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# The effects of demographic factors on learners' flow experience in gamified educational quizzes

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## Abstract

In recent years, gamification gained widespread adoption in education aiming to increase students' positive experiences (e.g., motivation, engagement, and flow state). However, the results of using gamification in education are still contradictory, challenging the community to comprehend the influence of individual factors on learners' experiences within gamified educational systems. To tackle this challenge, this study explored how various demographic factors (i.e., gender, degree, individualism/collectivism, and masculinity/femininity) impact the flow experience of learners in a gamified educational quiz. A quantitative cross-cultural study involving 205 participants was conducted, utilizing partial least squares structural equation modeling to explore the influence of demographic factors on learners' flow experience in the gamified educational quiz. The analysis revealed that age has a significant positive association with learners' flow experience, while individualism has a negative association. These findings provide insights into educational technologies and gamification, offering a deeper understanding of how demographic factors shape learners' flow experience in gamified educational environments.

**Keywords:** Gamified education, Cultural implications, Gamified systems, Demographic aspects, Cross-cultural study

## Introduction

Approaches that incorporate game elements, specifically gamification (i.e., “the process in which services, activities, and systems are transfigured to promote similar motivational benefits as found in games” (Hamari, 2019; Koivisto and Hamari, 2019)), involve the strategic design of systems, services, and activities to offer motivational advantages akin to those typically found in games (Koivisto and Hamari, 2019; Riar et al., 2022; Wei and Hamari, 2023). By implementing gamification, the designers and educators aim to create an environment that encourages active participation, fosters motivation, and ultimately enhances the overall user experience and learning outcomes (Hamari, 2019; Koivisto and Hamari, 2019; Bai, Hew, and Huang, 2020). The explicitness and precision of established objectives, rules, visual techniques, and mechanisms within gamification can contribute to an engaging learning experience (Oliveira and Bittencourt, 2019b;

Huang et al., 2020; Bai, Hew, and Huang, 2020). Consequently, in education, the use of gamification can yield enhanced academic performance among learners, promoting their overall progress and assimilation of information (Özhan and Kocadere, 2020; Zainuddin, Chu, Shujahat, and Perera, 2020; Sailer and Homner, 2020).

One of the primary experiential elements that gameful systems strive to influence is the phenomenon referred to as the “flow experience” (Hamari and Koivisto, 2014; Oliveira et al., 2020, 2021) (i.e., challenge-skill balance, action-consciousness fusion, clear goals, unambiguous feedback, concentration, sense of control, loss of self-awareness, the transformation of time, and *autotelic* experience (Csikszentmihalyi and Csikszentmihalyi, 2014)). This experience involves a profound immersion and complete absorption in an activity (Shi, Cristea, Hadzidedic, and Dervishalidovic, 2014; Csikszentmihalyi and Csikszentmihalyi, 2014; Csikszentmihalyi, 2020). By skillfully designing systems that facilitate the flow experience, gameful approaches aim to optimize user engagement, satisfaction, and performance, fostering an ideal state of focus and enjoyment that motivates individuals to persist in their interactions and derive maximum benefits from the gameful system (Miller, 2013; Hamari, Koivisto, and Sarsa, 2014; Urh, Vukovic, Jereb, and Pintar, 2015; Oliveira et al., 2021). At the same time, while “in flow”, learners can be motivated to explore their capabilities, push their boundaries, and surpass their limitations (Csikszentmihalyi, 2020).

Despite recent studies that involve the use of gamification to lead learners to a flow experience, the studies have illuminated that individuals may distinctively respond to gamification designs, influenced by their unique user characteristics (Hallifax et al., 2019b; Hallifax, Lavoué, and Serna, 2020; Guimarães Santos et al., 2021). Therefore, understanding how individual aspects (e.g., demographic aspects) affect learners’ experience (e.g., the flow experience) has become a major challenge (Klock, Gasparini, Pimenta, and Hamari, 2020; Oliveira et al., 2022; Hong, Saab, and Admiraal, 2024). Conducting such analyses can help to identify the beneficial and useless aspects of gamified educational systems, which allows the development of a more personalized and adaptive system, providing a valuable source for identifying areas for improvement (Hallifax et al., 2019b, a; L. Rodrigues et al., 2020; Guimarães Santos et al., 2021; Hallifax, Lavoué, and Serna, 2020; Oliveira et al., 2022).

To address the existing gap concerning the influence of demographic factors on learners’ flow experience, a quantitative cross-cultural research study (N = 205) by using partial least squares structural equation modeling (PLS-SEM) was conducted to investigate the effects of demographic aspects (i.e., age, gender, individualism/collectivism, and masculinity/femininity) on learners’ flow experience (i.e., challenge-skill balance, action-consciousness fusion, clear goals, unambiguous feedback, concentration, sense of control, loss of self-awareness, the transformation of time, and *autotelic* experience) within a gamified educational quiz. The research aimed to answer the following research question: Do demographic factors influence learners’ flow experience in a gamified educational quiz?

The main results of our research indicated that: (i) the age of learners positively influenced their autotelic experience and overall flow experience; (ii) the degree of learners negatively impact the clarity of feedback; (iii) the level of individualism among learners negatively affected aspects such as challenge-skill balance, loss of self-consciousness,

clarity of goals, merging of action-awareness, and transformation of time; and (iv) the level of masculinity among learners positively influenced their perception of transformation of time. These findings provide insights into educational technologies and gamification, offering an understanding of how demographic factors can influence learners' flow experience within gamified educational quizzes. By illuminating the role of demographic aspects, our study provides a foundation for further exploration and refinement of gamified educational systems, to enhance the flow experience and optimize user engagement and satisfaction during system usage.

## Background

This section provides a summary of the key concepts explored in this article, specifically focusing on flow experience, and cultural orientation within educational contexts. Furthermore, we introduce and contrast the principal related studies.

### Gamification and flow experience in education

Since 2008, gamification (i.e., “the process in which services, activities, and systems are transfigured to promote similar motivational benefits as found in games” (Hamari, 2019; Koivisto and Hamari, 2019)) has received significant attention and has become widespread across multiple disciplines (Hamari, Koivisto, and Sarsa, 2014). The field of education has become the most widely researched area concerning gamification studies have been conducted and a large body of literature has been published highlighting the intersection of gamification and education (Hamari, Koivisto, and Sarsa, 2014; de Sousa Borges, Durelli, Reis, and Isotani, 2014; Koivisto and Hamari, 2019). This growing popularity of gamification in an educational context highlights its relevance and potential for improving the learning process (Zeybek and Saygi, 2024; Hong, Saab, and Admiraal, 2024).

Simultaneously, an experience that has captured the interest of researchers in the field of education is the phenomenon known as the flow experience (Oliveira et al., 2021; Yen and Lin, 2022; Wang, Wang, Wang, Hwang, and Xu, 2023). The “flow” is considered a maximum experience that people use in various life tasks with great motivation (Faiola, Newlon, Pfaff, and Smyslova, 2013) and can directly affect learning (Özhan and Kocadere, 2020). Csikszentmihalyi (1975) initiated the study of the Flow Theory, in which he reached the significant finding that individuals can fully engage in profound experiences and derive genuine happiness, independent of external rewards. Csikszentmihalyi's research led him to conclude that the ability to experience true satisfaction and contentment lies in immersing oneself in activities that evoke a state of flow (Nakamura and Csikszentmihalyi, 2009).

The flow experience encompasses nine interrelated parameters/dimensions that contribute to its composition. These parameters are (i) challenge-skill balance, (ii) action-awareness merging, (iii) clear goals, (iv) unambiguous feedback, (v) concentration, (vi) sense of control, (vii) loss of self-consciousness, (viii) transformation of time, and (ix) *autotelic* experience (Jackson and Eklund, 2002).

- *Challenge-Skill Balance* refers to the alignment between the level of challenge presented by an activity or task and the individual's skills or abilities. A balance

between the two ensures that the task is neither too difficult nor too easy, leading to a state of optimal engagement (Csikszentmihalyi, 2020).

- *Action-Awareness Merging* entails a seamless integration of action and awareness, where individuals become fully absorbed in the activity and experience a sense of “being in the zone”. They are fully focused on the task at hand, with a heightened sense of concentration and attention (Csikszentmihalyi, 2020).
- *Clear Goals* parameter involves having well-defined objectives or targets for the activity. Clear goals provide individuals with a sense of direction and purpose, guiding their actions and providing a sense of structure and motivation (Csikszentmihalyi, 2020).
- *Unambiguous Feedback* refers to the immediate and clear feedback individuals receive about their performance and progress in the activity. Timely feedback helps individuals gauge their performance, adjust their strategies, and maintain a sense of control and progress (Csikszentmihalyi, 2020).
- *Concentration* refers to a deep state of focus and absorption in the activity. It involves undivided attention and an ability to block out distractions, allowing individuals to channel their mental and physical energies towards the task at hand (Csikszentmihalyi, 2020).
- *Sense of Control* represents the perception of having influence and control over the activity. Individuals feel empowered and capable of influencing the outcome, which enhances their motivation and engagement (Csikszentmihalyi, 2020).
- The *Loss of Self-Consciousness* parameter denotes diminished self-awareness and self-consciousness during the flow experience. Individuals become less concerned about how they are perceived by others, allowing them to fully immerse themselves in the activity without inhibitions or distractions (Csikszentmihalyi, 2020).
- *Transformation of Time* refers to the altered perception of time experienced during flow. Time may appear to fly by, or individuals may experience a distortion of time, losing track of its passage due to their intense focus and deep engagement in the activity (Csikszentmihalyi, 2020).
- *Autotelic Experience* refers to the inherent enjoyment and fulfillment derived from the activity itself, rather than external rewards or outcomes. An autotelic experience is self-rewarding and intrinsically motivating, where individuals find the activity inherently enjoyable and find satisfaction in the process of engagement (Csikszentmihalyi, 2020).

These parameters collectively contribute to the state of flow, creating an optimal and highly engaging state of being in which individuals can achieve heightened performance, satisfaction, and enjoyment in their activities (Csikszentmihalyi, 1975; Csikszentmihalyi and Csikszentmihalyi, 2014; Csikszentmihalyi, 2020). A significant hurdle has been the endeavor to gain a comprehensive understanding of how various factors impact users’ experiences within gamified systems, which lies in unraveling the intricate interconnections between different elements and their influence on user engagement, satisfaction, and overall learning experience within the gamified environments (Behl et al., 2022; Riar et al., 2022; Baptista and Oliveira, 2019; L.F. Rodrigues, Oliveira, and Rodrigues, 2019).

### Cultural orientation

Cultural orientation/aspects refer to the values, beliefs, practices, traditions, and customs that characterize a particular group, society, or community (Cialdini and Trost, 1998). They encompass the shared knowledge, norms, rituals, symbols, and behaviors that shape the way people perceive, interpret, and interact with the world around them (Cialdini and Trost, 1998). Cultural aspects play a crucial role in shaping individual identities, social interactions, and the overall fabric of societies (Kroeber and Kluckhohn, 1952; Geertz, 1973; Hofstede, Hofstede, and Minkov, 2005).

Different demographic aspects can be considered, and the specific number may vary depending on the categorization and classification used. In this work, we explored such demographic aspects as (i) age, (ii) gender, (iii) degree, (iv) individualism/collectivism, (v) masculinity/femininity.

- *Age* is an essential demographic aspect that provides insight into the distribution and composition of different age groups within a population.
- *Gender* is an important demographic aspect that considers the diversity of gender identities and their representation within a population.
- *Degree* indicates the level of formal education completed by an individual, such as a high school diploma, bachelor's degree, master's degree, or doctorate. Educational attainment is a demographic aspect that reflects a person's educational qualifications.
- *Individualism/collectivism* is a cultural aspect that pertains to the extent to which individuals prioritize personal goals, independence, and individual rights over collective interests. It reflects the degree of emphasis placed on individual freedom, autonomy, and self-reliance within a society (Cialdini and Trost, 1998).
- *Masculinity/femininity*, in the context of cultural dimensions, represents the degree to which a society values traditionally masculine traits, such as assertiveness, competitiveness, and the pursuit of success. It is a cultural aspect that characterizes societal norms and expectations regarding gender roles and behaviors associated with masculinity (Nations, 2019).

### Related work

Gamification has gained significant popularity as a means to enhance various types of applications, including those in the educational domain (Böckle, Novak, and Bick, 2017; Koivisto and Hamari, 2019; Raj and Renumol, 2022). Toda et al. (2020) presents the Gamification for Cultural Studies Model (GamiCSM), which examines how cultural factors and gamification interact in education. Expert evaluation refined this model, creating an innovative framework that links game elements with cultural dimensions in educational settings, advancing empirical understanding at the crossroads of culture, gamification, and education (Toda et al., 2020). The main results indicate that the model garnered positive feedback and acceptance from respondents (Toda et al., 2020).

The study conducted by Filippou et al. (2018) examines the factors that influence students' preferences for gamification. Through surveying students' experiences with

an app-based test called the Quick Quiz, which includes elements such as scores, progress bars, leaderboards, timers, and graphs, they used partial least squares analysis to evaluate various factors. Their results showed that factors such as “usefulness”, “use preference”, “knowledge enhancement”, “engagement”, “immersion” and “pleasure” significantly influenced students’ propensity to gamification in their learning environment (Filippou, Cheong, and Cheong, 2018).

Koivisto and Hamari (2014) investigated differences in perceived benefits from gamification in the context of exercise. Using an exercise gamification service, the authors examined the effects of gender, age, and time using the service on social, hedonic, and utilitarian benefits and facilitating features of gamifying exercise (Koivisto and Hamari, 2014). The authors’ findings show that women report greater social benefits from the use of gamification, while ease of use of gamification is shown to decline with age.

Guimarães Santos et al. (2021) investigated how gamification user orientations are associated with the preference for and perceived sense of accomplishment from different gamification designs, also considering the participants’ age. While a series of associations were identified between the different profiles, no results related to the age of the participants were identified (Guimarães Santos et al., 2021).

Oliveira and Bittencourt (2019a) investigated whether students’ gamer types and gender have different perceptions in terms of preferences for gamification elements. The results suggested that there are no significant differences in terms of students’ gamer types and gender preferences for most of the gamification elements (Oliveira and Bittencourt, 2019a). Table 1 presents a summary of the related works.

Although earlier research has examined various factors, such as cultural dimensions, preferences for gamification elements, and demographic aspects, no specific investigation has been conducted on how demographic factors affect learners’ flow experience in a gamified educational quiz. Filling this gap will provide important insights into designing gamified learning environments that cater to diverse learner

**Table 1** Related works

Article	Demographic aspect	Study	Type	N
Toda et al. (2020)	Power distance, individualism/collectivism, uncertainty avoidance, masculinity/femininity, long/short-term orientation, and indulgence/restraint	Evaluate a model	Quantitative	8
Filippou et al. (2018)	Gender, age group, mode of study, student type	Preference for User	Quantitative and Qualitative	76
Koivisto and Hamari (2014)	Gender, age and time using the service on social, hedonic and utilitarian benefits and facilitating features of gamifying exercise	Perceptions of facilitating factors and social, hedonic, and utilitarian benefits	Quantitative	195
Guimarães Santos et al. (2021)	Age, education level, gaming habits	Association of hexad user types with the gamification design	Quantitative	331
Oliveira and Bittencourt (2019a)	Age, gender, gamer type	Motivation	Quantitative	121

demographics. The main contribution of this paper, compared to earlier studies, lies in its focus on the impact of demographic aspects on learners' flow experience in a gamified educational quiz. While previous research has identified associations between users' experiences and demographic factors, this study is the first to specifically explore how these aspects influence flow experience, addressing a critical gap in the field of gamified educational technologies.

### Study design

In this study, we investigated how demographic factors influence learners' flow experience in a gamified educational quiz. In this part, we outline the research study design.

### Materials and method

This study was conducted using a gamified educational quiz, where learners actively participate in this system. For this study, the system included a logic reasoning quiz with 20 questions, to get points, badges, and positions within a ranking system (Albuquerque et al., 2017). This specific system was selected because it incorporates the most frequently utilized gamification elements in educational environments (Koivisto and Hamari, 2019; Oliveira et al., 2022). Figure 1 presents an example of a logic reasoning quiz presented in the system.

To ascertain users' flow experience, we employed the Short Flow State Scale (Short-FSS), developed by Jackson and Eklund (2002). The decision to use this scale was based on its psychometric qualities, which Hamari and Koivisto (2014) evaluated in the context of gamification. They used thorough analysis and inquiry to determine the scale's validity and reliability, which made it the most suitable option for evaluating the flow experience in our study (Hamari and Koivisto, 2014). In addition, Oliveira et al. (2018) claims that the FSS is the most frequently used in research on educational technologies. Finally, Jackson et al. (2004) recommends the use of the short version of the scale in studies that are not long-lasting. Following the recommendation of Kung et al. (2018), we additionally included an "attention-check statement" (i.e., If you are completing the

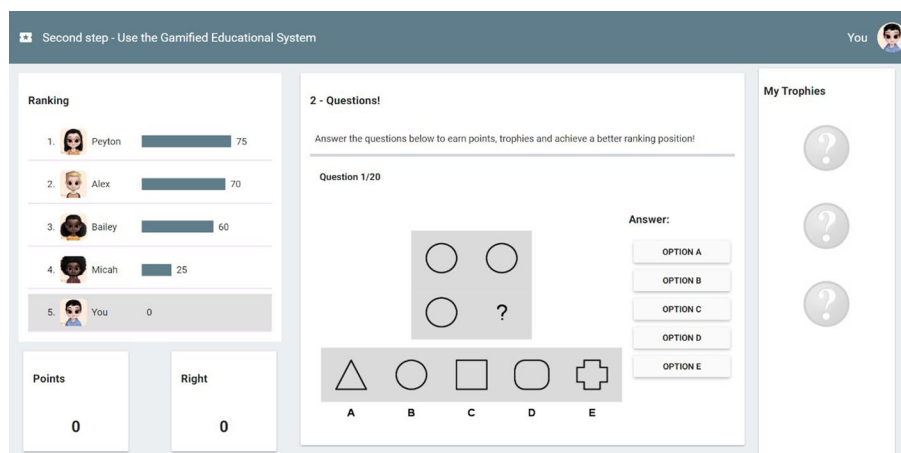
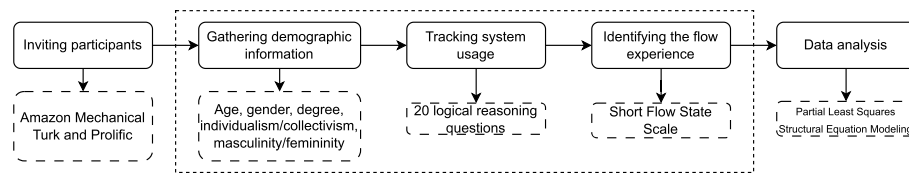


Fig. 1 Educational quiz example



**Fig. 2** Method

form attentively, respond to 4.) presented in a random order, intending to identify potential respondents who may not have given the appropriate attention to the scale.

The Hofstede Insights Culture Compass platform<sup>1</sup> which is based on Hofstede's Theory of cultural dimensions (Soares, Farhangmehr, and Shoham, 2007), was used to collect the cultural demographic data (i.e., individualism/collectivism, and masculinity/femininity). This platform is frequently used to learn more about the cultural values that people from other nations like. We were able to gather important information about the cultural demographic characteristics of our study participants by making use of this widely used tool (Cialdini and Trost, 1998).

In our research, we examined the following demographic aspects: age, degree, gender, individualism/collectivism, and masculinity/femininity. Specifically, individualism refers to the extent of interdependence maintained within a society among its members (Hofstede, 2009). In societies characterized by individualism, individuals are expected to prioritize themselves and their immediate families, whereas, in collectivist societies, community members support each other reciprocally, often exchanging care for loyalty (Hofstede, 2009).

*Masculinity* drives individuals to aspire to excellence (masculine) or to find enjoyment in their pursuits (feminine) (Hofstede, 2009). A high score (masculine) on this dimension suggests that society is oriented toward competition, accomplishment, and triumph, with success being defined by prevailing in one's domain (Hofstede, 2009). A low score (feminine) on this dimension indicates that the prevailing values in society prioritize caring for others and enhancing the quality of life (Hofstede, 2009).

The research comprised four distinct stages: (i) inviting participants, (ii) gathering demographic information, (iii) tracking system usage, and (iv) identifying the flow experience. Figure 2 present the study's method.

In the *first step* of the research study participants were recruited via two different online platforms (i.e., Amazon Mechanical Turk, and Prolific). Both platforms are crowdsourcing marketplaces that connect users with an on-demand, scalable, human workforce to complete tasks. In the *second step*, participants were requested to fill out a thorough demographic data collection form at this point, including important details about their background and pertinent features (i.e., age, gender, degree, and country). For their gender, we included the options "male", "female", and "I prefer not to inform". In the *third step*, participants actively interact with the gamified educational quiz that had been set up for this investigation. They were given a carefully selected set of 20 logical reasoning questions through this system, all of which were intended to encourage

<sup>1</sup> <https://www.hofstede-insights.com/product/culture-compass/>.

critical thinking and elicit analytical responses. Participants were able to actively engage in the gamified educational experience while also producing important data about their flow experience within the system by answering these questions. In the *fourth step* participants filled the short FSS.

### Participants description and data analysis

In this study, we analyzed the relationships between participants' demographic aspects and their flow experience using PLS-SEM. To ensure a sufficient sample to adequately detect effects, we used the *a-priori* sample size calculator method (Cohen, 1988). We used the Online Calculator for A-priori Sample Size Calculator for SEM proposed by Soper (2023) to conduct the calculations. This calculator uses formulas proposed by Cohen (1988) and Westland (2010) to compute the sample size required for a study based on SEM, given the number of observed and latent variables in the model, the anticipated effect size, and the desired probability and statistical power levels.

To set the correct number of participants for the study, we used the following parameters: anticipated effect size: 0.3; desired statistical power level: 0.8; number of latent variables: 6; number of observed variables: 14; probability level: 0.05. Especially, because we do not have proper previous literature with similar analyses to use as a base for defining the expected effect size, we used standard values from the literature to define the values (i.e., anticipated effect size: 0.3; desired statistical power level: 0.5; and probability level: 0.05 (Cohen, 1988; Westland, 2010)). The result indicated a minimum sample size to detect an effect of 161 participants.

The original database initially included 209 participants. One participant was excluded from the analysis because the country of origin wasn't available in the Hofstede Insights Culture Compass platform (with the country only as an estimate). Another participant was excluded because the country lacked data on the Hofstede Insights Culture Compass platform. Additionally, two participants were excluded for not disclosing their gender. As a result, our final sample consists of 205 participants (123 identified as male and 82 identified as female), which is deemed sufficient to detect effects (Cohen, 1988; Westland, 2010). The average age of participants is 24 years old (SD = 3.215 | Var = 10.287). Average individualism 61 (SD = 24.983 | Var = 621.099). Average masculinity 56 (SD = 12.268 | Var = 150.492). Appendix A present our study dataset.

Participants report the following countries of origin: USA 71 participants, India 48 participants, Portugal 26 participants, Poland 17 participants, Mexico 14 participants, Italy 10 participants, Brazil 4 participants, Spain 5 participants, Chile 3 participants, Greece 2 participants, Canada, Estonia, Germany, Latvia, and UK (1 participant each).

Participants were recruited from Amazon Mechanical Turk (MTurk)<sup>2</sup> (each receiving 25 cents for participation) and the Prolific platform<sup>3</sup> (each receiving 0.63 £ for participation). On the Prolific platform, the cost was automatically suggested based on the experiment's duration. We chose these two platforms to enlist participants from diverse countries and cultures, thus ensuring a heterogeneous demographic group.

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<sup>2</sup> <https://www.mturk.com/>.

<sup>3</sup> <https://prolific.co/>.

**Table 2** Composite reliability

	$\alpha$	CR ( $\rho a$ )	AVE
Flow	0.676	0.693	0.260

**Key:**  $\alpha$ : Cronbach's Alpha; CR: composite reliability; AVE: average variance extracted.

**Table 3** Discriminant validity

	Age	Degree	Flow	Gender	Individualism
Degree	0.425				
Flow	0.216	0.197			
Gender	0.040	0.043	0.145		
Individualism	0.464	0.014	0.161	0.144	
Masculinity	0.285	0.013	0.102	0.073	0.567

Additionally, no predefined criteria for participation were set to attract individuals with varied profiles. Data collection occurred in January 2020.

To examine how demographic factors influence users' flow experience, we utilized PLS-SEM, a method capable of modeling and analyzing intricate relationships (Sarstedt, Ringle, and Hair, 2021). The PLS-SEM method was used inside this framework to investigate the connections and interactions between the variables in our research model (Wong, 2013). With the aid of this cutting-edge software and approach, we were able to fully comprehend the intricate dynamics and associations present in our data (Wong, 2013). The software SmartPLS 3,<sup>4</sup> a program created exclusively for variance-based PLS-SEM, was used to analyze the data gathered for this investigation.

### Results

PLS-SEM operates similarly irrespective of assumptions regarding data normality (Sarstedt, Ringle, and Hair, 2021). Therefore, we first computed the composite reliability (CR) and discriminant validity (DV) of the models. Since each dimension of the flow experience consists of only one item in the short FSS, CR, and DV are required to calculate solely for the entire flow experience itself. Table 2 present the CR and Table 3 present the DV.

Subsequently, we assessed the impact of demographic information on participants' flow experience. Table 4 shows the path coefficients matrix and Table 5 present the  $R^2$  results. According to the path coefficients matrix data in Table 4. Findings demonstrate that age positively influences *autotelic* experience ( $\beta = 0.240 \mid p = 0.005$ ). Degree negatively impacts unambiguous feedback ( $\beta = -0.183 \mid p = 0.046$ ). Gender does not show any effect on flow experience dimensions. Individualism negatively affects *autotelic* experience ( $\beta = -0.186 \mid p = 0.027$ ), challenge-skill balance ( $\beta = -0.201 \mid p = 0.031$ ), clear goals ( $\beta = -0.210 \mid p = 0.018$ ), action-awareness merging ( $\beta = -0.367 \mid p = 0.000$ ), and transformation of time( $\beta = -0.265$

<sup>4</sup> <https://www.smartpls.com/>.

**Table 4** Path coefficients matrix

	$\beta$	Average	SD	<i>p</i> value	CI (B-C)	
					2.5%	97.5%
Age → A	<b>0.240*</b>	0.239	0.085	0.005	0.070	0.409
Age → C	0.096	0.092	0.082	0.238	-0.062	0.253
Age → CSB	<b>0.176*</b>	0.177	0.082	0.032	0.015	0.338
Age → CTRL	0.049	0.052	0.084	0.565	-0.124	0.208
Age → F	<b>0.199*</b>	0.197	0.081	0.014	0.038	0.357
Age → G	<b>0.214*</b>	0.215	0.090	0.018	0.032	0.383
Age → LSC	0.109	0.109	0.095	0.251	-0.077	0.294
Age → MMA	<b>0.184*</b>	0.184	0.083	0.026	0.022	0.338
Age → T	0.141	0.140	0.086	0.099	-0.025	0.310
Degre → A	0.018	0.020	0.073	0.809	-0.128	0.158
Degre → C	-0.101	-0.099	0.094	0.285	-0.285	0.088
Degre → CSB	-0.093	-0.088	0.092	0.314	-0.288	0.071
Degre → CTRL	0.036	0.036	0.078	0.647	-0.125	0.182
Degre → F	<b>-0.183*</b>	-0.181	0.092	0.046	-0.370	-0.012
Degre → G	-0.069	-0.066	0.094	0.462	-0.261	0.108
Degre → LSC	0.026	0.027	0.076	0.730	-0.120	0.177
Degre → MMA	0.137	0.141	0.073	0.059	-0.012	0.277
Degre → T	0.070	0.074	0.079	0.374	-0.095	0.221
Gender → A	-0.057	-0.058	0.069	0.409	-0.187	0.084
Gender → C	0.067	0.068	0.072	0.349	-0.077	0.205
Gender → CSB	0.050	0.048	0.070	0.477	-0.083	0.189
Gender → CTRL	0.024	0.024	0.071	0.733	-0.116	0.163
Gender → F	0.003	0.006	0.070	0.960	-0.136	0.139
Gender → G	0.054	0.055	0.075	0.471	-0.092	0.200
Gender → LSC	0.122	0.120	0.071	0.084	-0.014	0.264
Gender → MMA	-0.110	-0.111	0.064	0.088	-0.235	0.020
	$\beta$	Average	SD	<i>p</i> -value	CI (B-C)	
					2.5%	97.5%
Gender → T	0.101	0.100	0.069	0.141	-0.036	0.234
Individualism → A	<b>-0.186*</b>	-0.187	0.084	0.027	-0.347	-0.019
Individualism → C	0.055	0.060	0.097	0.571	-0.132	0.245
Individualism → CSB	<b>-0.201*</b>	-0.201	0.093	0.031	-0.374	-0.004
Individualism → CTRL	-0.062	-0.064	0.090	0.490	-0.240	0.111
Individualism → F	-0.128	-0.124	0.092	0.162	-0.312	0.047
Individualism → G	<b>-0.210*</b>	-0.209	0.089	0.018	-0.381	-0.031
Individualism → LSC	0.043	0.040	0.108	0.688	-0.170	0.259
Individualism → MMA	<b>-0.367*</b>	-0.374	0.082	0.000	-0.523	-0.202
Individualism → T	<b>-0.256*</b>	-0.256	0.086	0.003	-0.420	-0.080
Masculinity → A	0.078	0.077	0.075	0.298	-0.061	0.230
Masculinity → C	-0.025	-0.028	0.084	0.769	-0.191	0.137
Masculinity → CSB	0.018	0.018	0.072	0.803	-0.126	0.155
Masculinity → CTRL	-0.019	-0.018	0.084	0.818	-0.176	0.148
Masculinity → F	0.084	0.081	0.084	0.317	-0.086	0.243
Masculinity → G	0.128	0.127	0.083	0.124	-0.030	0.292
Masculinity → LSC	-0.100	-0.096	0.095	0.297	-0.279	0.088
Masculinity → MMA	0.148	0.153	0.081	0.068	-0.008	0.306
Masculinity → T	<b>0.159*</b>	0.159	0.080	0.048	0.004	0.318

**Table 4** (continued)

	$\beta$	Average	SD	<i>p</i> -value	CI (B-C)	
					2.5%	97.5%
<b>Age → Flow</b>	<b>0.304*</b>	0.318	0.100	0.002	0.022	0.457
<b>Degree → Flow</b>	0.035	0.030	0.137	0.798	−0.305	0.254
<b>Gender → Flow</b>	0.003	0.007	0.098	0.978	−0.183	0.197
<b>Individualism → Flow</b>	<b>−0.390*</b>	−0.402	0.111	0.000	−0.539	0.066
<b>Masculinity → Flow</b>	0.168	0.170	0.092	0.069	−0.039	0.332

\* The level of significance is the column *p*-value

**Key:**  $\beta$ , Regression Coefficient; CI, Confidence interval; B-C, bias-corrected; CSB, challenge-skill balance; MMA: action-awareness merging; G: clear goals; F, unambiguous feedback; C, total concentration on the task at hand; CTRL, sense of control; LSC, loss of self-consciousness; T, transformation of time; and A, *autotelic* experience; Values marked in bold are statistically significant

**Table 5** Internal predictive power ( $R^2$ )

	$R^2$	Adj. $R^2$
A	0.057	0.033
C	0.019	−0.005
CSB	0.036	0.012
CTRL	0.008	−0.017
F	0.040	0.016
G	0.046	0.022
LSC	0.035	0.010
MMA	0.123	0.101
T	0.071	0.048
Flow	0.128	0.106

**Key:** Adj.  $R^2$ , Adjusted  $R^2$ ; CSB, challenge-skill balance; MMA, action-awareness merging; G, clear goals; F, unambiguous feedback; C, total concentration on the task at hand; CTRL, sense of control; LSC, loss of self-consciousness; T, transformation of time; and A, *autotelic* experience

|  $p = 0.003$ ). Masculinity positively influences transformation of time ( $\beta = 0.159$  |  $p = 0.048$ ). Moreover, age has a favorable impact on flow ( $\beta = 0.304$  |  $p = 0.002$ ), while individualism, has a negative effect on flow ( $\beta = -0.390$  |  $p = 0.000$ ). Overall  $R^2$  values indicate a low internal predictive power (see Table 5).

The study’s findings point to different significant relationships between participants’ flow experiences and demographic information. Thus answering our research question (i.e., do demographic factors influence learners’ flow experience in a gamified educational quiz?), age has a positive impact on the autotelic experience and overall flow experience. The degree has a negative relationship with clear feedback. Individualism negatively affects challenge-skill balance, loss of self-consciousness, clear goals, action-awareness merging, and transformation of time. Masculinity had a positive effect on the transformation of time. Overall, although there are significant relationships between demographic factors and flow experience, the predictive power (i.e., *Adjusted  $R^2$* ) of the data is low, indicating that replications of the study in larger samples may be necessary to generalize the results.

## Discussion

Gamification is assuming an importance across a wide range of fields, and its use in educational institutions is gaining ground. The need to further investigate the precise modifications needed within the educational system is growing along with the need for tailored learning experiences. The focus of our study was determining how different demographic parameters affect users' flow experience in a gamified educational quiz.

Early study literature places a strong emphasis on the idea that autotelic experiences—rather than fleeting extrinsic rewards—are the main requirement for people to achieve flow, also emphasizing intrinsic drive and intense engagement in activities due to their inherent enjoyment (Csikszentmihalyi and Csikszentmihalyi, 2014). The results of our study provide insightful contributions to understanding how demographic factors influence flow experiences in a gamified educational environment. Specially, our findings indicate that age positively impacts both autotelic experiences and overall flow, suggesting that as individuals mature, they develop a deeper sense of purpose and engagement in tasks that enhance their flow states. This aligns with previous research suggesting that older adults have a more refined awareness of their goals and intrinsic motivations, which may facilitate more profound and sustained flow experiences (Chi, Ram, and Carstensen, 2023).

Conversely, the negative relationship between educational degree and clear feedback highlights an intriguing aspect of flow experiences. Participants with higher degrees reported less clarity in feedback, which may reflect a more nuanced or critical interpretation of feedback in complex tasks. This could imply that highly educated individuals might seek more specific or sophisticated feedback to maintain their engagement, a notion supported by similar studies (Mayordomo, Espasa, Guasch, and Martínez-Melo, 2022; Winstone and Carless, 2019).

At the same time, this result draws attention to the fact that feedback is an antecedent of the flow experience (Csikszentmihalyi and Csikszentmihalyi, 2014) and, when negatively affected, harms the flow experience as a whole (Csikszentmihalyi, 2020). It is also possible that a person with more knowledge has more expectations and accordingly less flow. This finding contradicts some earlier research but is consistent with studies that show gender has no bearing on the majority of the flow experience, even when other factors may be at play (Santos et al., 2022; Oliveira et al., 2022).

Interestingly, masculinity was found to positively influence the transformation of time, indicating that participants who align with traditionally masculine traits may experience a more fluid sense of time during flow states. This may be attributed to cultural factors that associate masculinity with action-oriented and goal-driven behaviors, which can facilitate an immersive experience (Hofstede, 2009). While these findings contribute valuable insights, the low predictive power of the demographic factors suggests that replications of the study with larger samples are necessary for the generalizability of the study.

## Threats to validity and limitations

During this study, some threats to validity and limitations inherent to the nature of the study arise and will be discussed in this section. At the same time, these limitations generated some insights for the future. Although participants were requested to indicate

their country of origin, our study was unable to ascertain if these individuals currently reside in their declared country of origin or if their responses have been influenced by other cultural factors stemming from their relocation or extended periods spent outside their native land.

The cross-sectional design of the study, by capturing data at a single point in time, limits the ability to infer causal relationships between variables. Although we included several demographic factors, simplifying variables such as individualism/collectivism and masculinity/femininity may not capture the full complexity of these constructs. Despite efforts to control variables, unconsidered external factors may have influenced participants' flow experience.

At the same time, the process of data gathering via crowdsourcing platforms may produce results that differ from those obtained from studies conducted within genuine ecological settings. The imposition of a regulated online environment may bring about certain partialities or discrepancies that would not typically exist in authentic settings, thereby possibly impacting the flow experience of participants. The flow experience is intrinsically complex, involving several psychological aspects. Although we explored multiple components, the complexity of the flow experience may not have been fully captured by the variables considered.

#### **Insights for future studies**

The demographic aspects were not analyzed the demographic aspects as a moderating variable between pedagogical aspects and participants' flow experience. Thus, it is recommended that future studies explore demographic factors as a moderating variable in the relationship between pedagogical aspects and participants' flow experience. This comprehensive analysis can contribute to a better understanding of the relationship between flow and learning experience.

The cultural identity of a nation comprises a wide range of demographic factors that surpass the parameters investigated in our research. To attain a more comprehensive comprehension of the impact of demographics on user experiences, it is recommended that forthcoming scholarly inquiries assimilate supplementary demographic facets. A more nuanced comprehension of the interplay between user experiences and demographics can be achieved by considering a wider range of demographic factors.

The main objective of the investigation was to investigate the relationships between demographic factors and the participants' flow experience in a gamified educational environment. However, personalized recommendations, it is beyond the purview of our research. Notwithstanding, it is suggested that forthcoming investigations can utilize our findings as a foundation to yield personalized recommendations that are founded on the recognized associations between demographic factors and the concept of flow experience. By utilizing the insights gleaned from our study, researchers can investigate more deeply how personalized methodologies can be employed to improve the flow experience.

In essence, the present investigation has provided insight into the influence of demographic variables on the phenomenon of flow within a gamified educational quiz. Forthcoming studies can extend beyond the boundaries of our research by delving into diverse human encounters in academic environments while taking into account a wider

spectrum of demographic factors. Moreover, based on the results of the study, researchers can delve into tailor-made methodologies and devise suggestions for enhancing the state of flow for individual users in educational systems.

### Concluding remarks

This study primarily aimed to explore how demographic variables influence the flow experience of learners while engaging with a gamified educational quiz. The findings indicate various significant relationships between participants' flow experiences and their demographic information. The results indicate that age positively influences both autotelic experience and overall flow experience. In contrast, the level of education shows a negative correlation with clear feedback. Individualism adversely affects the balance between challenge and skill, loss of self-consciousness, clear goals, action-awareness merging, and the perception of time. Interestingly, masculinity positively impacts the transformation of time. In general, while there are notable relationships between demographic factors and flow experience, the predictive power of the data remains low. The key finding suggests that older participants are more likely to experience an immersive and engaging flow state during their interaction with the gamified educational quiz. Additionally, our research highlights the influence of demographic factors on various aspects of the flow state.

In future studies, it is planned to broaden our investigation by replicating it with a larger and more diverse population, as well as incorporating additional demographic variables into our analysis, acknowledging the many factors that could affect the flow experience within a gamified educational context. Furthermore, future research could examine how cultural dimensions and socio-economic backgrounds impact the flow state, as these factors may interact with gamification elements in distinct ways. Longitudinal studies could also be beneficial in assessing how prolonged exposure to gamified systems influences the flow experience of learners over time, especially among participants from different demographic backgrounds. Future research could explore how technology accessibility and digital literacy influence the experience of flow. By using neurophysiological tools like EEG or eye-tracking, researchers might uncover more about the cognitive and emotional dimensions of flow. Additionally, interdisciplinary collaboration among psychology, education, and game design could foster the creation of more customized and inclusive gamified educational systems. Lastly, examining how different gamification design elements, such as feedback systems or adaptive difficulty, affect various demographic groups could enhance our understanding of how to improve gamified learning environments for a wide range of learners.

### Study dataset

The study dataset can be accessed from this link: <https://osf.io/rywqg/>.

#### Abbreviations

PLS-SEM	Partial least squares structural equation modeling
SD	Standard deviation
Var	Variance
CR	Composite reliability
DV	Discriminant validity

FSS	Flow estate scale
AVE	Average variance extracted
$\beta$	Regression coefficient
CI	Confidence interval
B-C	Bias-corrected
CSB	Challenge-skill balance
MMA	Action-awareness merging
G	Clear goals
F	Unambiguous feedback
C	Total concentration on the task at hand
CTRL	Sense of control
LSC	Loss of self-consciousness
T	Transformation of time
A	Autotelic experience
Adj. R <sup>2</sup>	Adjusted R <sup>2</sup>

#### Author contributions

Ainur Issabek: Conceptualization, Data curation, Formal analysis, Investigation, Writing original draft; Wilk Oliveira: Conceptualization, Methodology, Project administration, Supervision, Validation, Writing original draft, Writing review & editing; Juho Hamari: Funding acquisition; Andrey Bogdanchikov: Supervision.

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#### Availability of data and materials

The authors declare that all data and materials are available as an appendix in the article.

#### Declarations

##### Ethics approval and consent to participate

Not applicable.

##### Competing interests

The authors declare no Conflict of interest.

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