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RESEARCH ARTICLE

Ball Point Game: Playing or Learning Agile Project Management?

MARIA LYDIA FIORAVANTI[1,2], GUSTAVO M. N. AVELLAR[1], BRUNA OLIVEIRA ROMEIRO[1], BRUNA GONÇALVES REZENDE[3], ELLEN FRANCINE BARBOSA[1], AND ANA M. MORENO[2]

[1]ICMC, University of São Paulo (USP), São Carlos 13566-590, Brazil
[2]ETSI Informáticos, Universidad Politécnica de Madrid (UPM), 28660 Madrid, Spain
[3]Mercado Livre Brasil, Osasco 06233-903, Brazil

Corresponding author: Maria Lydia Fioravanti (mlfioravanti@usp.br; ml.fioravanti@alumnos.upm.es)

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ABSTRACT Agile project management has become essential in modern enterprises, particularly in the software industry, due to its flexibility and adaptability. This paper presents an empirical evaluation of the Ball Point Game (BPG), a non-digital serious game designed to teach Agile project management principles. The evaluation is based on three case studies conducted with undergraduate students at the University of São Paulo, aiming to explore the following aspects: ability to compare traditional methods and Agile methods; educational effectiveness, particularly regarding player experience and perceived learning; and skills development or improvement. The results indicate that the BPG effectively allows students to properly understand the pros and cons of Agile methodologies, fosters essential project management skills, and provides a positive and engaging learning experience. The BPG proved to be an effective tool for experiential learning by allowing students to go through all stages of the experiential learning cycle. This approach not only made learning more engaging, but also helped students develop essential skills for Agile project management. The study highlights the potential of educational games to bridge the gap between theoretical knowledge and hands-on activities, making them valuable tools in Agile management education. Our work has as novel element the integration of both game-based learning and experience-based learning approaches to teach Agile project management.

INDEX TERMS Agile management education, Agile project management, case study, educational game, empirical evaluation, experiential learning, skill development, software engineering education.

I. INTRODUCTION

Projects are crucial in modern enterprises, serving as a primary means to generate value and benefits for organizations. In the current business landscape, leaders must navigate challenges such as tighter budgets, shorter timelines, resource constraints, and rapidly evolving technology [1]. As defined by the PMBOK® Guide, a project is a temporary effort aimed at producing a unique product, service or result. Consequently, project management involves applying knowledge, skills, tools and techniques to project activities to meet project requirements [1]. Project management is achieved by properly applying and integrating the project management processes identified for a given project, allowing organizations to execute projects both effectively and efficiently.

In a growing number of industries, project-based systems are supplementing or even replacing traditional functional

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and divisional organizational structures [2]. The Project Management Institute (PMI) estimated the creation of 15.7 million new project management roles between 2010 and 2020 [3]. As project management assumes a more central role in project execution, effective education and talent development for project managers are essential to maintain organizational competitiveness [4].

In the software industry, project management is a critical success factor. Jones [5] analyzed the software project management practices of 250 large projects from 1995 to 2004. He found that successful projects, which met their cost and schedule estimates, excelled in six areas: project planning, cost estimation, measurements, milestone tracking, change control, and quality control. In contrast, projects that were delayed, over budget, or canceled often struggled in these same areas. In particular, Jones [5] highlighted that these issues were related to project management rather than technical staff. In this context, the relevance of software project management stands out.

Particularly in the software industry, project management is one of the key factors. Jones [5] analyzed software project management practices of 250 large software projects between 1995 and 2004. When comparing large projects that successfully achieved their cost and schedule estimates against those that ran late, were over budget, or were canceled without completion, six common problems were observed: poor project planning, poor cost estimating, poor measurements, poor milestone tracking, poor change control, and poor quality control. By contrast, successful software projects tended to be better than average in all six of these areas. Jones points out that the most interesting aspect of these six problem areas is that all are associated with project management rather than with technical personnel.

Despite efforts to address the challenges of software development, traditional approaches have introduced new difficulties due to their excessive formality and bureaucracy [6], [7], [8], [9], [10]. Their lack of flexibility has made it difficult to respond quickly and effectively to the constant changes imposed by rapidly changing markets [6], [7], [8], [9], [10]. In response to this scenario, approaches emerged in the early 1990s that became known as Agile methodologies. In short, Agile methodologies have been consolidated as a response to the problems faced with traditional models of software development and software project management [11].

With the emergence of Agile methodologies, the term Agile project management (APM) also emerged. In this context, APM is a new approach to project management, especially for innovative projects developed in contexts subject to constant change and permeated by uncertainties, where it is difficult to start from a well-defined initial scope [12]. This fact implies the tendency of traditional project management models to fail because they are not suitable for this type of environment [6], [12], [13], [14], [15].

Although the importance of teaching APM is widely recognized, both teaching and learning present significant challenges, particularly in a university setting. Effectively teaching any subject is a complex task on its own. Theory and practice disconnection can discourage students, highlighting the need for education to be more closely integrated with real-world scenarios [16]. To address this gap, various resources and methods have been proposed and implemented to enhance the learning and teaching experience in computing courses.

Experiential learning (EL) is seen as a valuable approach to address the challenges in APM education. Broadly, experiential learning is defined as learning that emerges from exploration, hands-on experience, creativity, discovery, and interaction with the world [17]. Educational games have also been used to improve project management education [18], [19], [20]. Serious games [21], [22], [23], in turn, have been used as a training strategy. In particular, some authors [24], [25] have adopted a non-digital serious game entitled Ball Point Game (BPG) to teach Agile project management.

Nevertheless, the literature still lacks of studies regarding educational games considering the use of experiential learning in the context of Agile management education. Aiming to bridge this gap, our work intends to be a step forward in this direction by showing the learners can go through all the stages of EL by playing BPG, therefore, learning and fostering skills. Therefore, the goal of this research is to investigate if by playing BPG, students are merely playing a non-digital game or actually learning APM and fostering skills. To do so, we conducted an empirical evaluation aiming to investigate the following aspects:

- ability to compare traditional and Agile methods,
- educational effectiveness, particularly regarding player experience and perceived learning; and
- skills development or improvement.

The remainder of the paper is structured as follows. Section II presents the related work. Section III details the non-digital serious game adopted. Section IV presents the design of the empirical evaluation. The findings drawn from this investigation are presented and discussed in Section V. Finally, conclusions and directions for future work are provided in Section VI.

II. RELATED WORK

Agile project management education has become more widespread recently, because of its focus on flexibility, adaptability, and customer satisfaction. Academic institutions have responded by incorporating Agile principles and methodologies into their curriculum. Agile management is typically taught through a combination of theoretical concepts and practical application [26]. This approach ensures that learners not only understand the underlying principles but can also effectively implement them in real-world scenarios.

Instructional strategies, such as educational games, have risen due to the need to provide more hands-on opportunities [27]. According Brown and Vaughan [28], playing is not merely joyful and invigorating; it is profoundly integral to human development and intelligence. Therefore, educational games are crafted to provide an enjoyable and secure setting where students can experiment with different approaches, observe the outcomes, and learn from their mistakes [29], [30]. Dempsey et al. [31] characterize an educational game as a teaching approach that generally entails competition and is structured by specific rules and limitations aimed at fulfilling a particular educational objective. Educational games serve not only as a source of enjoyment but are also crafted to educate individuals on specific topics, enhance and refresh their understanding, support personal growth, or help them practice a skill while fostering a shift in perspective through game-play [30], [31].

Integrating Agile methodologies and game-based learning within educational settings shows promising results in enhancing student engagement, project management skills, and the application of theoretical knowledge to real-world scenarios [18], [19], [20], [21]. Specialized tools like *ScrumBoard* [18] further support these endeavors by facilitating project management and providing valuable data to assess student performance and understanding of Agile principles.

Experiential learning has also been investigated in Agile project management education. Hefley and Thouin [32] evaluate the use of experiential learning to teach Scrum and Agile in a setting where students used a simulation-based Agile project management training exercise as a key component of their learning activities. Datta [33] also used experiential learning in an Agile software development course with the aim of giving students industry/real-life experience while still at university.

However, the literature still lacks studies that teach APM integrating both the experiential learning approach and the educational games approach. Thus, our work has as a novel element the integration of both game-based learning and experience-based learning approaches to teach Agile. The novelty lies in the fact that, unlike other similar works, we adopted a serious game and indicated for each event of the activity how it is correlated to the experiential learning theory.

III. BALL POINT GAME

The Ball Point Game (or Ball Flow Game), developed by Boris Gloger in 2008, was designed to teach Agile software development and project management methodologies [34]. As a tech consultant, Gloger aimed to demonstrate to tech professionals the advantages of APM techniques compared to the traditional Waterfall/Linear approach. In this context, Calderón et al. describe this game a non-digital serious game designed to demonstrate the dynamics of a team working iteratively with a focus on continuous improvement [24]. According to Roberto [25], Gloger also focused on helping software teams practice self-organization, as the game provides an excellent opportunity to introduce individuals to fundamental Agile principles and values in an engaging and immersive way. The Agile principles are the following.

- **Self-organization**: How the team independently makes decisions to optimize their work, without external managerial control.
- **Adapt & Inspect**: How the team regularly steps back to reflect during retrospectives, aiming to continuously improve their work.
- **Time-boxed, incremental delivery**: How the team estimates, plans, and improves quality iteratively.
- **Agile ceremonies**: Familiarize with *Sprint*, *Retrospective*, *Planning*, and *Estimation*.
- **Improvement**: How quickly the team achieves success.

The game emulates an Agile production process, essentially mirroring the Scrum framework. The team self-organizes and develops a process based on the rules provided. The primary objective is to pass as many balls as possible within the given time-boxes, following the established rules.

The resources to play the game are: a room with no obstacles large enough so all participants can move around freely, a flip chart/board with a score table, a stopwatch, and lots of ping-pong balls. Ideally, teams should have at least 6 or 7 participants. According to Gloger, to score a point, the rules are the following [34]:

- Each ball must have air-time.
- Each ball must be touched at least once by each team member.
- Balls cannot be passed to your direct neighbor to your immediate left or right.
- Each ball must return to the same person who introduced it into the system.
- There are a total of five iterations.

The game is conducted in four stages after the game leader had set up the game:

- **Estimation meeting:** The players of the team should organize themselves according to the rules, decide if they have a leader or not, and design their system. They should also estimate the number of points they will score. This estimate should be registered on the Score Card (Figure 1), in the field *Forecast*. The time for this stage is defined by the game leader (usually between 1 and 3 minutes).
- **Iteration:** Throughout the iteration period, the team should focus on score as many points as they can, i.e., operate the system they previously designed, following the rules explained. The game leader is responsible for ensuring the teams respect the rules and controlling the time. The time for this stage is usually between 2 and 4 minutes.
- **Improvement meeting:** After each iteration, the number of points scored must be registered on the Score Card in the field *Actual*. Teams should also use this time to review and retrospect, similarly to Scrum, in order to

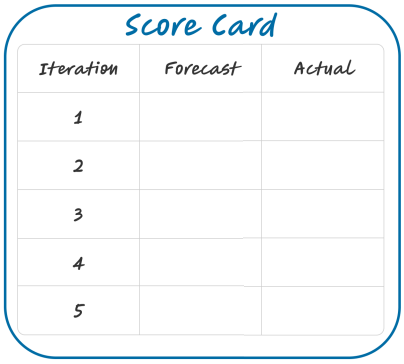

FIGURE 1. Ball point game - score card.

improve the next iteration. At the end of 5 iterations, the team that scored the most points is the winner.

- **Debriefing:** Following the announcement of the winner, the game leader and instructors should organize the debriefing session asking questions and discussing concepts with the students. Some possible questions for the debrief could be [34]:
  - What did you learn from the game?
  - How did the team make decisions?
  - How would things have gone differently if the team had an appointed leader?
  - How important were the retrospectives?
  - Would the results have been better with more time allocated to planning and less time devoted to action?
  - How did you feel when we changed the rules?
  - What team dynamics did you experience?

  Allow ample time to thoroughly discuss the learnings and observations.

However, for teams to experience what actually happens during an Agile software project, the recommendation is that the game leader change some rules mid-game; for instance, a team member shall be removed in the middle of the iteration, emulating that a member got sick or got fired. Another possibility is that the game leader can request changes during the round, such as adding or removing balls, representing change requests in software development projects. There are several possible variants, and the game leader can adopt them accordingly.

IV. METHOD

To conduct the evaluation efficiently and without disruption, a case study design was selected, allowing in-depth research. Yin [35] defines a case study as "*an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident*". Case studies yield research results from real-world projects that would be challenging to obtain through other research methods [36].

The evaluation consists of three distinct case studies, labeled CS_1, CS_2, and CS_3 designed for undergraduate students who played the BPG. As discussed in Section I, the aim of this research is to explore whether by playing the BPG, students are merely playing a non-digital game or actually learning APM and fostering skills. To do so, we split this research goal into three research questions (RQs).

- **RQ1**: Can students compare the Agile approach with the Waterfall methodology through the use of an educational game?
- **RQ2**: What is the educational effectiveness regarding player experience and perceived learning when viewed from the students' standpoint?
- **RQ3**: Can students foster skills through playing an educational game?

Based on Yin's definition [35] and the guidelines provided by Runeson and Höst [37], we categorize this case study as explanatory [35]. For that reason, the research design for the case studies CS_1, CS_2 and CS_3 follows the guidelines proposed by Runeson et al. [36].

A. CASE AND SUBJECT SELECTION

A case represents a contemporary phenomenon within its real-life context [35]. In this study, three cases (that is, course activities) were carried out at the University of São Paulo.

For our study, we recruited students in three different courses from the Bachelor's Degree in Information Systems. The students who participated in this study were enrolled in undergrad courses entitled *Software Engineering* and *Software Development Methodologies*, both of which included topics on Agile software project management.

CS_1 was conducted in the *Software Engineering* course, involving a sample of $n_1 = 46$ participants. CS_2 and CS_3 took place in a *Software Development Methodologies* course, with $n_2 = 41$ and $n_3 = 31$ students, respectively.

B. DATA COLLECTION INSTRUMENTS

A questionnaire is a specialized instrument comprising a series of questions intended to collect information or data from individuals or groups. It is a structured tool designed to systematically and uniformly gather responses. Questionnaires may include [38]: (i) descriptive questions to collect demographic information; (ii) attitudinal questions aimed at eliciting the respondents' attitudes and opinions; and (iii) behavioral questions to evaluate differences or changes in respondents' behaviors.

1) CASE STUDY 1

In CS_1, we adopted a pre- and post-game questionnaire strategy. The pre-game questionnaire aimed to characterize students from the point of view of knowledge in APM. Therefore, the questions listed in Table 1 were asked.

TABLE 1. Pre-game questionnaire.

Question	Type
(1) Do you know Agile methods?	Yes/No
(2) Have you ever used Agile methods?	Yes/No
(3) What problems are typically found in traditional software development models (Waterfall, RUP, ...)?	Open
(4) Can Agile methods minimize or solve such problems?	Likert scale
(5) How?	Follow up

The post-game questionnaire aimed to gather the students' perspective on their experience playing the game, particularly regarding the concepts of Agile project management. Therefore, the questions listed in Table 2 were asked.

TABLE 2. Post-game questionnaire.

Question	Type
(1) Did adopting an Agile method help the team?	Yes/No
(2) If so, in what aspects?	Multiple choice
(3) If not, please list which aspects harmed the team.	Follow up
(4) Which problem(s) occurred during the game?	Multiple choice
(5) Which skill(s) were needed to mitigate the issues?	Multiple choice
(6) Can Agile methods be used in all types of software projects?	Yes/No
(7) Justify briefly.	Follow up
(8) Do Agile methods really increase team productivity?	Likert scale

Such questionnaires were paper-based, leading students to skip some questions, particularly open-ended ones. Therefore, CS_1 should be considered primarily a feasibility study, although its findings offer valuable results, as outlined in Section V.

2) CASE STUDIES 2 AND 3

Considering the lessons learned from CS_1, we chose to adopt an already validated instrument in the conduction of case studies CS_2 and CS_3. Among the options available in the literature, we used the MEEGA+ model questionnaire [39]. The MEEGA+ model is designed to evaluate educational games, focusing on assessing their quality from the students' perspective [39]. The model includes a validated questionnaire with 35 items that must be answered by students only once after playing the game. Responses are given according to a five-point Likert scale, which allows them to be normalized to a score from zero to 100 for analysis and comparisons. The items in the model are categorized into nine different dimensions [39]: usability, confidence, challenge, satisfaction, social interaction, fun, focused attention, relevance, and perceived learning. Considering that MEEGA+ model has items aimed at digital games and non-digital games, and following the guidelines from the model's authors, the questionnaire for this study was adapted from 35 to 28 items (Table 3). Therefore, certain items from the usability dimension were removed, such as items about aesthetics, accessibility, and protection against user errors, which are not applicable in the context of non-digital games.

TABLE 3. Questionnaire used in case studies CS_2 and CS_3 (Petri et al. [39]).

Dimension	Item #	Description
Usability	3	I needed to learn a few things before I could play the game
	4	Learning to play this game was easy for me
	5	I think that most people would learn to play this game very quickly
	6	I think that the game is easy to play
	7	The game rules are clear and easy to understand
Confidence	13	When I first looked at the game, I had the impression that it would be easy for me
	14	The contents and structure helped me to become confident that I would learn with this game
Challenge	15	This game is appropriately challenging for me
	16	The game provides new challenges (offers new obstacles, situations or variations) at an appropriate pace
	17	The game does not become monotonous as it progresses (repetitive or boring tasks).
Satisfaction	18	Completing the game tasks gave me a satisfying feeling of accomplishment
	19	It is due to my personal effort that I managed to advance in the game
	20	I feel satisfied with the things that I learned from the game
	21	I would recommend this game to my colleagues
Social Interaction	22	I was able to interact with other players during the game
	23	The game promotes cooperation and/or competition among the players
	24	I felt good interacting with other players during the game
Fun	25	I had fun with the game
	26	Something happened during the game (game elements, competition, etc.) which made me smile
Focused Attention	27	There was something interesting at the beginning of the game that captured my attention
	28	I was so involved in my gaming task that I lost track of time
	29	I forgot about my immediate surroundings while playing this game
Relevance	30	The game contents are relevant to my interests
	31	It is clear to me how the contents of the game are related to the course
	32	This game is an adequate teaching method for this course
	33	I prefer learning with this game to learning through other ways (e.g. other teaching methods)
Perceived Learning	34	The game contributed to my learning in this course
	35	The game allowed for efficient learning compared with other activities in the course

Aiming to assess the students' ability to reflect on the skills they developed or improved during the game and on the problems faced, we asked them some additional questions. In CS_2, we asked all the questions shown in Table 2. However, off the record, students commented that the questionnaire was too long. For CS_3, we chose to keep only questions 4 and 5 from Table 2. These questions were included with the aim of assessing students' ability to reflect on the skills they fostered during the game and on the problems that arose. In the first question, students received a list of soft skills for software project managers (extracted from

Fioravanti et al. [40]), from which they marked which skills they believed they had exercised during the activities. The skills options included, for example, communication, conflict resolution, and decision making. The second question aimed to verify whether students were able to identify and reflect on common problems that arise in projects, such as decision-making, changes, and estimation. To this end, a list of problems was provided, and students were asked to mark as many options as they considered relevant.

C. DATA ANALYSIS

The data gathered using the MEEGA+ questionnaire are examined by looking at frequency distribution (illustrated with bar graphs) and central tendency (represented by median) for each dimension.The MEEGA+ model [39] offers a spreadsheet to analyze the collected data, aiding in the organization of information and the automatic creation of graphs that visualize evaluation results.

The remaining data were analyzed using descriptive statistics. For the open-ended questions, we employed certain Grounded Theory procedures [41] to examine the comments of the students. Specifically, we used *open coding* to identify concepts by breaking them down into discrete parts for analysis, and *axial coding* to explore connections among codes and group them based on their similarities.

D. THREATS TO VALIDITY

We assess the potential threats to the validity of this case study in accordance with the guidelines established by Runeson and Höst [37]. It is important to note that this research does not investigate causality, and therefore *internal validity* is not considered.

Construct validity indicates the degree to which the research questions align with the operational measures being studied [37]. A potential threat is whether the collected data can adequately address research questions. To mitigate this threat, we iteratively refined both the research questions and the data collection strategies used in this study.

External validity relates to the generalizability of the findings [37]. This case study involved undergraduate students from the Bachelor's Degree in Information Systems at the University of São Paulo. There is a risk that the findings may not be applicable to other contexts (e.g., different undergraduate programs, graduate programs, or industry settings). However, replicating this case study can help mitigate this risk.

Reliability concerns whether the study would produce the same results if replicated by other researchers [37]. To minimize personal bias, the case study protocol was reviewed and discussed iteratively by the authors. Another potential threat is the reliability of the instrument used. The reliability and internal consistency of the MEEGA+ questionnaire were ensured using Cronbach's Alpha [42]. Petri [42] analyzed the standardized items of the MEEGA+ measurement instrument, finding an excellent Cronbach's alpha value ($\alpha = 0.927$). Petri also assessed the reliability when the items were tailored to evaluate an educational game, and the Cronbach's alpha was similarly excellent in this case ($\alpha = 0.953$).

V. FINDINGS

A. RESULTS

Most of the students in CS_1 (89%) reported being familiar with Agile methodologies, and 54% had previously used them in some context. In CS_2, these figures were 73% and 22%, respectively. This difference may be attributed to the stage of the undergraduate program they were in, as CS_1 primarily consisted of 4th-year students, while CS_2 was conducted with the majority of first-year students.

When asked about common issues in traditional software development models like Waterfall, students primarily identified five problems (Figure 2): (i) Unresponsiveness to changes; (ii) Delayed delivery; (iii) Emphasis on deliverables, documentation and completion; (iv) Communication; and (v) Limited customer involvement.

Conversely, when asked how Agile methods could address these issues, the students emphasized five key aspects: (Figure 3): (i) Sprints; (ii) Customer cooperation; (iii) Responsiveness to changes; (iv) Working software; and (v) Continuous delivery.

When asked if adopting an Agile method helped the team, the majority of students in both CS_1 (96%) and CS_2 (98%) responded affirmatively. Students in both case studies positively evaluated the adoption of Agile methods during the activity, noting improvements in organization, team integration, faster deliveries, and motivation. Furthermore, all students (48%) partially or completely (52%) agreed that the method significantly boosts team productivity. However, 59% of the students still believe that Agile cannot be applied to all types of software projects.

We also sought to identify any issues that emerged during the game (Figure 4). Students from CS_1, CS_2, and CS_3 pointed out the following: (i) Change; (ii) Estimate; (iii) Adequacy to customer needs; (iv) Late viewing; and (v) Customer involvement.

Concerning the skills required to address these issues (Figure 5), the students identified: (i) Communication; (ii) Teamwork; (iii) Decision-making; (iv) Creative thinking; and (v) Problem solving.

Regarding the results obtained from the MEEGA+ questionnaire, we analyzed the data using descriptive statistics, focusing on frequency distribution and central tendency to address the research questions outlined in the research method. The frequency of the responses was identified on a 5-point Likert scale, ranging from -2 (complete disagreement) to 2 (complete agreement).

Figure 6 depicts the cumulative results gathered in CS_2 and CS_3. Data collected from these case studies were combined into a single sample, allowing a cumulative summary of empirical evidence. This grouping was feasible due to the

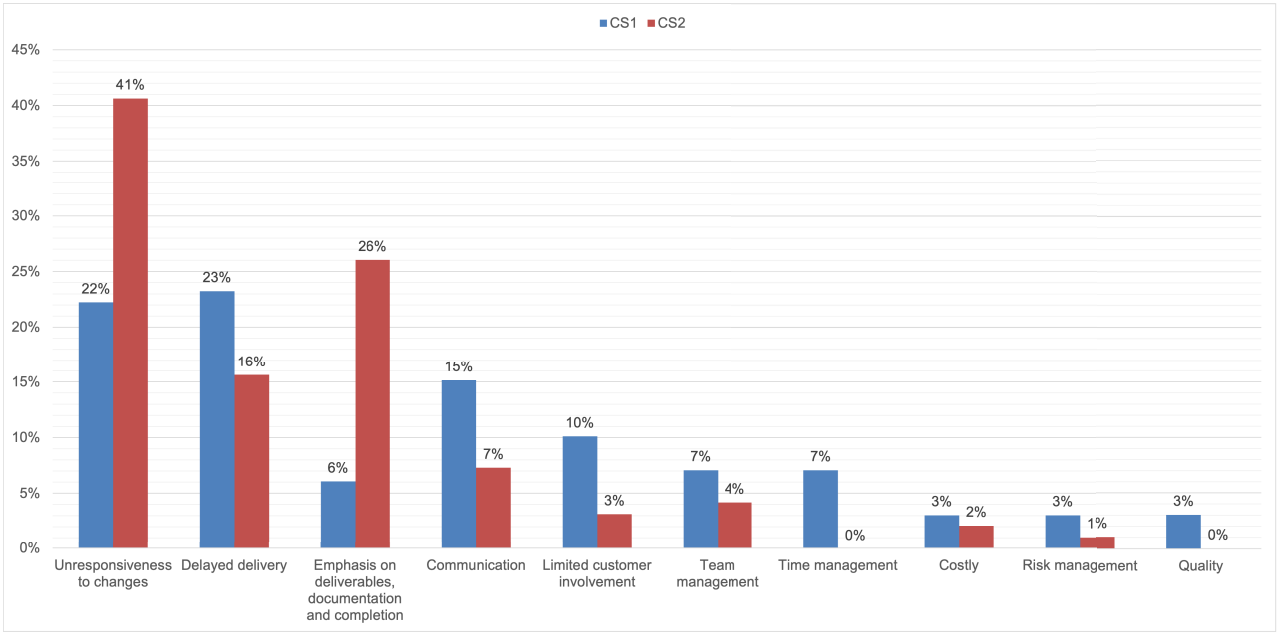

FIGURE 2. What problems are typically found in traditional software development models (Waterfall, RUP, ...)?.

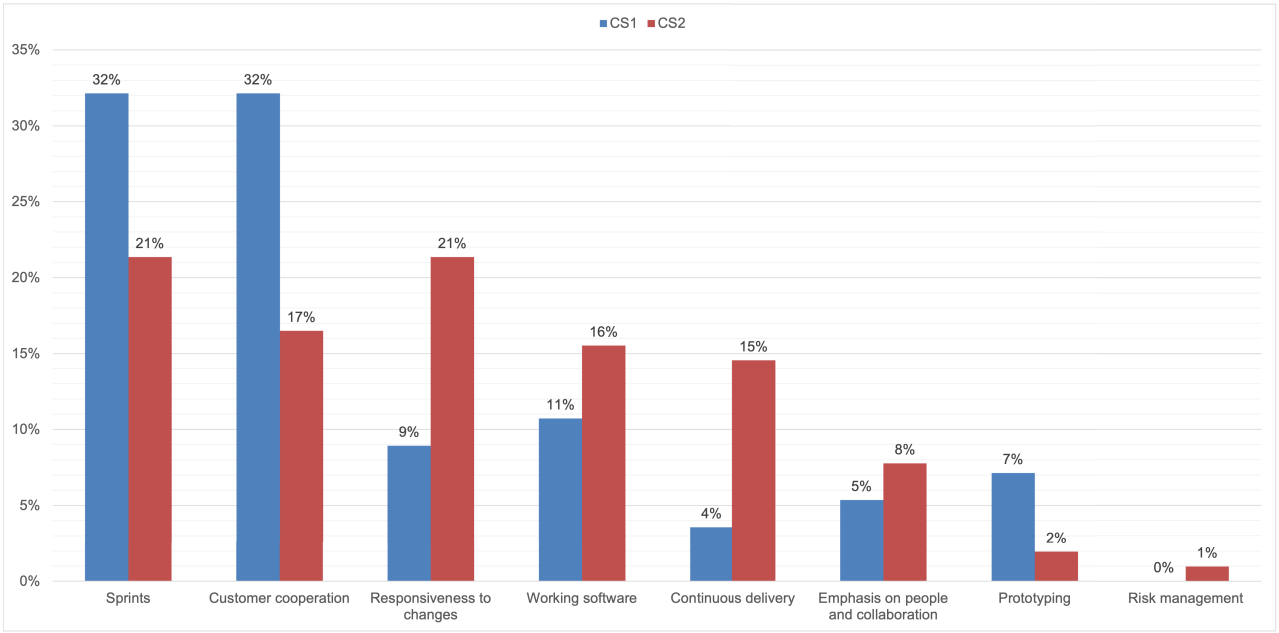

FIGURE 3. How can Agile methods minimize or solve such problems?.

similarity of the selected case studies and the standardization of the data collection methods. However, individual results from CS_2 and CS_3 are also shown.

B. DISCUSSION

This section contains a discussion of the RQs addressed in the research based on the results shown in Section V-A.

1) RQ1: CAN STUDENTS COMPARE THE AGILE APPROACH WITH THE WATERFALL METHODOLOGY THROUGH THE USE OF AN EDUCATIONAL GAME?

To address RQ1, we examined the students' prior knowledge of Agile methods and their perspectives on the game-playing experience, particularly concerning APM concepts. Despite not having direct experience with an Agile environment, their solid understanding of the Waterfall model allowed them

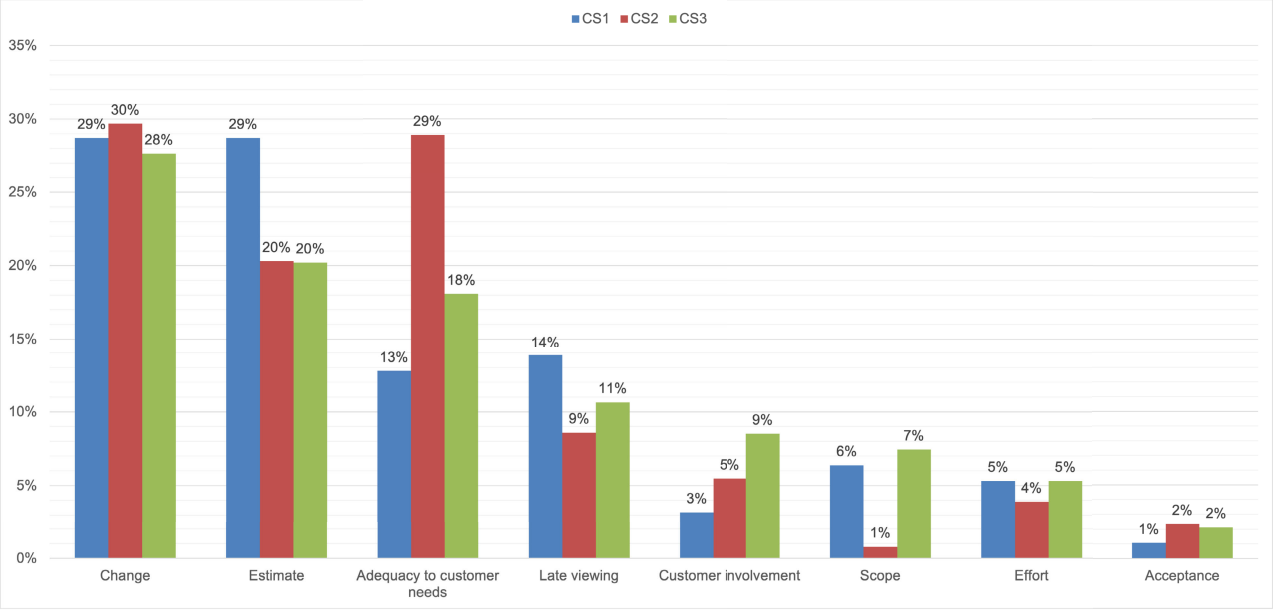

FIGURE 4. Which problem(s) occurred during the game?.

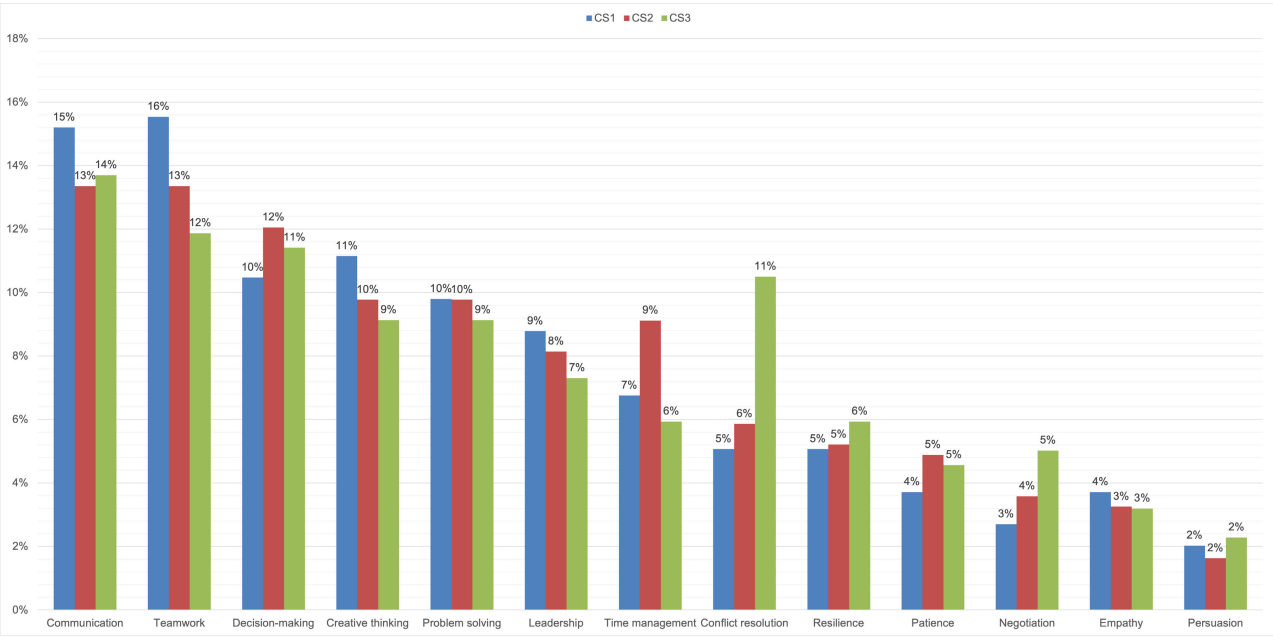

FIGURE 5. Which skill(s) were needed to mitigate the issues?.

to identify issues in traditional methodologies that Agile methods could potentially mitigate.

One of the most significant issues students identified with the Waterfall methodology was its *unresponsiveness to changes* (Figure 2). Before the game, they observed that an Agile environment's *responsiveness to changes* (Figure 3) could mitigate this issue. Following the game, the students confirmed that *change* (Figure 4) requests remain problematic due to frequent modifications by the client to the project.

Another significant issue with Waterfall projects is the *limited customer involvement and cooperation* (Figure 2), which the students believed Agile methods could reduce, as illustrated in Figure 3. In fact, after participating in the BPG, they observed that *customer involvement* (Figure 4) was not a major concern in the Agile environment, highlighting a key difference between the two approaches.

Delivery was another issue that students were able to contrast. In the Waterfall methodology, they highlighted the

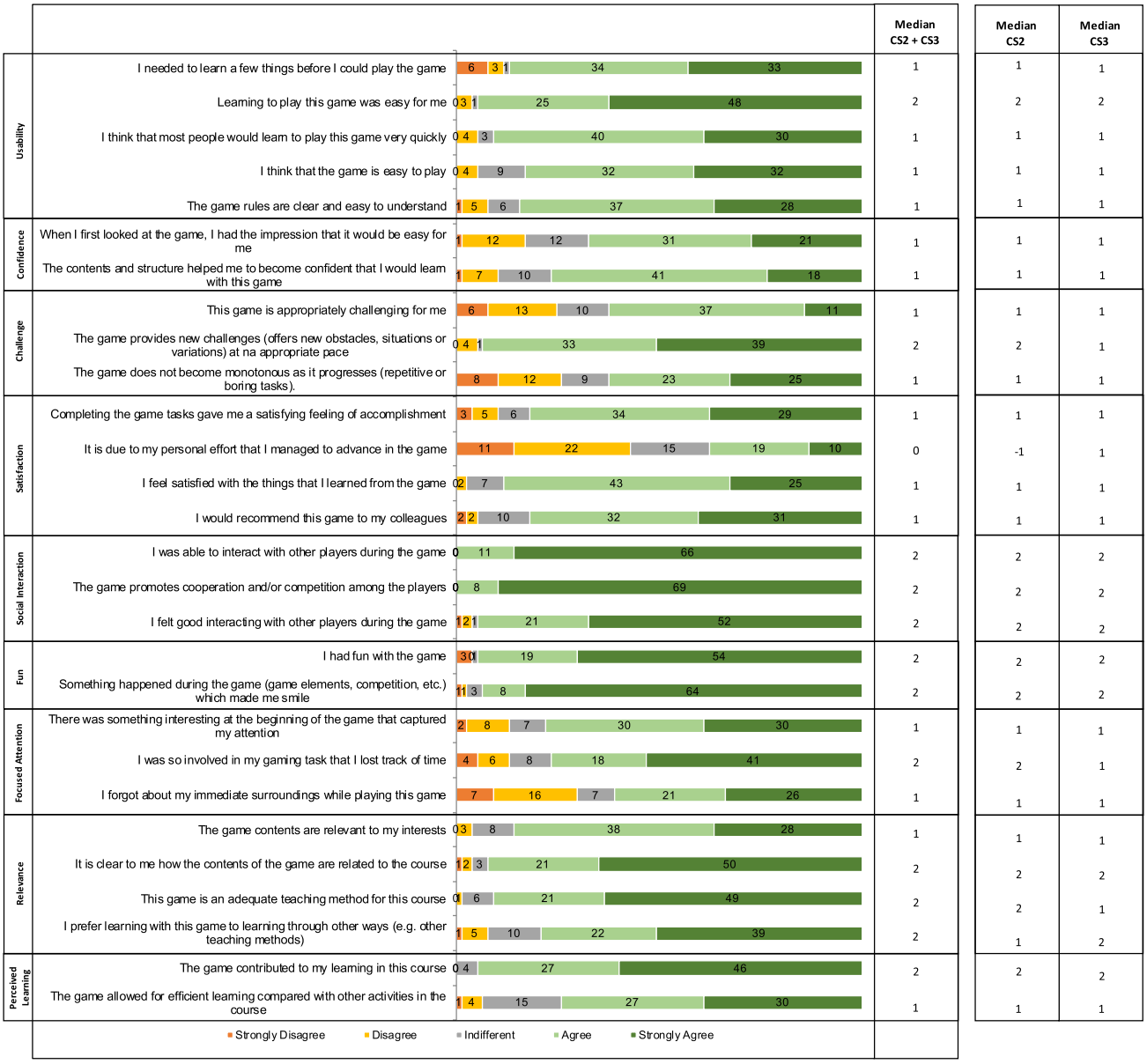

FIGURE 6. **Results gathered from MEEGA+ questionnaire: Frequency diagram for $CS_2 + CS_3$ and medians of answers for $CS_2 + CS_3$, CS_2, and CS_3, respectively.**

problem of *delayed delivery* (Figure 2), which Agile methods could mitigate through *continuous deliveries* (Figure 3). After the game, the students observed that the absence of delivery problems and the low rate of *acceptance* problems (Figure 4) underscored a significant contrast between Agile and Waterfall methods.

It is also important to highlight the *focus on deliverables, documentation, and completion* (Figure 2) as a major issue in Waterfall projects, in contrast to the *focus on people and collaboration* (Figure 3) in Agile projects. This difference contributed to a low rate of *acceptance* problems (Figure 4) during the BPG.

Students were asked whether Agile methods can be applied to all types of software projects. Although all students agreed, either partially (48%) or completely (52%), that Agile methods significantly boost team productivity, the majority (59%) still believe that Agile methods are not suitable for every type of software project.

Students were asked if Agile methods can be used in all types of software projects. Although all students agree, partially (48%) or completely (52%), that Agile methods really increase team productivity, most of them (59%) still consider that Agile methods cannot be used in all types of software projects (Section V-A).

A student who believes Agile methods are suitable for any project stated, "*I think that the Agile methodology, being less bureaucratic and more adaptive, can adapt to any type of software, from the simplest, benefiting from*

being less bureaucratic, to the most complex, benefiting from having a slightly more complete bureaucracy.'' Conversely, some students argue that certain projects are not ideal for Agile methods. For example, one student noted, ''*In critical projects that require care and well-defined modeling, Agile methods are not recommended.*'' Several students cited critical systems as examples where Agile methods might not be the best fit. Another student mentioned, ''*There are some projects that require a lot of redundancy, such as rockets, and in these cases traditional methods would be a better fit to ensure everything is in the best condition before final delivery.*''

Therefore, students were able to compare the Agile approach with the Waterfall methodology. The data confirmed that even before playing the BPG, they already believed that Agile methods could mitigate some critical issues that arise in development projects using traditional methodologies. However, after the game, they could evaluate which problems Agile methods can actually address and which they cannot. By experiencing the Agile environment, even through an educational game, students realized that Agile methods are not a silver bullet [43], [44] and have their own limitations and most suitable applications.

2) RQ2: WHAT IS THE EDUCATIONAL EFFECTIVENESS REGARDING PLAYER EXPERIENCE AND PERCEIVED LEARNING WHEN VIEWED FROM THE STUDENTS' STANDPOINT?

To answer RQ2, we analyzed the results gathered from MEEGA+ questionnaire. According to Petri et al. [39], the *player experience* was assessed based on *usability*, *confidence*, *challenge*, *satisfaction*, *social interaction*, *fun*, *focused attention*, and *relevance* (Figure 6). From the data collected, we found that the BPG used as an instructional strategy for teaching APM generally offers a positive experience, particularly regarding relevance, social interaction, and enjoyment. In this context, games can serve as an effective and engaging instructional strategy for learning. They foster feelings of enjoyment and happiness, create a pleasant learning environment, and encourage cooperation and idea-sharing among students.

Overall, students affirmed that the BPG offers good *usability*, particularly in terms of how easy it is to learn to play the game. When examining the *confidence* dimension, students noted that the game's structure and content helped them feel assured they would learn effectively with BPG. Additionally, some students mentioned that their initial impression of the game was that it would be easy to play.

Examining the *challenge* dimension, 72% of students reported the game is challenging, presenting new tasks at a suitable pace and generally avoiding repetitiveness or monotony. Regarding *satisfaction*, 63% of students felt a sense of accomplishment upon completing the game. Additionally, 68% of students were satisfied with the content they learned through BPG, and 63% would recommend the games to their peers.

Social interaction emerged as the most highly rated aspect of the games. Most students strongly agreed that the game fostered cooperation and competition among players, and they enjoyed interacting with others during game-play. Similarly, the *fun* aspect was also highly rated, with students confirming that they enjoyed playing the game and that certain situations of the game made them smile.

Analyzing the students' *focused attention*, while 59% of students reported losing track of time while playing the BPG, indicating a positive rating, there is still room for improvement. The results suggest that the game does not fully capture the students' attention to the extent that they completely forget their immediate surroundings.

The *relevance* of the BPG to the students' interests was highly rated, with 71% affirming that the game content aligns with the course material. Additionally, 70% of students viewed the game as an effective active instructional strategy, and 61% expressed a preference for learning through gameplay. These findings indicate that students had a positive and relevant learning experience with the game's content.

Regarding *perceived learning*, most of the students acknowledged that the BPG had a positive impact on their learning. When asked if the game contributed to their learning, 73% agreed or strongly agreed. Students particularly found the chosen game to be more effective in their learning compared to other course activities.

3) RQ3: CAN STUDENTS FOSTER SKILLS THROUGH PLAYING AN EDUCATIONAL GAME?

Ball Point Game is a teaching strategy that can be classified as a non-digital serious game since it simulates an Agile environment context so that practitioners can learn, as discussed in Section III. However, since their learning is through experience, this approach could also be framed into an experiential learning approach. experiential learning is the process of ''*learning through reflection on doing*'' [45]. In adult learners, cognitive structures are fully developed, and learning focuses on the relationship between the environment and the individual, encompassing three dimensions: acquisition, specialization, and integration. can also be defined as the outcome of how adults live, experience the world, and evolve through interactions between humans and their environment in the contexts of work, education, and personal development. Beard and Wilson [46] highlight that experiential learning is one of the most basic and natural forms of learning available to everyone, which is why the concepts of experience and learning appear closely intertwined and inseparable. Kolb's work [17] has been particularly influential in shaping the cycle of experiential learning, which encompasses four distinct stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Figure 7). New knowledge, derived from recent experiences, is compared with preexisting knowledge,

resulting in the potential for knowledge to be updated, integrated, or replaced.

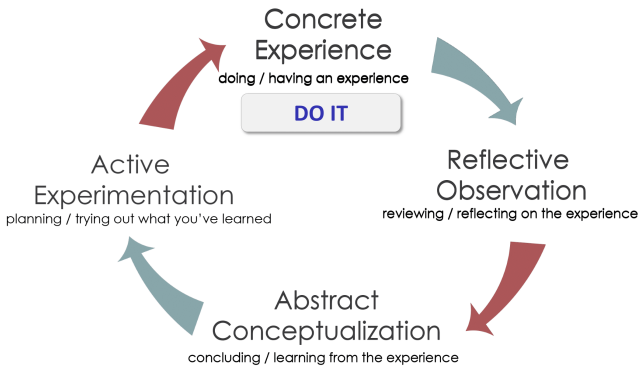

FIGURE 7. Structural dimensions underlying the process of experiential learning and the resulting basic knowledge forms (Adapted from Kolb et al. [17]).

The experiential learning cycle consists of four stages (Figure 7), and for the learning process to be fully effective, the learner must progress through each of the following stages [17]:

- **Concrete Experience (CE)**: learning through basic sensory perceptions – touch, hearing, sight, smell, and taste – triggered by a specific reality, in an active process of direct engagement. In essence, this stage involves the apprehension and capture of immediate sensory impressions, which tend to disappear once the experience ends, leaving no lasting trace.
- **Reflective Observation (RO)**: process of internal reflection that involves comparing current experiences to past knowledge. Learners develop understanding by analyzing the meaning of situations and reflecting on the attributes of experiences and ideas.
- **Abstract Conceptualization (AC)**: organization of the sensation stream into a coherent understanding, although this process risks distorting or altering the original flow. In this stage, a model of the lived experience is formed, which may persist or be modified by future experiences. Here, the experience is connected to concepts and theories through thought and logic, enabling its application to solve future problems.
- **Active Experimentation (AE)**: application of theories, concepts, and meanings derived from lived experiences to real-world situations and practical problems. This process allows learners to apply their acquired knowledge.

Experiential learning for skills development fosters a dynamic learning environment where learners actively contribute to their education. By engaging in real-world tasks, individuals not only acquire practical skills but also develop critical soft skills, such as teamwork, communication, and adaptability, which are crucial in today's job market.

Fioravanti et al. [47] showed how each *Scrum Event* corresponds to at least one stage of the experiential learning cycle. Therefore, this allowed students to engage in each stage of the EL during a Software Engineering course. Likewise, it is possible for students to experience EL by playing BPG. How are such elements connected? Each BPG activity corresponds to at least one stage of the EL cycle, as shown in Table 4 and illustrated in Figure 8.

TABLE 4. Associations of BPG events and EL stages.

BPG Event	EL stage(s)
Estimation Meeting	Concrete Experience; Active Experimentation
Iteration	Concrete Experience
Improvement Meeting	Reflective Observation; Abstract Conceptualization
Debriefing	Reflective Observation; Abstract Conceptualization

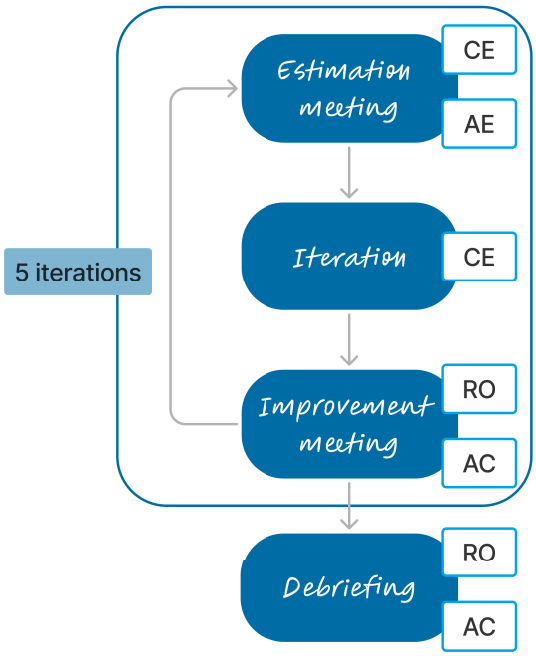

FIGURE 8. An overview of the ball point game, associating its stages and experiential learning stages.

But how exactly do the students develop the skills? In their work, Kolb and Kolb [48] state that overall learning effectiveness is enhanced when individuals are highly skilled in engaging all four modes of the learning cycle. One way to develop in learning modes is to develop the skills associated with them. Kolb and Kolb also state the learning skills associated with the four modes of the learning cycle: (i) interpersonal skills for CE, (ii) information skills for RO, (iii) analytical skills for AC, and (iv) action skills for AE. In this sense, going through the four modes of the experiential learning cycle will lead students to develop skills through experience.

Regarding the skills they fostered while playing BPG, according to Figure 5 the students listed more than ten skills. *Communication* and *teamwork* were the main skills mentioned by the students and that were used during the game.

They also mentioned the following other skills: *decision-making*, *creative thinking*, *problem solving*, *leadership*, *time management*, *conflict resolution*, *resilience*, *patience*, *negotiation*, *empathy*, and *persuasion*. It is important to highlight that these skills were used in the context of the game and identified by the students in a set of limited skill options. However, this does not limit the student to developing other skills or improving the skills they already have during the educational game.

VI. CONCLUSION

This study offers an empirical evaluation of the Ball Point Game, seeking to determine whether students are merely engaging in a non-digital game or genuinely learning Agile project management and fostering relevant skills through game-play. To conduct such evaluation, a case study design was chosen. We investigated the following aspects: (i) ability to compare traditional methods and Agile methods; (ii) educational effectiveness, particularly regarding player experience and perceived learning; and (iii) skills development or improvement.

Although traditional lectures are effective, the BPG has achieved significantly interesting results. This game serves as an excellent introduction to iterative methodologies such as Scrum. It emphasizes the advantages of early feedback loops, collaboration, self-organization, and teamwork. Observing the game provides valuable insights into the team's communication and collaboration patterns. Additionally, it offers an enjoyable way to enhance understanding of flow and maintain a sustainable pace. Therefore, the findings of our study provide consistent evidence of the positive impact on learning APM, as perceived by the students. They reported a pleasant and engaging experience, particularly in terms of relevance, social interaction, and enjoyment.

As discussed previously, the literature has been lacking studies on educational games that incorporate experiential learning in the context of Agile management education. Our work advances this field by demonstrating that learners can experience all stages of EL through playing a non-digital serious game, thereby having fun, learning the content, and developing skills.

We aim to extend this research by examining the BPG in an online context. Richard Kasperowski proposed the Agile Ball Point Game[1] which he defines as "*like the Ball Point Game, but 100% online*". Likewise, the Remote Ball Point Game[2] is a browser-based version of the BPG, created as an open-source project.[3] We are particularly interested in observing its impact on skill development in a remote education scenario.

We hope that our contributions help researchers and educators experiment with experiential learning in Agile project management education themselves; which we also aim to extend more systematically.

[1]https://miro.com/miroverse/category/workshops/Agile-point-game
[2]https://remoteballpointgame.openforce.com/
[3]https://github.com/openforce/remoteballpointgame

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MARIA LYDIA FIORAVANTI received the B.Sc. degree in computer science and the M.Sc. degree in computer science from the University of São Paulo (USP), in 2011 and 2017, respectively, the M.B.A. degree in business administration from Fundação Getúlio Vargas (FGV) in 2012, and the M.B.A. degrees in project management and educational management from USP in 2019 and 2021, respectively. She is currently pursuing the joint Ph.D. degree in computer science with USP and Universidad Politécnica de Madrid.

She is the author of scientific publications in venues, such as IEEE Transaction on Education, *Education and Information Technologies*, the ACM Technical Symposium on Computer Science Education, IEEE Frontiers in Education Conference, Hawaii International Conference on System Sciences, and holds two software patents. Her research interests include software project management, software engineering education, Agile, and active learning.

Ms. Fioravanti received the award for 2nd best master's dissertation in the area of informatics in education in Brazil ("Alexandre Direne" Award), in 2018. In 2019, she was also awarded the best final project of the MBA in Project Management at the University of São Paulo ("Professor Pedro Valentim Marques" Award).

GUSTAVO M. N. AVELLAR received the B.Sc. degree in information systems from São Paulo State University (Unesp), in 2017, and the M.Sc. degree in computer science from the University of São Paulo (USP), in 2021, where he is currently pursuing the Ph.D. degree in computer science.

His research interests include computational thinking, virtual and augmented reality, mobile learning, and metaverses.

Mr. Avellar received the award for 3rd best master's dissertation in the area of informatics in education in Brazil ("Alexandre Direne" Award), in 2022.

BRUNA OLIVEIRA ROMEIRO received the B.A. degree in business administration from the University of São Paulo (USP), in 2015, where she is currently pursuing the M.Sc. degree in computer science.

Her research interests include IT business management, business strategy administration, project and process management, skills development, professional development in tech careers, and computing applied to education.

BRUNA GONÇALVES REZENDE received the B.Sc. degree in computer science from the University of São Paulo (USP), in 2011, the degree in software engineering from the University of Campinas (Unicamp), in 2014, and the degree in project management from USP.

She is currently the Software Project Leader of Mercado Livre and has had experience in the tech industry in companies such as Venturus, Sensedia, Via Varejo, Thomson Reuters, and KPMG. She holds the following certifications: Scrum Fundamentals (SCF), Kanban Management Professional (KMP) 1 and 2, Management 3.0, and Mindful Leadership. She is also a mentor with the Frida's Initiative, a program designed to inspire, strengthen, and generate professional growth for women.

ELLEN FRANCINE BARBOSA received the B.Sc. degree in computer science from Londrina State University (UEL), in 1995, and the M.S. and Ph.D. degrees in computer science from the University of São Paulo (USP), in 1998 and 2004, respectively.

She was a Research Visitor with Georgia Institute of Technology, in 2002, and the University of Florida, in 2003. She has been a Faculty Member with the Computing Systems Department, Institute of Computer Science and Computational Mathematics, since 2005. She is currently an Associate Professor of software engineering. Her research interests include computing applied to education (OERs, mobile learning, educational data mining, and LMSs), software engineering (quality, testing, and reference architectures), usability, accessibility, entrepreneurship, and innovation.

Prof. Barbosa has been the Director of the MBA in computing applied to education, since 2002. She has also coordinated: ICMC Advanced Center for Innovation Support (ICMC-In), since 2022, the Bachelor's Undergraduate Degree Program in Information Systems, from 2016 to 2022, the Professional Master's Degree Program in Mathematics, Statistics, and Computing applied to Industry, from 2016 to 2017, and the Software Engineering Laboratory (LabES), from 2008 to 2011. She is also the Founder and a Current Coordinator with the Laboratory of Computing Applied to Education and Advanced Social Technology (CAEd), USP.

ANA M. MORENO received the B.Sc. degree in computer science and the Ph.D. degree in computer science from Universidad Politécnica de Madrid (UPM), in 1994.

She has been a Faculty Member with the Software Engineering Department, UPM, since 1997. She is currently a Full Professor of software engineering. She is the author of more than 20 scientific publications in journals, such as IEEE TRANSACTIONS ON SOFTWARE ENGINEERING, IEEE SOFTWARE, *Empirical Software Engineering*, and *Journal of Systems and Software*; and the author of other papers published in international conferences, such as the International Conference on Requirements Engineering, INTERACT, or the NASA Workshop on Software Engineering. She is the co-author of two international books published *Empirical Software Engineering* (Springer) and *Software Process* (Springer). She has led several research projects in the field of software engineering both in Spain and in European Union. Her research interests include project management, UX, and Agile methods.

Prof. Moreno is the Director of the Software Project Management Master Program at Universidad Politécnica de Madrid, since 2002, and has participated in different international initiatives related to software engineering education, such as the SEI Working Group on Software Engineering Education, the IEEE Computer Society International Committee for Software Engineering Certification Programs, the International Reviewers Committee of the Graduate Software Engineering Program (GSwE), or the IEEE Computer Society Educational Awards Subcommittee.