Understanding Undergraduate Students' Flow State in Gamified and Non-Gamified Educational Systems: A Qualitative Case Study

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***Abstract*—Contribution: In this full research paper, we provide a qualitative view of how undergraduate students experienced flow state dimensions (*i.e.*, challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, total concentration, sense of control, loss of self-consciousness, transformation of time and autotelic experience) in a gamified educational and a non-gamified educational system. Background: When in a flow state, individuals experience deep immersion and focus on tasks. Encouraging educational experiences toward flow is important because this construct is linked to cognition (academic performance) and behavior (engagement). Gamification has been implemented to bring students to a flow state. However, despite several studies (mostly quantitative) little is known about how the flow state is experienced in gamified educational systems. Research Questions: Advancing the literature, we answered the following research question: how do students experience flow state when performing tasks using a gamified and non-gamified educational system? Methodology: 68 students from 20 countries participated in an experiment. They were randomly assigned to an experimental group (a gamified system with 10 different gamification elements based on Self-determination theory) and a control group (the same system without gamification). Immediately after the experiment, we asked them to share some thoughts from their experience openly. We then conducted a qualitative study based on Thematic Analysis with 18 of them who volunteered for further interviews. Findings: We found that students who completed questions in the non-gamified version acknowledged time and social pressure as elements that sustained their engagement. However, we did not intentionally expose them to these game elements. A sense of competence emerged strongly as they completed the educational tasks through the system. We found different nuances of competition, including self-competition, associated with the sense of flow in both groups. The findings also suggest that the tasks play a role in the sense of flow they experienced.**

***Index Terms*—Game-based learning, gamification, gamified education, flow state, thematic analysis**

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I. Introduction

The primary value of using gamification (*i.e.*, "the design that provides motivational benefits similar to those games usually create" [1], [2]) is to drive changes toward a desired behavior, attitude, or outcome [1]–[3]. Especially higher education has become an area of growing practice and research on gamification [4]–[6], playing an important role due to its potential to create an environment where students may want to invest time, effort, and develop learning behaviors [7]. When designed properly, gamification can impact individuals psychologically and bring their experience closer to a flow state [2], [8], [9]. At the same time, Flow Theory [10] can elucidate how gamification enhances learning, considering that when people are in a flow state, they have a sense of commitment, regardless of whether they are interacting with a task, activity, or content [10]–[12].

The recent literature investigated how some choices, such as gamification elements/gamification designs and their combination, can affect students' flow state [13]–[16]. When examining how individuals experience flow state in a gamified setting, the findings often revolve around discretionary aspects of the experience of being in the flow state [14]. By comprehending experience as a multifaceted process involving both the mind and body, encompassing aspects such as cognition, perception, memory, interaction, as well as the management of sensations and emotions [17], it becomes apparent that our understanding of users' flow state in gamified settings is still limited and little is known about how each experience (or not) the different dimensions of the flow state in gamified educational environments.

Facing these problems, in this paper, we contribute to this literature by providing a deeper view of how undergraduate students experienced a sense of flow. Through a qualitative case study based on Thematic Analysis, we describe the experience of two groups, one using a gamified system (with a gamification design composed of ten different gamification elements based on Self-determination theory [18]) and the other group using a non-gamified version of the same system (but both with the same educational tasks). We discuss how participants experienced some dimensions of the flow state by describing what elements are present in the setting, and also how individual characteristics influence their sense of flow state.

Our findings underscore how challenging it can be to get students into a higher level of flow state in educational settings. Just the presence of gamification elements *per se* is not a driver of a flow state. However, gamification can trigger micro experiences of it. We believe it is important that researchers discuss their findings in light of Flow Theory to be more precise about the "power" of gamification to cause a flow state and also to raise some thresholds. Furthermore, studying this phenomenon (flow in gamified educational settings) from an ecological perspective (*i.e.*, a real gamified environment) of inquiry, as we did, is a way to advance the existing body of knowledge.

II. Background

In this section, we describe the main concept addressed in this paper, *i.e.*, flow state in gamified education. Finally, we also present and discuss the main related work.

A. Flow state in gamified education

Flow was defined as an absorbing experience where a person is fully engaged and deeply focused on a task or activity [19]. It is experienced subjectively through a series of moments in which a sense of overcoming challenges, achieving goals, and making progress are triggered [20]. Flow is associated with optimal performance and enjoyment [10]. For conceptualizing the conditions of a person gets in a flow state, Csikszentmihalyi [21] described nine dimensions:

1) **Challenge-skill balance** contributes to flow and it is considered an antecedent of it. When faced with a challenge, people tend to assess their level of ability. Feeling that one's level of ability is not too high or too low (just enough) to meet a goal creates a space to engage a person with a challenge without overwhelming.
2) **Action-awareness merging** occurs when one becomes absorbed in what one is doing, a feeling of effortlessness arises, and this is what is associated with this criterion of flow. This dimension is usually associated with physical tasks.
3) **Clear goals** help individuals develop a sense of purpose and direction. Personal goals are also important as a plan to achieve something important, regardless of the effort required. This condition leads to a sense of what and how to do. It is also considered an antecedent of flow.
4) **Sense of control** is a sense of empowerment that allows people to navigate challenges and adjust their actions accordingly.
5) **Total concentration** is a key dimension and involves complete absorption of an individual's attention and cognitive resources into the task at hand. When it is achieved, distractions fade away and people have a sense of integration between their actions and awareness.
6) **Feedback** is important for a person to continually assess the progress they are making toward their goals.
7) **Transformation of time** is a distortion of our perception of the passage of time, causing the experience of time to either slow down, speed up or become completely irrelevant. Whether from an external or internal source, it is human nature to place value on the evaluation of our actions.
8) **Loss of self-consciousness** occurs when a person is no longer concerned with criticism. Silencing this human capacity is a condition for experiencing flow.
9) **Autotelic experience** happens when the flow is activated. Some activities can be intrinsically rewarding and drive people to perform for their own sake. It's the case when people do something for themselves.

The flow state dimensions are crucial components of the flow state as they help individuals maintain focus, motivation, and a sense of mastery over their activities, ultimately leading to enhanced performance and enjoyment [19]. Each condition serves as a potential trigger, and not all of them need to be met for a person to experience flow [22]. Flow can be experienced at different levels, as a micro experience, it follows the patterns of everyday life like the humming of a tune and as a macro experience, it occurs at higher levels of complexity and cognitive demand. Sense of selflessness, timelessness, effortlessness, and abundance is perceived in their greatest intensity [23]. Macro flow occurs when multiple conditions are set off. When all conditions are triggered this is called the optimal flow state [24].

Scholars have emphasized the relationship between gamification and its ability to foster the conditions for individuals to enter a flow state. Gamified systems often provide users with clear goals, immediate feedback, and a calibrated balance between perceived challenge and skill [2], [25].

B. Related work

Flow Theory is ranked as the second most common theoretical model in the literature discussing gamification and education [11]. Although many researchers advocate positive outcomes, claims about whether gamification influences the flow state are still controversial and inconclusive [26]. At the same time, recent literature reviews reported that the majority of studies are quantitative [14]–[16]. In this subsection, we present some recent studies investigating students' flow state in gamified educational systems.

Rossin *et al*. [27] investigated the relationship between students' flow state and different learning outcomes in an online information management course taught in an MBA program. The authors found that autotelic experiences improved performance. In addition, their study found that three dimensions of flow, clear goals, feedback, and challenge-skill balance, were positively correlated with learning outcomes.

More recently, by examining nursing students' perceptions of flow when participating in a gamified course, Han *et al*. [28] found that gamification encouraged students to spend time in class. Participants reported being immersed in what they were being asked to do.

In a sequence of different studies, Oliveira *et al*. [29]–[32] analyzed the relationships between students' behavior when using a gamified educational system and these students' flow state when using the system. The results show that students' behavior is related to some of the dimensions of the flow state, but not to the macro flow state.

Finally, Sangroya and Kabra [33] explored the interaction between gamification principles and students' psychological processes, specifically focusing on the SDT and flow theory. The results suggest that integrating SDT and flow theory can provide a more comprehensive understanding of students' experience during gamification.

The studies advance the literature toward understanding students' flow state in gamified educational systems. However, a comprehensive understanding of how students experience the different flow state dimensions is still beyond reach. Thus, our study was conducted to contribute to this theoretical gap. At the same time, to the best of our knowledge, there are only a few qualitative findings related to the flow state in gamified educational settings, especially those related to undergraduate students in the Science, Technology, Engineering, and Mathematics (STEM) area. Thus, as far as we know, we are the first to qualitatively explore the students' flow state dimensions while using a gamified and a non-gamified educational system.

III. Study Design

In this study, we used an interpretive phenomenological design to answer the following research question "How do students experience flow state when performing tasks using a gamified and non-gamified educational system?". This method was chosen because we wanted to understand how students make sense of their experience taking into account their context and personal meaning-making. In this section, we present the study's design, from the overall project to the data collection and analysis.

A. Project landscape

This study was an unfolding of a larger project aimed at identifying multiple aspects of students' experiences through a gamified educational system, where 68 undergraduate students participated in a between-subjects controlled experiment. The study occurred in a controlled environment called Ludus Laboratory at the University of Tampere, a place for learning about and studying playful interactions with technology. The space is useful for many other purposes such as usability testing, studies on technology-mediated collaboration, and others.

During the experiment, students were individually assigned to a booth equipped with an eye-tracking device and a device for collecting biological data attached to the hands of the participants (see Figure 1). They were given a time window to complete the questions (from 15 to 30 minutes). There was no countdown inside the booths. They completed questions in a quiz format. The questions covered topics related to Logical Reasoning, English, and general knowledge (see subsection III-C). Participants were randomly assigned to two distinct groups. One of them interacted with the gamified system, which was set up with ten elements based on Self-Determination Theory (SDT): acknowledgment, chance, competition, economy, imposed choice, level, objective, point, progression, and statistics. These elements are explained in the taxonomy presented by Toda *et al*. [34] (see subsection III-C). The other group used the same system without any element of gamification (however, in both versions of the system, participants were subjected to the same educational tasks). In this specific paper, a qualitative case study was conducted with 18 of those students aiming to understand in-depth their perceptions about some dimensions of flow state.

Fig. 1. Booth used by participants during the experiment

B. Participants

Participants were recruited via Tampere University DM-Lab pool, utilizing ORSEE3 software for coordination [35]. The recruitment process for the qualitative study took place immediately after the participants completed the assignment. All of them were invited to participate in an interview in the following days. As we interviewed the students who volunteered, convenience was the sampling method adopted. Data were collected from 10 males and 7 females. One participant preferred not to identify their gender. Most of them consider themselves gamers, are from European countries, and attending undergraduate or graduate programs at Tampere University, Finland. All research procedures were conducted in strict adherence to the guidelines established by the Finnish National Board on Research Integrity (TENK). Demographic data is presented in Table I.

All participants have a technical background in STEM, such as data science, mathematics, statistics, computer science, engineering, and chemistry. They ranged in age from 20 to 46,

TABLE I
DEMOGRAPHIC DATA OF PARTICIPANTS

ID	Gender	Age	Country	Background	Group
S001	Male	27	Sri Lanka	DS	NG
S002	Male	28	Sri Lanka	ITCS	NG
S003	Male	21	The Netherlands	ENS	NG
S004	Female	28	Guatemala	ENS	G
S005	Male	21	Finland	CS	G
S006	Male	23	Finland	ENS	G
S007	Male	26	Bangladesh	DS	NG
S008	Female	26	Finland	DS	G
S009	Male	46	Finland	DS	NG
S010	Female	26	Finland	ENS	NG
S011	Female	27	Finland	DS	NG
S012	Male	25	Sri Lanka	ENS	G
S013	Female	21	Vietnam	Chemistry	G
S014	Female	35	Finland	ITCS	G
S015	PNM	20	Germany	DS	NG
S016	Male	36	Iran	ITCS	NG
S017	Male	20	Finland	ENS	NG
S018	Female	30	Greece	ITCS	NG

Keys: DS: Data Science; CS: Computer Science; ITCS: Information Technology and Communication Sciences; ENS: Engineering and Natural Sciences; PNM: Preferred not to mention; G: students who interacted with the gamified version; NG: students who interacted with the non-gamified version.

averaging 27 years old. 11 students interacted with the non-gamified version of the system and 7 with a gamified version of it.

C. Study' context

For this research, the Eagle-edu was used as a gamified learning platform[1]. Its selection was based on the flexibility it offers educators in devising a variety of instructional activities. It includes 21 distinct elements of gamification (in accordance with the Taxonomy of Gamification Elements for Educational Environments (TGEEE) introduced by Toda *et al*. [34], which educators have the discretion to enable or disable, thus affording them the opportunity to create tailored gamification strategies.

We designed 25 questions in English, partly based on a famous and standard test for admission to a Faculty of Medicine in Italy - a national test covering many different topics. Not all the questions were from there, especially the general knowledge ones, where we decided to explore different subjects. The difficulty level was based on another test suitable for individuals aspiring to become university students. All modifications to the standard questions aimed to adapt them to an international context, given that our study was conducted at a Finnish university, which had this characteristic. The questions were made as general and understandable as possible for everyone. Images were added to help participants to understand questions, if necessary. In Figure 2 we present an example of a general knowledge task. Students are asked to decide who is the artist of the painting.

The questions were the same for all participants. However, they interacted with them in different ways depending on

[1]https://eagle-edu.com.br/

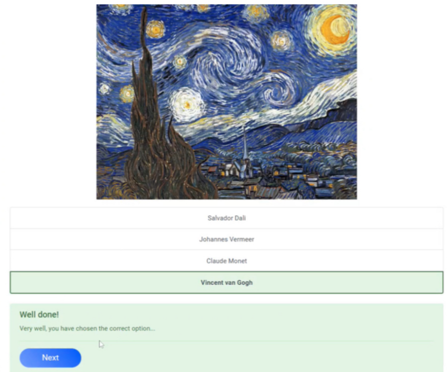

Fig. 2. Example of a question related to general knowledge

which version of the system they were assigned to. For example, for those using the gamified version only, the questions were displayed in three groups and students could choose which topic they wanted to start with.

Regarding the gamification design, in this investigation, 10 gamification components were incorporated, consistent with the taxonomy delineated by Toda *et al*. [36]: **Chance** (commendations for specific player actions, symbolized within the system by the exhibition of students' badges); **Randomness** (elements of unpredictability and chance influencing the likelihood of certain events or results, manifested in the system through various decision-making scenarios, *e.g.*, selecting among treasure chests); **Competition** (scenarios where multiple players vie for a shared objective, depicted in the system by a leaderboard showcasing up to 10 students); **Economy** (in-game financial dealings, the capitalization of gaming assets, among others, and represented in the system by currency that can be exchanged for virtual goods); **Imposed choice** (choices that players must make to progress in the game, represented in the system by a randomly presented option to augment their reward); **Level** (sequential levels in a game offering players incremental benefits as they advance, represented in the system by stages (*i.e.*, Bronze, Silver, Gold, Ruby, and Diamond)); **Objective** (measurable or spatial targets, ranging from short to long term, represented in the system by a mission tree); **Point** (metrics for evaluating player achievement, represented in the system by experience points (XP)); **Progression** (mechanisms that enable players to ascertain their location and progression within a game, represented in the system by a progression indicator in the activity tree); and **Stats** (conspicuous data available to the player, pertaining to their gaming performance and represented by all information regarding user advancement). Some of the gamification elements are illustrated in Figure 3 and Figure 4. Examples of feedback in both versions of the system are shown in Figure 5 and Figure 6.

D. Data gathering and analysis

While completing the assignment, we recorded the students' screens. In particular, we wanted to observe the group of

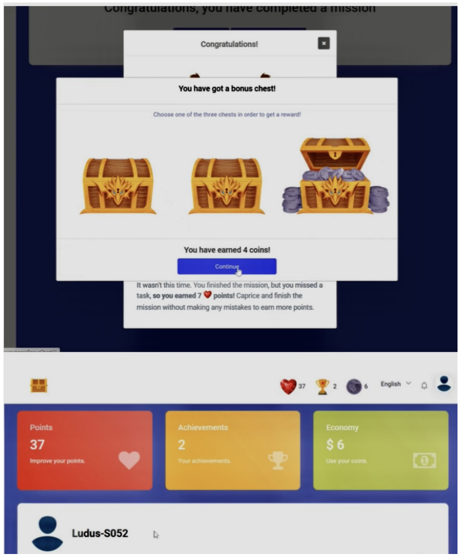

Fig. 3. Points, economy, achievements, coins, acknowledgment

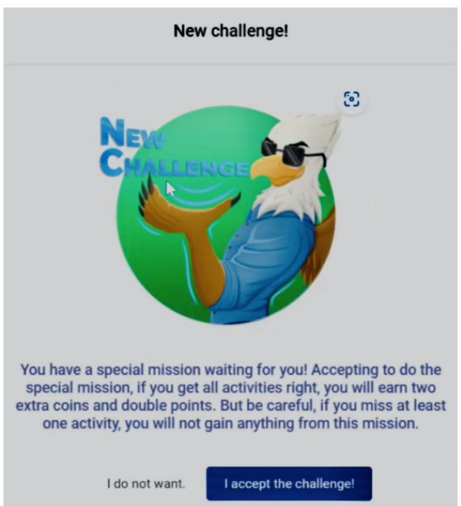

Fig. 4. Imposed choice

students who would be taking the gamified questions and how they would interact with the system. After completing the tasks, participants completed the Short Flow State Scale (FSS) [37] which was chosen because it is a unidimensional model that provides a holistic assessment of flow [14]. According to the FSS, flow is derived from nine dimensions, but not necessarily all of them. This instrument made it possible to get a better understanding of what flow state dimensions were experienced by each student. Based on a 5-point Likert scale [38], students expressed their opinions about the nine dimensions of responding to questions.

We used these two data sources in combination with the qualitative data set based on semi-structured interviews. The interview outline included a core set of open-ended and probing questions designed to encourage participants to create a narrative of their experiences. Questions have been added

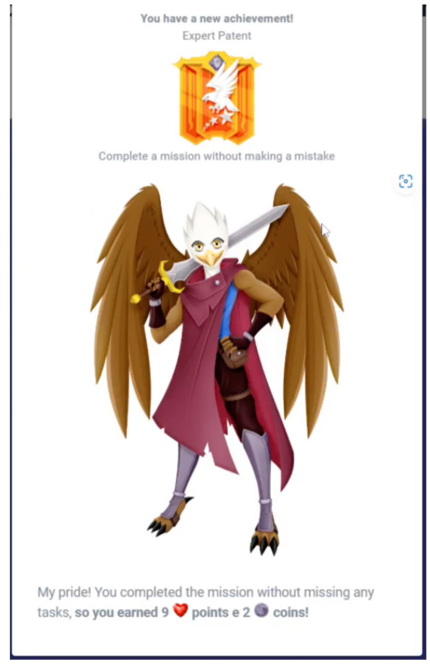

Fig. 5. Feedback with gamification elements

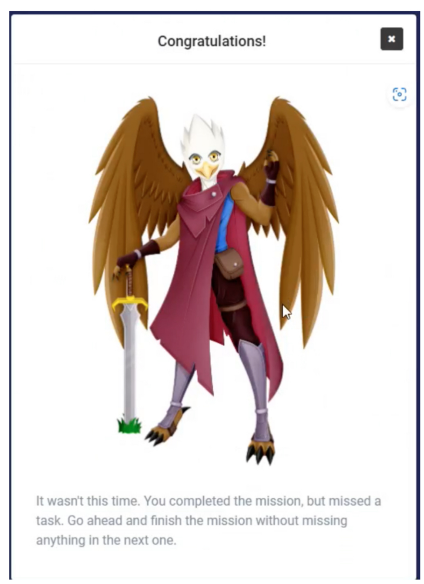

Fig. 6. Feedback without gamification elements

along the way to allow for a more in-depth understanding of specific responses. Two researchers were present during the interviews, but only one was the interviewer. After each interview, there was a discussion, and notes were taken. The combination of multiple data sources strengthened the instrument of data collection and also supported triangulation. All data were anonymized and interviews were transcribed verbatim.

Following the steps of the Thematic Analysis technique [39], we read the transcriptions several times to become fully familiar with the data set. We followed both inductive and deductive coding strategies. First, codes were created to identify meaningful parts of the discourse that could be related to the flow state. Immediately after this first stage of coding, we used the data from the FSS to check which dimensions were experienced according to it. This methodological decision was made to reduce bias. Since the scale indicates which flow state dimension is met, the codes gave us a better understanding of how the students perceived them. After analyzing the relationships among the codes, they were organized into themes that provided an acceptable view of their experiences. Theoretical saturation was achieved through the discourse of these 18 participants. We were able to develop strategies for triangulation because we had access to psychometric and observational data.

IV. Findings

Initially, it is important to highlight that our study does not aim to carry out any type of confirmatory analysis or related variables, therefore, when using data from the scale, we intend to triangulate the information to obtain deeper insights into how individuals experienced each dimension of the flow.

In this study, our participants experienced flow in unique ways. Based on their self-reports on the nine items present in the FSS, we present a view of how flow was experienced. From our data, we were able to reach a qualitative view of which dimensions were experienced more and which less. Challenge-skill balance, clear goals, and feedback (both considered flow state antecedents) were experienced more. They represent the antecedent conditions for the occurrence of flow. Based on data from FSS, we counted how many dimensions were experienced. In Table II, the number 7 in the first column indicates that seven dimensions were experienced. Looking at the table, it is possible to see that three students who interacted with the gamified version experienced seven dimensions. In another example, the number 0 means that three students who were exposed to the non-gamified experience did not experience any of the nine dimensions. It seems that students who interacted with the chosen gamification design experienced a slightly higher number of dimensions than the other group.

The dimensions experienced by both groups were the same. After the flow state antecedents, experiences with the transformation of time, total concentration, and autotelic experience were more common. Those related to self-consciousness, action-awareness, and sense of control seemed to be more difficult to reach in the context in which our study took place.

TABLE II
Number of dimensions experienced by the students per group

Group	**0**	**2**	**5**	**6**	**7**	**9**
Non-gamified	3	2	2	3	0	1
Gamified system	1	0	1	1	3	1

From our data set, it was not possible to address the exact level of flow, whether it was a micro or macro flow state. However, since the dimensions are central elements in supporting the existence of a flow state, it is acceptable to mention that the more dimensions students experienced, the more focused and motivated they were likely to be in completing the questions. According to Csikszentmihalyi [21], when a flow state is experienced, it leads to performance and enjoyment.

Because of our epistemological beliefs, we did not separate into themes what we understood about the dimensions of flow as students described their experiences. We came to understand that time and the presence of others was important to all participants. They developed a sense of time and social pressure that was related to how they experienced total concentration and the transformation of time. Interestingly, none of the participants were intentionally exposed to these kinds of pressures. However, the students played an important role in the experience of flow, adding many different layers of meaning to the way they performed the questions.

Even though they were alone in the booths and had not been told whether they would be competing or collaborating, they felt the presence of others and this affected them. The fact that they were given a limited amount of time to complete the questions may explain the sense of time pressure that many participants co-created. In the booths, they were not warned about how much time was left, but we often found in their discourse the perception of the "need to finish as fast as possible". In our context, similar to what happens in a classroom when the instructor gives assignments, the mere mention of a time frame was enough to establish a strong meaning in what they were experiencing. To illustrate, the following excerpt is shown and it exemplifies much of what we learned from their narratives:

> "*I tried my best, but since the time was going on and we need to complete it, I mean, there was no countdown, but even though I tried my best to complete it as soon as possible. I had to go through that answer. It felt for me like there was some tense environment, but it was interesting to work with that. I was just time was flowing I didn't know even how much time I spent in there because I was just so immersed.*"

Many of them reported a strong sense of perception of self-competence when completing the questions. According to SDT, competence is a basic human need that is important for sustaining engagement [18]. People have an inherent drive to pursue their potential and use capabilities. Therefore, they seek opportunities to express and demonstrate abilities in social environments, especially in the face of challenging circumstances. These challenges serve as critical indicators of motivation within a given endeavor. Once opportunities to satisfy these needs are identified, the way people interact is aligned with the goals they want to achieve. The sense of "completing the tasks quickly and correctly" has appeared often in their experiences. In our context, when students felt a sense of competence, this influenced the experience with the following dimensions: total concentration, transformation of time, and challenge-skill balance. The next excerpts illustrate this relationship:

> "*Time flew. I can tell what caused it. When I get to answer instantly that is one thing that causes my emotion more compared to that I get it like, for example, after I've done all the questions in one mission and then I get that I got like seven out of ten or eight out of ten.*"

> "*[...] I was a little bit in a rush because I knew that the time was slim even though I got all the other results correctly the tiny mistakes still bothered me and we couldn't realize that to a person who likes to get things done very well.*"

The questions were a relevant force in creating a sense of competence and, consequently, influenced their experience in those dimensions. Regarding the level of difficulty, even those students with a strong background in mathematics rated the logical reasoning questions as challenging but not complex. As they reported, the tasks were interesting because they were short and created a space for out-of-the-box thinking. Because of the way we set up the system, students in both groups could have chosen to skip the questions at any time they wanted to, but they did not do so. This finding also suggests that not only the way a task is designed, but also how it is presented, is an influential factor in the sense of some dimensions of flow that students might experience.

It is important to note that different nuances of competition, including self-competition, are associated with flow in both groups. However, this may have more to do with personal characteristics than with our instructional choices per se. During the interviews, many students mentioned their competitive nature. Individual characteristics influenced how they interpreted questions, faced failure, set goals, and evaluated the presence of others. Competition was mentioned frequently in both groups and seems to have influenced their perception of total concentration and time transformation. They expressed how much they felt rewarded during the experience of 'competing' with others (autotelic experience). The following excerpt is from a student who used the non-gamified system and had no contact with elements related to sense of competition:

> "*[...] the structure of the tasks was the sort of that you need to know stuff. Kind of makes you want to know so that in that in that way it's a competition. I think to me it's it makes me feel: okay I need to beat those guys or is somebody going ahead of me. I think it makes me feel like I'm competing with others but mostly I'm not so interested in how the others do, but I'm kind of critical towards myself that I should know this.*"

When we analyzed the videos of the screens of the students who used the gamified version, most of them did not try to explore the existing gamification elements such as points or coins. They navigated through the screens after answering the questions. They also seemed to be interested in exploring one particular element: the weekly ranking. This suggests that the presence of gamification elements did not jeopardize their focus on the assigned educational goal.

A. Discussion

In this study, we describe how 18 undergraduate students experienced dimensions of flow state. From a theoretical perspective, our results showed that the dimensions of concentration on a task, total concentration, transformation of time, and challenge-skill balance can be experienced when a sense of competition/self-competition, time and social pressure, and self-competence are triggered. They were driving mechanisms to influence the students' perception of being in a flow state.

Our findings showed how students interacting with the non-gamified version of the system co-created their experience, considering that the students experienced the use of the non-gamified version of the Eagle-edu as a gameful experience. As McGonigal [40] and Huotari and Hamari [41] pointed out, an activity or system may be perceived as playful even if it is not a game, if it is close to the experience created in a game. Our participants added a new layer to what had been decided as the educational questions assigned to them. In doing so, they may influence their own experience of flow. In part because they recognized the presence of other students and themselves playfully. This is similar to what Gombrich [42] states about the concept of magic circle, as they transformed the task into a temporary playground with its own rules regarding time, space, and social grouping. As Ejsing-Duun and Karoff [43] explain, the boundaries and rules are not necessarily explicit and can be established either when the experience is designed or through the process of playing.

There are not many qualitative studies in this literature, making it difficult to compare our results in any way, but some of the existing research converged with our findings. In Sillaots [44], the authors conducted a study to understand how master's and bachelor's students taking a gamified course experienced some dimensions of flow. The authors found that the master's students, who were supposed to be more mature than the undergraduates, seemed to have more difficulty reaching a flow state. Despite the fact that a different instrument to measure the flow dimensions was adopted, our results converge. Sillaots [44] reported competition as an influential force related to total concentration. Similar to our students, their participants could not meet the condition of loss of self-consciousness. The way their course was designed made it difficult for the students to experience autonomy, which is related to the dimension of a sense of control. In our findings, the sense of being competent led many students to meet some conditions of flow, such as transformation of time and total concentration. When comparing how many dimensions each group experienced and also their overall experience, we believe that the presence of gamification elements in and out of the instructional design made a difference in their perception of flow.

In another qualitative study, competition was identified as a factor to consider because students choose it as a way to socialize and consequently experience a sense of flow [43]. We understand that competition may be considered controversial. Kristensen *et al*. [45] cites culture, genetics and the values of a society as possible explanations for competitive behavior and argues that cooperation may be more beneficial. We understand that, especially in higher education, the development of competitiveness is closely related to success. However, we do not argue that competitive practices are better for all individuals. However, with this study, we aim to inform and provide insights for educators and researchers to help them think about how individual factors might influence the design of more effective instructional interventions.

Our goal is to provoke reflection on how achieving a sustained flow state requires a deeper understanding of how individual characteristics. Also how contextual factors play a role in framing the experience. Our findings underscore the complexity of inducing flow in educational contexts, even with the addition of gamification elements. We might say that there is not a clear conclusion specific to the gamified group. That said, it is important to open a dialogue about the complexities of creating effective gamified experiences in educational settings that are capable of influencing any level of student flow state or even sustaining this psychological state for long periods. To the best of our knowledge, this study is pioneering, as not many studies related to higher education have taken a holistic approach to understanding the phenomena of flow as we did.

B. Limitations

Despite our contribution, we acknowledge some limitations of this study and its applicability to specific contexts. It is noteworthy that competitiveness was a prominent characteristic among participants. We did not thoroughly assess how this individual trait might have influenced our results. Although 68 students participated in the experiment, only 18 of them volunteered for further interviews. This smaller sample size may restrict the breadth and diversity of perspectives captured in the qualitative analysis. Additionally, the students who volunteered for further interviews may not be representative of the broader participant pool. There could be inherent differences between those who opted for interviews and those who did not, potentially resulting in sampling bias.

Participants who chose to participate in the experiment and subsequent interviews might have had a pre-existing interest or positive experiences with gamification, potentially biasing their responses toward the intervention. Moreover, although the students came from 20 different countries, their backgrounds, experiences, and cultural perspectives may still be relatively homogeneous, especially if they were recruited from the same institution or educational program. However, we recognize that some questions, such as those related to general knowledge, may have been more familiar to students with more exposure to Western art history. But we cannot make this assumption for all of them.

Participants may have felt compelled to provide socially desirable responses, particularly since they were asked to openly share their thoughts immediately after the experiment. This bias could impact the accuracy and depth of the insights obtained. Given the diversity of participants' cultural backgrounds, it is crucial to consider cultural differences in understanding and interpreting their responses. Failing to account for cultural nuances could lead to misinterpretation or oversimplification of findings.

V. Research Agenda

Beyond our theoretical contribution, from a holistic perspective, our findings may help designers and educators understand how individual characteristics influence certain conditions to reach the flow state. Thus, based on our results and the limitations of our study, we take advantage of this space to propose a series of studies that can be conducted to advance the literature.

Although the characteristics of our students varied in terms of nationality, culture, and age, most of them shared a strong competitive trait. Considering their technical background, rooted in STEM-related fields, it is important to investigate the relationship between a competitive trait in university education and the flow state. Thus, **we recommend that future research investigate how individual traits moderate the flow state in gamified settings based on competition or cooperation. We should work on looking at the influence of age, gaming experience, and major (computing, engineering, science) on the findings**. A large sample size would also allow more conclusive findings.

The participants in our study come from different countries and consequently have different cultural backgrounds. These cultural backgrounds can lead to different perceptions regarding gamified interface designs and different behaviors when interacting with this system. Thus, **we recommend that future studies investigate how different cultural backgrounds affect students' flow state in gamified settings**.

It is not uncommon to find studies reporting how educational experiences, whether gamified or not, can induce a flow state. However, the view of which dimensions of flow can be achieved from an instructional design perspective is still narrow. We have not yet fully understood how a learning experience should be designed to achieve a macro flow state, even if possible. Thus **we recommend that future studies be developed to measure the level of flow state created by educational interventions**. This is also a way to understand possible existing relationships between flow and engagement levels.

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