the skills mentioned above (i.e. creativity, teamwork, project management and critical thinking) was problem solving. Having to complete one's training independently, especially on the IT side, and to manage a project that had never been done before led to the emergence and management of numerous inconveniences. The nature of the project itself required students to face difficulties with determination as well as try to identify and implement the best solution in each situation.

- *“There were several difficulties during the course of the project that made us slow down the process and required a specific case study, but in the end we always managed to find a solution”*

RQ11: Did you find it difficult to learn how to use Twine and do you think it can be useful now?

Students stated that learning how to use Twine was challenging, not much because of the software interface but more because of the programming logic behind it. At the beginning, a high level of difficulty was perceived, which gradually decreased as time went by, partly with self-training and partly with the support of tutors (i.e. second-year students of the Management

Engineering degree program). Once again, generative artificial intelligence has somewhat helped in setting the right codes for the implementation of the story on Twine.

- *"Chat GPT was not always reliable but it was a good starting point for working on Twine"*
- *"We learned how to set prompts correctly: the way you pose a problem to Chat GPT is very similar to that it will be solved"*

RQ12: Do you have any particular comment or suggestion on the project itself?

When this question was posed to the students, several issues were raised.

The training on Twine was found to be useful by the students because it introduced some elements of diversity from the software they had been using. For this reason, they would have appreciated more hours of training dedicated to this topic.

In contrast, the training part on storytelling was generally perceived not as particularly valuable because, although it was interesting, it was too scattered and complex compared to the practical project. For most students, it would have been more useful to have the story of an already existing gamebook modeled and explained as an example. Some others disagreed, arguing that the added value of the project lied in the autonomous learning and the self-reliance.

- *"More training on Twine would have helped; the rest of the training was a 'learning by doing' process"*
- *"Attending the presentation of similar gamebooks before starting the project would have helped me"*

Another important theme that emerged in this part of the analysis was that of responsibility and self-reliance: students really appreciated being able to do a project with very few constraints. The

freedom and autonomy that characterized the work turned into personal satisfaction once the project was successfully completed.

- *"Freedom and autonomy in the project management represent one of the main strengths, according to me"*

Three critical aspects were also highlighted by respondents. The first aspect is related to time, which many felt to be tight to do the project well, especially considering that there were exam appeals during the months of March, April and May. From their point of view, it would have been useful to have different timelines: set up the work in December in order to start working on it in late January and February, instead of March.

The second aspect concerns the faculty and peer evaluation, as both of them were found to be quite poorly explained at the beginning of the project as well as in the very end.

The last aspect has to do with the purpose of the work, which was not made clear enough at the beginning of the project. Some respondents pointed out that it would have been interesting to put more emphasis on the final output of the project, presenting it to peers in the classroom but especially outside, in high schools. These represent key factors to watch out for in the future, as they may affect students' motivation and engagement.

- *"We are overall satisfied with the work but we could have done better if we had more time"*
- *"Initially, I was attracted by the additional scores obtainable through the project, but in the end, when they fell short of my expectations, I realized that the interest and engagement developed towards it were the most important part"*
- *"I honestly expected the work we did to be more recognized, especially outside, while it seems that it is an end in itself"*

6. DISCUSSION

In Section 3, we outlined the primary objectives of both the research, which we aimed to achieve through the design and implementation of the gamebooks. After summarizing the results of both quantitative and qualitative analyses, it is evident that:

(i) There was a noticeable increase in student involvement and enjoyment in learning through GBL, particularly during the game creation process. The majority of participants exhibited high levels of motivation in both the gamebooks development and play. Elements of intrinsic motivation clearly emerged when investigating the level of satisfaction and commitment to the project through the focus groups, during which students talked about: their interest and passion for the nature of the project; their sense of responsibility and autonomy in managing roles and deadlines; their desire to improve their skills and feel competent in the assigned activities , their challenge to themselves to finish what they started during the exam period, their sense of self-fulfillment, and, finally, their perception that the meaning and purpose of the project went far beyond the extra points on the exam. This underscores the effectiveness of GBL in making learning more engaging, not only playing games, but also developing them. Although some students initially participated for extrinsic motivations, such as additional points towards their final grades, they ultimately found that the interest and engagement they developed were the most rewarding aspects of the project. The students expressed enjoyment in developing a gamebook and highlighted the satisfaction derived from joining and successfully completing a voluntary project that turned out to be quite challenging. Having participated as developers, the game phase of the book did not remain an isolated and decontextualized experience, but it could also serve as a form of peer evaluation for students. In fact, most of the interviewed students emphasized that, during this phase, they

focused not only on completing the story but also on studying the strengths and weaknesses compared to what they themselves had developed.

(ii) Integrating game development with subjects such as Mathematics, Statistics, and Computer Science was intended to allow students to apply their knowledge in a practical, hands-on manner. The results of the "ImpaRa" project suggest that this was more successfully achieved in the IT domain, where students had to learn how to use new software and implement a digital, interactive story on it, with little impact in areas such as mathematics and statistics, due to the little time devoted to embedding disciplinary problems in the story and the simple level of challenges initially planned for high school students. Although the mean perceived impact of specific topic learning was not exceptionally high, a substantial subset of students reported considerable benefits. This heterogeneity in responses indicates variability in how individual learners interpret and value the application of theoretical concepts to practical scenarios.

(iii) Our third objective centered on equipping students with skills essential for real-world challenges, demanded by the current job market. With this regards, teamwork, creativity and communication came out to be three key competencies highly enhanced by the project. These skills are vital in any job environment and our project demonstrated that GBL can be an effective means of developing them, especially when students are engaged as game developers. The team dynamics fostered an understanding of how to manage a group project and allocate tasks based on individual skills and interests, even in stressful situations, as the project was carried out during a period when students had to prepare for their end-of-semester exams. Furthermore, the project effectively fostered students' creativity and their ability to articulate and convey novel ideas. This outcome underscores the project's significance not only in its primary objectives of

fostering students' motivation but also in developing students' creative thinking and communication skills. Critical thinking, still emerged in the analysis, was mentioned only by a few students both in the survey and in the focus groups, this suggesting that it was perceived as a less prominent element. This may be due to the fact that students focused their efforts on the primary focus of the project, which was that of developing and implementing the story, rather than thinking about the best challenges to include within it.

(iv) We aimed to enhance students' proficiency with new technology, especially through learning how to use Twine software. Coding emerged to be one of the most significant constructs in both quantitative and qualitative analyses. The students excelled in the area of IT, mastering not only Twine but also acquiring and consolidating a broader range of technical skills. In fact, their prior knowledge of Python gave them a common language and an important foundation from which to develop more complex skills in Twine and beyond. This success exemplifies the adaptability of GBL in teaching practical, IT-related skills to undergraduate students.

In general, the overall quality of the educational activity's output was perceived to be sufficiently high.

7. LIMITATIONS

The limitations of this study are primarily related to the methodologies adopted.

With regards to the quantitative analyses, the main limitation lies in the smallness of the sample, which makes the results of the analysis not highly meaningful and generalizable. Moreover, as the questionnaire participants were junior members who were invited to take part in the study by their professors or lecturers, they may have felt a certain degree of obligation. Nevertheless, there was no direct communication between the researchers and the participants, thus eliminating the

potential of influencing their responses. The research bias was further reduced first by providing the confidentiality statement, by asking semi-structured open-ended questions and by having another researcher review the data analysis performed by the first researcher, in order to achieve greater objectivity.

With regards to the qualitative analyses, a first limitation of focus groups consists in the potentially self-censoring and conforming influence exerted by the so-called "group effect", whereby participants may follow the “popular trend” and adjust their contributions according to the perceived location in the social expectations of the group (Powell & Single, 1996). Moreover, this methodology could encourage certain types of dominant behaviors by group members that would require a constant control and the eventual intervention by the moderator. Last, it is argued that, compared to other types of qualitative methods (i.e. in-depth interviews), focus groups may appear superficial, generating only surface information (Powell & Single, 1996). On the other hand, leveraging explicitly on group interaction (Kitzinger, 1994), focus groups offer the advantage of uncovering the complete spectrum of perspectives held by participants and empower them to enhance their contributions in response to points raised by others, thereby expanding on ideas that might remain underdeveloped in one-on-one interviews (Powell & Single, 1996).

A further limitation is related to the construct of motivation developed for the purpose of this study. GBL is known in the literature to increase the level of intrinsic motivation and this construct has often been measured through the adoption of appropriate and extensive theoretical frameworks, such as the ARCS Motivational Model (Jääskä, Lehtinen, Kujala, & Kauppila, 2022; Camacho-Sánchez et al., 2023; Ghani et al., 2024). Due to the fact that the objectives of this study were multiple (i, ii, iii, iv) and motivation was only one of them, it would have been problematic to administer a questionnaire to the students that was long and articulated enough to incorporate

the ARCS motivational model or a similar framework. The two questions formulated in the survey to measure the students' overall engagement and satisfaction with the project resulted in a proxy for motivation that was then further explored during the qualitative interview. Otherwise, future studies should conduct two separate analyses, one related to motivation, which requires a separate framework, and one related to the other objectives mentioned above (consolidation of prior knowledge, cultivation of higher-order skills, and development of new technical skills) that emerged from the literature review.

Another limitation of different nature concerns the learning outcomes we expected to achieve from the project, particularly for the courses of Mathematics and Statistics. As seen also from the results of the questionnaire analysis and from what has emerged in the focus group discussions, the students did not perceive a particular advancement in their knowledge of the mentioned subjects, for different reasons. Firstly, at the beginning of the project, the target audience for the gamebook players was set to high school students. For this reason, the student developers kept the level of challenges in the gamebooks relatively low, which did not allow them to sufficiently deepen their mathematical and statistical knowledge. However, it is easily understandable that, had the final target been different, it would have been particularly complicated for the student developers to include challenges that contained particularly advanced content of math or statistics. This would indeed have forced them to use part of the project development time to independently explore in depth some topics and understand how to possibly integrate them into the storytelling. As such, it would have been complicated, also because of the limited time available for the development of the project. Nonetheless, it would be very interesting, in a learning-by-doing approach, to give students the opportunity to learn new things during the process of game development. The same consideration can also be made for the student-player. The results highlighted that, in playing the books developed by their colleagues, the students

encountered a rather low level of mathematical-statistical challenges, and probably not very engaging. To provide the player with an experience that is truly relevant and satisfying, it would be desirable to include challenges pushing the player to seek new knowledge, in a context of critical thinking, problem-solving, and personal satisfaction for the results achieved even autonomously.

8. FUTURE RESEARCH

The results of the questionnaires and group discussions, although limited in the number of participants, highlighted some critical issues that could be improved in the future and some aspects that should be investigated more thoroughly.

Firstly, it becomes evident that a project of this type requires a significant amount of development time, especially when engaging the student as a game developer. The time provided must be sufficient for two main activities. Initially, it should allow the student to learn the use of the Twine software at least at a basic, consolidated level. More advanced skills will be acquired along the project development in a relatively spontaneous process of learning by doing.

Secondly, it would enable the student developers to better explore the narrative structure of the story and include mathematical-statistical challenges of a more advanced level. To do so, the students have to deepen their knowledge independently and understand how it can be integrated into the story, without being trivial or obvious. In this way the learning process could be really enhanced.

For these reasons, a second edition of the “ImpaRa” project could be envisaged, which would develop over the entire academic year and not just a few months, allowing for greater participation of the students. Indeed, proposing the project towards the end of the year had a somewhat distorting effect, resulting in participation mainly from students who felt already prepared and more confident, and were already motivated. Students who may have encountered

difficulties during the year preferred to focus on studying and preparing for the final exams. Yet, this type of learning process could particularly help students who face some challenges, even placing them in a group work context that could help them create positive relationships, which could serve them not only in completing the specific project, but generally as support and motivation for learning throughout the year.

Last but not least, data collection could also be more systematic and comprehensive, focusing on different phases of the book's development, with the administration of ad-hoc questionnaires and the possibility of more feedbacks from the researchers overseeing the project. The sample would be larger and less biased, ensuring a more robust final analysis, especially regarding the expected learning outcomes.

9. CONCLUSIONS

The body of literature analysed in section 2 consistently highlighted the effectiveness of GBL in enhancing student engagement and deepening their understanding of complex concepts. This aligns seamlessly with the findings from our “ImpaRa” project, where we observed a notable increase in student involvement and enthusiasm towards the subjects when engaged through gamebooks. This practical experience reinforces the theoretical framework suggesting that GBL not only captivates students' attention but also fosters an immersive learning environment. Furthermore, studies indicated that GBL could act as a catalyst for intrinsic motivation, leading to a more self-directed learning approach. In “ImpaRa”, students also demonstrated a proactive attitude in problem-solving and critical thinking tasks, supporting the notion that GBL can effectively translate theoretical motivation into tangible learner autonomy and engagement.

This correlation between the literature and our empirical observations underlines the potential of GBL as a transformative tool in modern education, bridging the gap between theoretical understanding and practical application.

The enhancement of 21st-century skills through GBL finds concrete evidence in the outcomes of our project. In “ImpaRa”, we observed significant improvement in students' project management, teamwork, and IT skills.

Our findings contribute to the growing body of evidence suggesting that GBL is not only effective in theoretical knowledge acquisition but also crucial in acquiring practical skills necessary for the modern job environment.

10. STATEMENTS & DECLARATIONS

Ethical Considerations:

This study did not require formal ethical approval.

Consent to Participate:

All authors confirm their consent to participate in the development and submission of this manuscript.

Consent for Publication:

All authors consent to the publication of this manuscript in the Journal of Management Education.

Declaration of Conflicting Interests:

The authors declare that there are no potential conflicts of interest with respect to the research, authorship, or publication of this article.

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The authors confirm that the data supporting the findings of this study are available upon request.

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Appendix A

Table 1: six-point scale for item evaluation

Score	Meaning
1	Very low
2	Low
3	Lower than high
4	Higher than low
5	High
6	Very high

Table 2: mean and standard deviation of the items collected in the developing experience questionnaire

Item	**Mean**	**Std Dev**
Critical Thinking	4.28	1.03
Creativity	3.69	1.20
Team work	4.82	1.25
Project management	4.61	0.96
Statistics	3.79	1.18
Mathematics	3.48	1.02
IT related skills	4.45	0.91
Motivation 1	4.83	0.76
Motivation 2	5.17	1.00

Table 3: occurrences of the features appearing in the open-ended question of the developing experience questionnaire

Feature	**# occurrences**
Teamwork	19
Coding	13
Creativity	12
Application of topics	7
Challenge	3
Project management	2
Success	2
Problem -olving	2
Writing	2
Use of AI	1
Support	1
Setting	1
Innovation	1
Variety	1
Interactivity	1

Table 4: mean and standard deviation of the features identified by the playing experience questionnaire

	Mean	Std
Written style	4.62	0.59
Story	4.56	0.54
Disciplinary contents	4.41	0.84
Implementation	4.23	0.73
Overall	*4.56*	*0.44*

Figure 6: frequency distribution of the items collected in the developing experience questionnaire

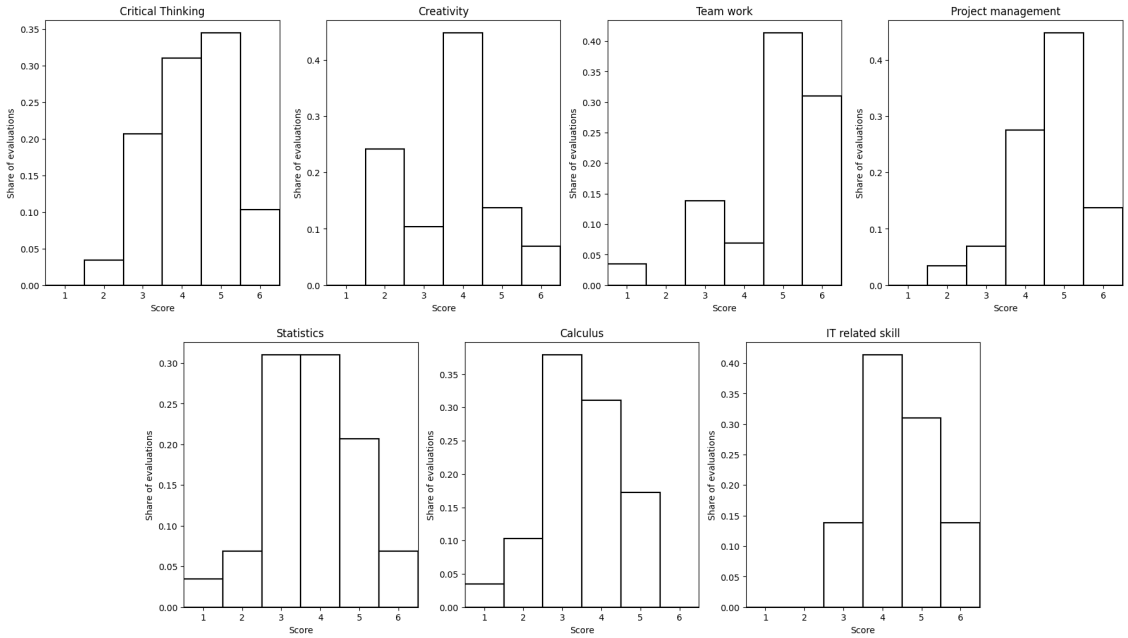

Figure 7: frequency distribution of the items related to motivation collected in the developing experience questionnaire

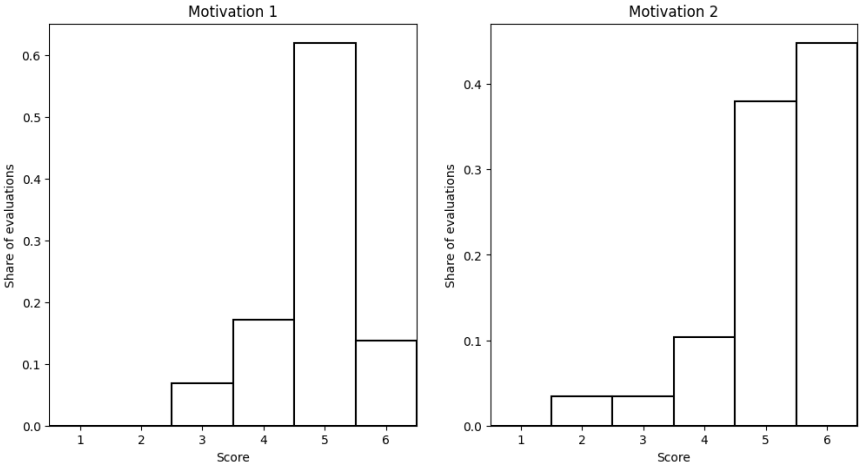

Figure 8: scatter plot of the two motivation items employed in the survey

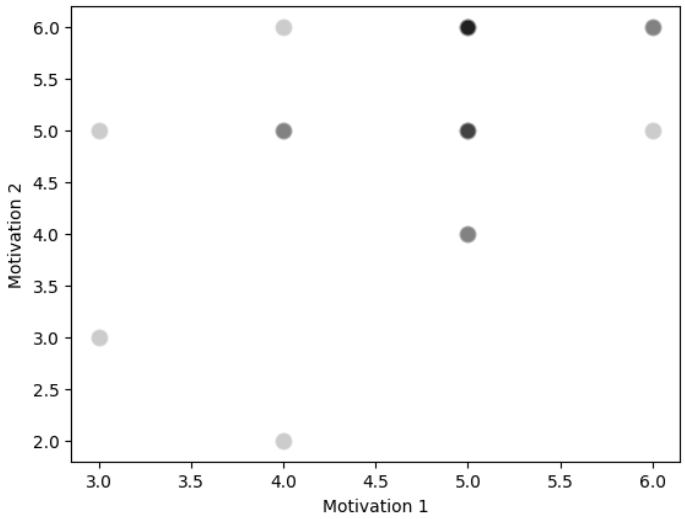

Figure 9: share of the answers in which a feature occurs in the question regarding the positive elements of the developing experience. Given that they were ask up to three features per answer, the sum exceed the unit.

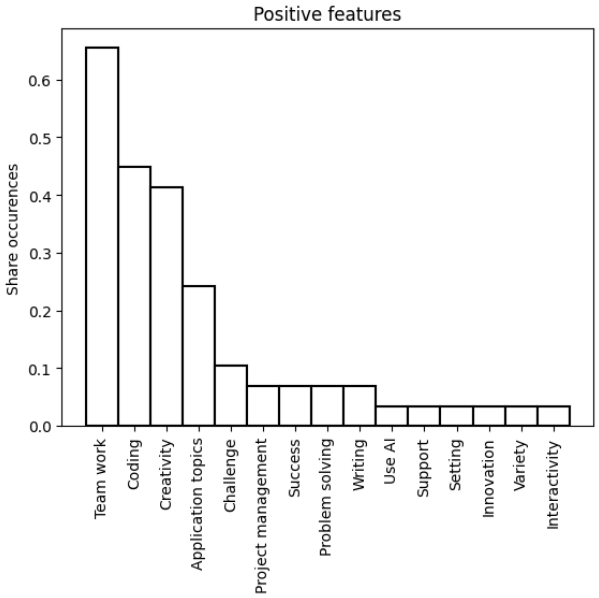

Figure 10: frequency distribution of the features identified by the playing experience questionnaire