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# To Use or Not to Use: Impact of Personality on the Intention of Using Gamified Learning Environments

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**Abstract:** Technology acceptance is essential for technology success. However, individual users are known to differ in their tendency to adopt and interact with new technologies. Among the individual differences, personality has been shown to be a predictor of users' beliefs about technology acceptance. Gamification, on the other hand, has been shown to be a good solution to improve students' motivation and engagement while learning. Despite the growing interest in gamification, less research attention has been paid to the effect of personality, specifically based on the Five Factor model (FFM), on gamification acceptance in learning environments. Therefore, this study develops a model to elucidate how personality traits affect students' acceptance of gamified learning environments and their continuance intention to use these environments. In particular, the Technology Acceptance Model (TAM) was used to examine the factors affecting students' intentions to use a gamified learning environment. To test the research hypotheses, eighty-three students participated in this study, where structural equation modeling via Partial Least Squares (PLS) was performed. The obtained results showed that the research model, based on TAM and FFM, provides a comprehensive understanding of the behaviors related to the acceptance and intention to use gamified learning environments, as follows: (1) usefulness is the most influential factor toward intention to use the gamified learning environment; (2) unexpectedly, perceived ease of use has no significant effect on perceived usefulness and behavioral attitudes toward the gamified learning environment; (3) extraversion affects students' perceived ease of use of the gamified learning environment; (4) neuroticism affects students' perceived usefulness of the gamified learning environment; and, (5) Openness affects students' behavioral attitudes toward using the gamified learning environment. This study can contribute to the Human–Computer Interaction field by providing researchers and practitioners with insights into how to motivate different students' personality characteristics to continue using gamified learning environments for each personality trait.

**Keywords:** educational technology; technology acceptance; gamification; personality; learning



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## 1. Introduction

Gamification is the use of game design elements, such as points, badges, and leaderboards, in a non-gaming context to improve user engagement and motivation [1]. The idea behind the use of gamification in educational environments is to improve students'

motivation and learning experience in a learning environment by employing gamification elements [2]. Students' motivation is considered to be one of the most important factors leading to their academic success [3] and, therefore, several studies have focused on enhancing students' motivation while learning through the application of gamification [4,5]. In particular, several studies showed the effectiveness of gamification in enhancing students' intrinsic motivation and engagement in higher education [6], as well as its feasibility in higher education teaching and learning processes, as many options and platforms are available to be utilized [7].

Despite the revealed positive impact of gamification on education, some studies reported negative effects regarding its implementation [8–10]. For instance, the use of competitive game elements, such as badges and leaderboards, can have a negative impact on low performing students [8]. Additionally, Mert and Samur [11] found that if the gamification system is not well implemented and correctly used, it can negatively affect student behaviors and participation. The aforementioned studies confirm Kapp [12] and Werbach and Hunter [13], who stressed that gamification might not work in every system or create the same effect, as learning experiences are affected by a wide range of factors.

Initial acceptance and use of a gamified learning environment are essential for its success in motivating and engaging students in higher education [14]. Therefore, several previous studies in the related literature focused on the acceptance of gamified learning environments [7,14,15]. For instance, Rahman et al. [14] proposed a gamification acceptance model based on the Technology Acceptance Model (TAM) to test students' acceptance of gamification and its effects on their engagement rate during the lessons. Results showed that students' acceptance of gamification affects their engagement while learning. Specifically, to test students' acceptance of gamified learning environments, various studies used TAM and extensions of TAM, such as TAM 2 [16] and Unified Theory of Acceptance and Use of Technology (UTAUT) [17]. TAM, proposed by Davis [18], is a theoretical framework that explains user acceptance of technology in a wide range of fields. According to earlier meta-studies, TAM is also used in a large number of empirical studies to explore users' participation intention [19,20].

On the other hand, students have different personalities and because of that they may behave differently, which means that they may have different technology acceptance behavior [21,22]. In this context, Svendsen et al. [22] highlighted the relationship between personality and technology acceptance. Therefore, it is not surprising that several recent studies investigated the effect of personality traits on technology adoption, such as smartphones [21], social networking sites [23], business intelligence tools [24], e-Learning [25], and digital library systems [26]. However, according to the recent literature review of Panagiotarou et al. [15], and to the best of our knowledge, no study has investigated the effect of personality on students' adoption of gamified learning environments. In this regard, this study investigates the relationship between personality and the intention to use gamified learning environments. In particular, it uses TAM [18] to explore the factors affecting students' intention to use gamified learning environment.

In this study, an adoption model was developed to explain how different personality traits can affect students' acceptance of gamified learning environments. In particular, the self-determination theory was applied while implementing the game design elements in the learning environment to fulfill students' psychological needs. Besides, this study focuses on the FFM of personality, which is derived from common language descriptors [27,28] and is widely acceptable.

## 2. Related Literature

The first subsequent section summarizes literature relevant to the development of gamification in education to justify using TAM in this specific domain. The second subsequent section presents the factors affecting the perception of gamification in education, specifically personality, which is considered to be the most relevant factor in students'

characteristics [29], as well as the relationship between TAM and personality. Finally, the last subsection presents the research gap and the need for this study.

### 2.1. Gamification and Technology Acceptance

Gamification can be defined as a set of activities and processes used to solve problems by utilizing or applying game design elements [30]. Several studies have highlighted the potential of gamification in increasing students' motivation and engagement as well as boosting their performance [6,31]. For instance, Kaufmann [32] showed that gamification can help students overcome complex academic challenges, such as those involved in the dissertation process and other elements of higher learning. Ahmad et al. [33] showed, in an experimental study for computer science majors, that gamification is an effective tool to teach tough courses in higher education. Çakıroğluet al. [34] showed that points, leaderboard, quests, and reputation increased students' engagement and participation in an undergraduate course. However, despite the great benefits of gamification [35], it can also have negative outcomes. For instance, gamification can cause loss of performance, where it harms or hinders students' learning process [9]. It can also cause undesired behavior due to the use of some game design elements [9].

The mixed (positive and negative) findings on gamification are linked to the perception of technology that can vary based on the target groups' backgrounds and earlier experiences. For instance, Collan [36] stated that the acceptance of a new technology by students goes through stages like identifying needs or minimally selecting a solution to fulfill a need from a set of possible alternatives. Thus, students seek new technologies that they can use for different purposes. Behl et al. [37] referred the acceptance of the gamification concept to the acceptance of the whole environment (e-learning environment), since there is a link between the concept of gamification and technology, as it plays a vital role in facilitating gamification features. In particular, the use of gamified learning environments is still a sensitive subject for many educational systems [38,39]. In the Hungarian education system, for example, when analyzing students' behaviors while interacting with a gamified learning environment using TAM, it was found that students have different intentions toward using this environment [38]. Additionally, it was found that students' positive attitudes toward using gamified learning environments contributed to the improvement of their performance. Feriande [39] also found that students' acceptance of the gamified environment affects their interactions with course materials.

Several recent studies have further highlighted the influence of external factors, such as students' characteristics, on technology acceptance [15,40]. Therefore, different studies in the literature have focused on the factors affecting students' acceptance of gamified learning environments. For instance, Panagiotarou et al. [15] found that digital skill levels can affect students' acceptance of gamified learning environments. Oluwajana et al. [41] found that curiosity can affect students' acceptance of gamified learning environments. Moreover, Vanduhe et al. [42] found that social influence and social recognition can affect students' perception of ease of use and usefulness in a gamified learning environment. The next subsequent section discusses personality, which is considered to be an important student characteristic that can affect technology acceptance [40].

### 2.2. Personality

Saucier and Srivastava [43] defined personality as "all of the attributes, qualities and characteristics that distinguish the behavior, thoughts, and feelings of individuals". Several personality models exist in the literature; however, FFM is the predominant dimensional model of general personality structure [27]. It is based on five dimensions that describe people's diversity [44], namely (1): Extraversion reflects an individual's degree of assertiveness, sociability, and positive emotions; (2) Agreeableness reflects an individual's degree of kindness, maintenance of social harmony, cooperation, and trust; (3) Conscientiousness reflects an individual's degree of organization, self-discipline, and tendency to be responsible; (4) Neuroticism reflects an individual's degree of stress, dissatisfaction, and sadness; and

(5) Openness reflects an individual's degree of imagination, creativity, and appreciation of esthetic experiences.

The related studies suggest that personality is the reason people accept or reject a given technology [26], as well as educational tools like educational games [45]. Tlili et al. [46] further highlighted the effect of personality on students' perception of intrinsic motivation in a gamified learning environment. In addition, recent studies showed that students' personalities can affect their perception of using different game design elements in a gamified learning environment [47,48]. Bayne [49] stated that students' personalities can differently affect their involvement in the learning progress regardless of their personal interests or the degree of cognitive development. With respect to TAM, several studies in the literature have highlighted the relationship between personality and TAM [21–23,40]. Specifically, they consider that any difference in perceived ease of use and usefulness may be caused by personality differences.

### *2.3. Research Gap and the Purpose of This Study*

Despite the importance of personality in affecting students' behavioral acceptance, some studies still highlight the gaps in knowledge concerning the relationship between personality and technology acceptance [40]. Additionally, a previous study critiqued TAM for not including personality, based on the five-factor model, as a determinant toward technology adoption [22]. Specifically, according to the literature review of Panagiotarou et al. [15] regarding gamification acceptance and to the best of our knowledge, no study has investigated the impact of personality on gamification acceptance in the educational domain, i.e., the effect of extraversion or any other personality trait (within FFM) on students' perception of usefulness or any other measure, within TAM, in a gamified learning environment. In this context, it is believed that this paper contributes as a complementary study by examining the effect of personality on gamification acceptance in a learning environment. Specifically, the findings of this study could provide researchers and practitioners with insights into how to motivate different students' personality characteristics to continue using gamified learning environments for each personality trait group.

## 3. Research Model and Hypothesis

Based the theoretical background of TAM, gamification, and the FFM of personality, we propose a research model that identifies personality as a predictor of the continuance intention to use gamified learning environments. The relationship between the personality traits is integrated in the conceptual model depicted in Figure 1. This model was adapted from a prior Information Systems-related study [50]. The basic assumption is that the continuance intention to use gamified learning environments is jointly determined by perceived usefulness and attitude, which are functions of perceived ease of use and personality traits. Each of the hypotheses (H1-H16), highlighted in Figure 1, are discussed in the next subsequent sections.

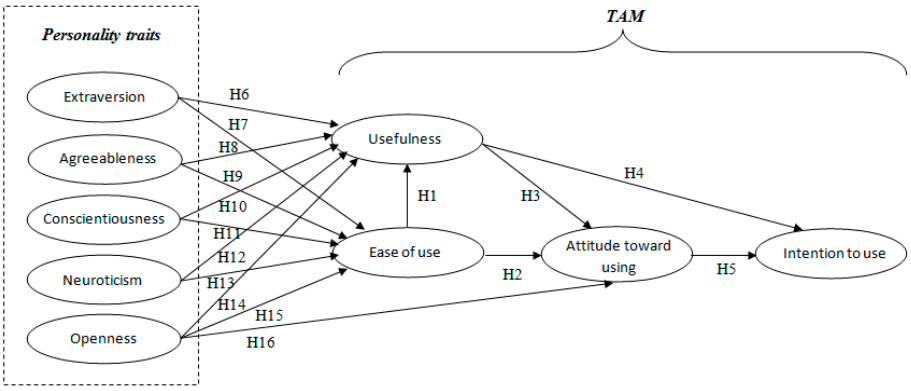


**Figure 1.** Proposed research model of personality and intention to use gamified learning environments.

### 3.1. TAM

#### 3.1.1. Perceived Ease of Use

In the context of gamification in online learning environments, perceived ease of use can be defined as the extent to which a person believes that interacting with a gamified learning environment will be free of effort [18]. Past studies have shown that perceived ease of use can affect users' perceived usefulness of and behavioral attitudes toward using systems [50,51]. For instance, Wu and Chen [50] found that perceived ease of use was vital for the perceived usefulness of and behavioral attitudes toward using Massive Open Online Courses (MOOCs). Similarly, perceived ease of use could affect the intention to accept gamified learning environments directly or indirectly through perceived usefulness. Thus, we propose the following research hypotheses:

**H1.** Perceived ease of use affects the perceived usefulness of gamified learning environments.

**H2.** Perceived ease of use affects behavioral attitudes toward using gamified learning environments.

#### 3.1.2. Perceived Usefulness

Perceived usefulness refers to the extent to which users believe that using a particular system can enhance the performance of their job [52]. In this study, the perceived usefulness of gamified learning environments can be described as the extent to which students believe that gamified learning environments can help them in enhancing their learning achievements. Perceived usefulness is a construct that has repeatedly been shown to influence behavioral attitudes toward a given system and to be a direct predictor of continued intention to use a given system [50]. For instance, Huang et al. [53] found that perceived usefulness had a positive effect on undergraduate students' intention to use mobile learning. Thus, we propose the following research hypotheses:

**H3.** Perceived usefulness affects behavioral attitudes toward using gamified learning environments.

**H4.** Perceived usefulness affects intention to use gamified learning environments.

#### 3.1.3. Perceived Behavioral Attitudes toward Using a System

A strong relationship between behavioral attitudes toward using a given system and intention to use it was highlighted in TAM. The attitude toward using gamified learning environments can be defined as the degree to which a student perceives a positive or negative feeling related to gamified learning environments. Previous study found that attitude has a strong impact on intention to use technology [54]. In the educational gamification context, it has been reported that the behavioral attitudes toward using gamification was a significant determinant of intention to use it [15]. In another study, regarding the adoption of online education in crisis, it was found that behavioral attitudes affect positively the intention to use online education [20]. Thus, we propose the following research hypothesis:

**H5.** Behavioral attitudes toward using gamified learning environments affect the intention to use them.

### 3.2. Personality

The relationship between personality based on the FFM and TAM has been highlighted in the literature [24,26]. Several studies have found that personality traits can have an affect, specifically perceived ease of use and usefulness [22,55], which are considered the most important factors affecting the intention to use a given system [18]. Therefore, we expect that different personality traits can affect students' perception of usefulness and ease of use of gamified learning environments.

The relationship between extraversion and TAM, specifically usefulness and ease of use factors, was highlighted by Svendsen et al. [22]. Specifically, the reason to hypothesize that extraversion can affect perceived ease of use and usefulness is that optimism, which is one of the characteristics of extraversion, was shown to relate positively to perceived

ease of use and usefulness [56]. In this context, Mouakket [57] also found that extraversion positively affected students' perception of usefulness. Therefore, we propose the following hypotheses:

**H6.** Extraversion affects perceived usefulness of gamified learning environments.

**H7.** Extraversion affects perceived ease of use of gamified learning environments.

According to Svendsen et al. [22] and Mouakket [57], agreeableness is proposed to affect technology acceptance. In this regard, we propose the following hypotheses:

**H8.** Agreeableness affects perceived usefulness of gamified learning environments.

**H9.** Agreeableness affects perceived ease of use of gamified learning environments.

For conscientiousness, Svendsen et al. [22] also identified a positive relationship between this personality trait and technology usage. Specifically, people high in conscientiousness are more likely to look for opportunities to use technology that will allow them to improve their performance in their jobs [55]. In this regard, we propose the following hypotheses:

**H10.** Conscientiousness affects perceived usefulness of gamified learning environments.

**H11.** Conscientiousness affects perceived ease of use of gamified learning environments.

People high in neuroticism are more likely to see technological advancements in their work as a threat and source of stress [24]. Additionally, it has been found that emotional stability can significantly affect internet use, social use, and information searches [58]. On this basis, we propose the following hypotheses:

**H12.** Neuroticism affects perceived usefulness of gamified learning environments.

**H13.** Neuroticism affects perceived ease of use of gamified learning environments.

Openness refers to people's willingness to examine new and different things [59]. Therefore, Devaraj et al. [55], Mouakket [57], and Harb and Alhayajneh [24] proposed a relationship between openness and perceived ease of use and usefulness of technology. Thus, we propose the following hypotheses:

**H14.** Openness affects perceived usefulness of gamified learning environments.

**H15.** Openness affects perceived ease of use of gamified learning environments.

The openness personality trait has been found to be highly correlated with behavioral attitudes, since it reflects human openness toward new experiences [60]. Therefore, we propose the following hypothesis:

**H16.** Openness affects perceived behavioral attitudes of gamified learning environments.

## 4. Method

### *4.1. Study Context*

To evaluate the acceptance of gamification in higher education, a newly gamified course for learning "Object-Oriented Design Methodology" (OODM) was developed. This course aims to help students learn Unified Modeling Language (UML) diagrams, such as the class diagram and the use case diagram. The course was deployed on Moodle (Modular Object-Oriented Dynamic Learning Environment) platform because it allows the integration of game design elements, such as points and badges. In addition, the students who participated in this study were familiar with Moodle and used it for non-gamified courses. To assess students' performance in the gamified learning environment, various forms of activities were included in Moodle to be completed individually or in teams. Additionally, weekly learning materials in different forms, such as PowerPoint presentations, videos, external links for online resources and mental break items (e.g., images) were added to the course.

To achieve effective and meaningful gamification that can promote students' motivation and engagement, the implemented game design elements should fulfill students' basic psychological needs [61,62]. Therefore, Self Determination Theory (SDT), which has been successfully applied in the context of games and gamification [47,63,64], was used in this study. This theory is based on three basic needs that reflects personal growth and psychological well-being, namely: (1) Competence, which refers to the desire to feel effective in interacting with the environment [65]; (2) Autonomy, which refers to the feeling of freedom in making choices and self-direction [66]; and (3) Social relatedness, which refers to the need to interact and to be connected to others [67]. Several gamification design frameworks have been proposed in the literature. For instance, Marczewski [68] proposed a framework based on 52 game design elements. Additionally, Werbach and Hunter [13] proposed another framework based on 30 game design elements. In summary, eight game elements are commonly used in both frameworks. Table 1 presents these eight game design elements which were later used in the design of our gamified course and their matching with the three psychological needs within the SDT. It should be noted that the efficiency of the proposed gamification design, based on the SDT, has already been validated in [46]. In particular, the obtained results showed the effectiveness of the designed gamified and self-determined environment in improving students' intrinsic motivation while learning.

**Table 1.** Implemented game design elements in OODM course.

| Psychological Needs | Game Design Elements | Matching Psychological Needs to Game Design Elements |
|---|---|---|
| Competence | *Points*: a numerical presentation of students' performance. | Element that shows students' performance. |
| | *Badges*: a sort of virtual rewards. | Element that shows students' performance. |
| | *Leaderboard*: shows the ranking of each student against other students. | Element that shows students' expertise. |
| | *Progress bar*: shows students' progress in a given course. | Element that shows students' progression. |
| | *Feedback*: teachers' feedback. | Element that shows students' performance |
| | *Levels*: the level achieved by each student in a given course. | Element that shows students' expertise. |
| Autonomy | *Avatar*: a visual representation of the student. | Students have the freedom to choose the photo/avatar that better represent them in the gamified course. |
| | *Badges*: a sort of virtual rewards. | Students can display or hide their awarded badges on their profiles. |
| Social relatedness | *Chat*: instantaneous discussion. | Students have the possibility to interact and work together to complete a given task. |

The functionalities of the eight implemented game design elements (presented in Table 1) in our gamified course are detailed below.

1. Points: Zichermann and Cunningham [69] recommended using different types of points based on students' contributions to promote participation in the course. Therefore, each completed learning activity in the gamified course supported students with 50 experience points. They were also given 9 skill points for completing the teacher's supplementary learning activities.
2. Levels: There were twenty levels in the course. According to Simões et al. [70], these levels should be sorted from easiest to hardest for reflecting the students' newly acquired skills. Each week, students had the challenge of accumulating a set amount of points by completing a series of activities in order to advance to the next level. The intricacy of these weekly tasks was also taken into consideration when they were added (from the easiest to the hardest). For instance, in the first week, students were expected to graduate from level 1 to level 2. Each student had to score at least 120 points to do so. Virtual badges displaying the reached level number were used to present levels.
3. Badges: Enders and Kapp [71] recommended the use of badges only for meaningful achievements that demand some work to obtain. Therefore, in order to acquire a badge,

students had to complete an assignment or quiz at the end of each level, which assessed their comprehension of all the content learned at that level. As indicated in Figure 2, several sorts of badges were used in the course depending on the completed activity. For instance, when students finished all the required assignments, they received a badge entitled "Problem solver", which means that the student has solved all the problems related to the given assignments. In addition, the illustration of this badge, as shown in Figure 2, shows a picture of a lamp to refer to students' ideas for solving the required assignments.


**Figure 2.** Examples of the badges used in the gamified course.

4. Avatar: Students had the freedom to upload personal avatars, which represented them within the gamified course, to make the course more enjoyable. Students were also given the freedom to create their own individualized avatars in order to increase their emotional attachment, which resulted in a higher degree of engagement [72]. The avatars chosen by the students were also shown on the leaderboard.
5. Leaderboard: Students' ranks were shown on a leaderboard based on the points they had earned in the course. Its goal was to make students more competitive while learning. In addition, the leaderboard featured a real-time update system for students' ranks (i.e., if a student earned more points, his or her place on the leaderboard was updated automatically in real time). As a result, students were able to see themselves on the board, which gave them the feeling that they had a chance to win [73]. The student with the highest position on the leaderboard at the end of the semester was announced as the course winner. Figure 3 presents the leaderboard of the OODM course, displaying students' avatars, levels, progress in this level and collected points.
6. Feedback: Every week, students received amusing feedback from their teacher via Moodle, including photos and texts, to ensure their psychological well-being and inspire them to study more [74]. The teacher wrote the evaluation based on each student's performance during the course (e.g., according to the accumulated points or badges).
7. Progress bar: Students should be able to clearly see their growth toward the course goal in order for a course to be meaningful to them [75]. As a result, a colored progress bar was created, to which weekly activities were added. In the progress bar, an unfinished activity was colored blue, while a completed activity was colored yellow, as seen in Figure 4. When feedback was received on an activity, it was colored green. This provided students with a sense of progression throughout the course.

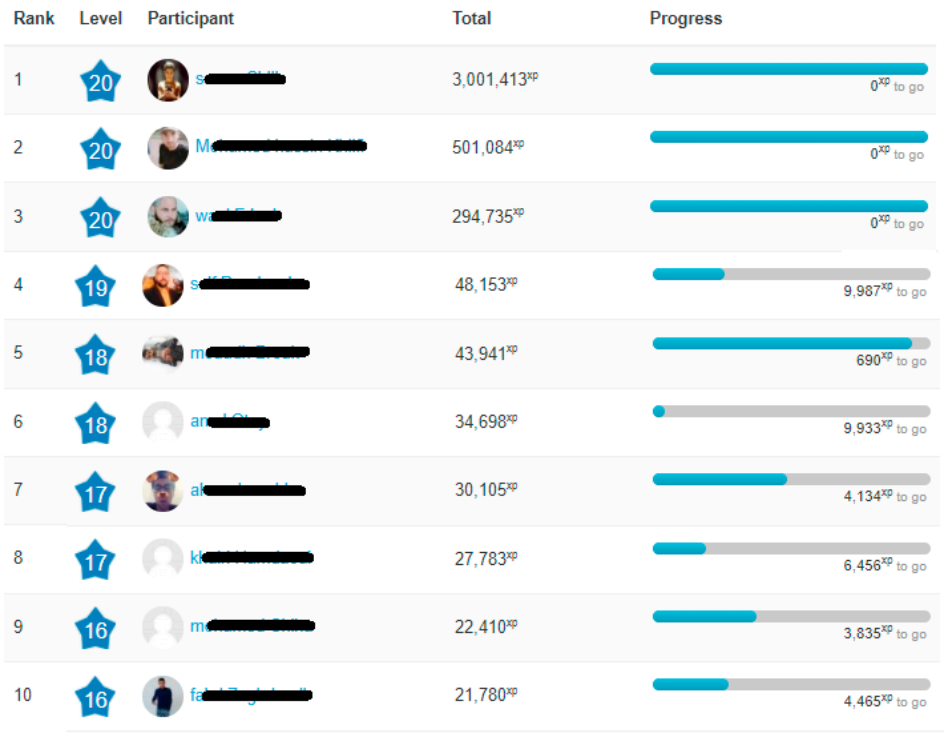


**Figure 3.** Leaderboard of the OODM course.


**Figure 4.** Progress bar of OODM course.

8. Chat: Students could use immediate discussion to collaborate with their friends or to assist them if they had any questions. Furthermore, as recommended by Hou and Wu [76], in order to encourage students to complete the required goals in teams, they received several points once they had completed them.

### *4.2. Research Participants and Procedures*

An experiment was conducted at a public Tunisian university. The participants were eighty-three undergraduate students aged between 18 and 25, majoring in computer science. Among the eighty-three students, fifteen students were removed because they dropped out and twelve because they did not complete all the questionnaires. Finally, fifty-six students took part in this experiment. The demographic details of the students are presented in Table 2.

At the beginning of the semester, the students answered the Big Five Inventory (BFI) to determine their personalities. After that, they used the gamified Moodle to learn OODM for one semester (three months). Before starting the course (at the beginning of the semester), the instructor briefly explained the role of each game design element to help students manage and use all the game design elements during the learning process. Finally, after the learning process using the gamified Moodle, the students answered the TAM questionnaire. Each of the instruments used is detailed in the next subsection.

**Table 2.** Demographic of surveyed students.

| Characteristics | Sample | |
|---|---|---|
| | **Count** | **%** |
| Gender | | |
| Male | 16 | 28.57 |
| Female | 40 | 71.42 |
| Age Group | | |
| 18–25 | 56 | 100 |
| 26–29 | 0 | 0 |
| 30–35 | 0 | 0 |

### *4.3. Measurement*

#### 4.3.1. Independent Variable: Big Five Inventory (BFI)

The BFI was selected to identify students' personalities. This is a validated and well-known instrument for identifying individuals' personalities [44]. BFI is a 5-point Likert-type questionnaire that ranges from 1 = strongly disagree to 5 = strongly agree. It includes 44 items regarding the five personality dimensions presented in the FFM, such as "I am someone who is full of energy" for the extraversion personality trait and "I am someone who is curious about many different things" for the openness personality trait.

#### 4.3.2. Dependent Variable: Technology Acceptance Model (TAM)

TAM was selected to evaluate the students' acceptance of gamified learning environments. TAM is one of the most accepted models in e-learning acceptance studies [77,78]. According to Davis [18], TAM specifies four measures, namely: perceived usefulness, perceived ease of use, attitude toward using a system, and behavioral intention to use a system. The students had to answer the TAM questionnaire by giving their positive or negative opinions, ranging from 1 (strongly agree) to 5 (strongly disagree). In particular, three items were associated with perceived usefulness, such as "I find the gamified learning environment useful to learn new a course"; three items were associated with perceived ease of use, such as "The interaction with the gamified learning environment is clear and understandable"; four items with attitude toward using the system, such as "I believe that using a gamified learning environment is a good idea"; and four items with behavioral intention to use a system, such as "I intend to continue to use gamified learning environments in the future".

### *4.4. Validity and Reliability*

The data collected were analyzed using path analysis, which was carried out using a component-based partial least squares structural equation model (PLS-SEM) application. The Smart-PLS 3.3 software was applied to perform the approach and to measure the correlation between observation variables and latent variables through a reflective measurement model. Compared with other modeling approaches, such as covariance-based structural equation modeling (CB-SEM), the PLS-SEM is more than adequate for dealing with a small sample size (minimum n = 20) [79–81].

To check the properties of the measurement scales, we conducted confirmatory factor analysis (CFA) to assess the reliability, convergent validity, and discriminant validity of the scales. Reliability was assessed using Cronbach's alpha, where all alpha values exceeded 0.70. Convergent validity was assessed through average variance extracted (AVE), composite reliability (CR) and item factor loadings, making sure that all item loadings exceeded 0.60. Table 3 presents the results of the validity and reliability tests of the measurement model. Discriminant validity was also met as no inter-correlation of the constructs exceeds the square root of the AVE of either of the compared constructs (see Table 4).

**Table 3.** Validity and reliability of the measurement model.

| Constructs | Items | Cronbach's $\alpha$ | CR | AVE |
|---|---|---|---|---|
| Usefulness | 3 | 0.72 | 0.85 | 0.75 |
| Ease of use | 3 | 0.79 | 0.81 | 0.80 |
| Attitude toward using | 4 | 0.71 | 0.77 | 0.53 |
| Intention to use | 4 | 0.76 | 0.81 | 0.79 |
| Extraversion | 8 | 0.88 | 0.92 | 0.89 |
| Agreeableness | 9 | 0.82 | 0.89 | 0.76 |
| Conscientiousness | 9 | 0.84 | 0.87 | 0.79 |
| Neuroticism | 8 | 0.78 | 0.88 | 0.75 |
| Openness | 10 | 0.86 | 0.93 | 0.79 |

**Table 4.** Discriminant validity.

| Constructs | Use | EU | ATT | INT | Extra | Agre | Cons | Neuro | Open |
|---|---|---|---|---|---|---|---|---|---|
| Use | 0.86 | | | | | | | | |
| EU | 0.08 | 0.79 | | | | | | | |
| ATT | 0.58 | 0.14 | 0.72 | | | | | | |
| INT | 0.21 | −0.16 | 0.48 | 0.77 | | | | | |
| Extra | −0.12 | 0.23 | −0.19 | −0.27 | 0.80 | | | | |
| Agre | 0.11 | 0.02 | −0.13 | 0.04 | 0.22 | 0.82 | | | |
| Consc | 0.10 | −0.09 | −0.06 | −0.21 | 0.24 | 0.54 | 0.80 | | |
| Neuro | −0.28 | 0.11 | −0.05 | −0.14 | −0.07 | −0.44 | −0.46 | 0.81 | |
| Open | −0.24 | −0.04 | −0.28 | −0.38 | 0.36 | 0.15 | 0.24 | −0.14 | 0.87 |

Usefulness (Use), Ease of Use (EU), Attitude toward using (ATT), Intention to use (INT), Extraversion (Extra), Agreeableness (Agre), Conscientiousness (Consc), Neuroticism (Neuro), Openness (Open). Note: The diagonal means the square root of AVE.

## 5. Results

As shown in Figure 5, the model explained 18.2% ($R^2$ = 0.182) of the variance for usefulness, 10.1% ($R^2$ = 0.101) of the variance for ease of use, 37.4% ($R^2$ = 0.374) of the variance for behavioral attitude toward using, and 24.5% ($R^2$ = 0.245) of the variance for intention to use. Thus, the $R^2$-values for the measures of TAM each explained a substantial amount of variance.

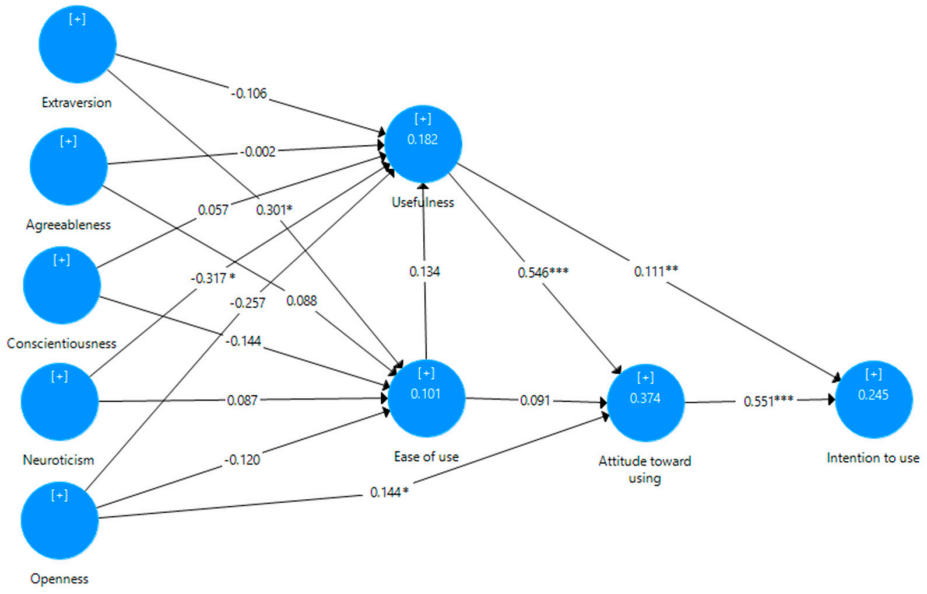


**Figure 5.** Structural model results. *$p$ <0.05; ** $p$ < 0.01; *** $p$ < 0.001.

### *5.1. TAM*

As per the relationship between interaction with the four dimensions of TAM, the results showed that the perceived ease of use did not affect students' perception of usefulness and behavioral attitude toward using the gamified learning environment ($p > 0.05$). Thus, H1 and H2 were rejected in this study. However, the results showed that perceived usefulness has a significant positive effect on behavioral attitude toward using the gamified learning environment ($\beta = 0.546$, $p < 0.001$) and intention to use the gamified learning environment ($\beta = 0.111$, $p < 0.01$), thus supporting H3 and H4. This means that students who find the gamified learning environment useful will have high behavioral attitude and intention to use this environment. Moreover, there is a positive relationship between behavioral attitude toward using and intention to use the gamified learning environment ($\beta = 0.551$, $p < 0.001$), which supports H5. This means that students with high behavioral attitude toward using the gamified learning environments are more likely to have high intention to use it.

### *5.2. Personality*

For the relationship between personality traits and TAM measures, and specifically between the FFM and ease of use and usefulness, the results showed that extraversion personality trait did not affect students' perception of the usefulness of the gamified learning environment ($p > 0.05$), but it affected positively their perception of ease of use of the gamified learning environment ($\beta = 0.301$, $p < 0.05$). This means that students high in extraversion are more likely to find the gamified learning environment easier to use than students low in extraversion. Thus, H6 was rejected and H7 was supported in this study. For the agreeableness personality trait, the results showed that there was no relationship between agreeableness and perception of usefulness and ease of use of the gamified learning environment ($p > 0.05$ for both). Thus, H8 and H9 were rejected. Additionally, no relationship was found between conscientiousness and perception of usefulness and ease of use of the gamified learning environment ($p > 0.05$ for both), thus rejecting H10 and H11. However, for the neuroticism personality trait, a significant negative effect was found on perceived usefulness ($\beta = -0.317$, $p < 0.05$). This means that students low in neuroticism are more likely to find the gamified learning environment more useful than students high in neuroticism, whereas no effect was found on perceived ease of use of the gamified learning environment ($p > 0.05$). Thus, H12 was supported and H13 was rejected. Finally, for the openness personality trait, no relationship was found between openness and perceived ease of use and usefulness of the gamified learning environment ($p > 0.05$); however, a significant positive effect was found between openness and behavioral attitude toward using the gamified learning environment ($\beta = 0.144$, $p < 0.05$), which means that students high in openness are more likely to have high behavioral attitude toward using the gamified learning environment than students low in openness. Thus, H14 and H15 were rejected, whereas H16 was supported. The full hypothesis results are presented in Table 5.

**Table 5.** Model path analysis.

| Hypothesis | Path Coefficients | *p* Value | Support |
|---|---|---|---|
| H1: Ease of use → Usefulness | 0.134 | $p > 0.05$ | No |
| H2: Ease of use → Attitude toward using | 0.091 | $p > 0.05$ | No |
| H3: Usefulness → Attitude toward using | 0.546 | $p < 0.001$ *** | Yes |
| H4: Usefulness → Intention to use | 0.111 | $p < 0.01$ ** | Yes |
| H5: Attitude toward using → Intention to use | 0.551 | $p < 0.001$ *** | Yes |
| H6: Extraversion → Usefulness | −0.106 | $p > 0.05$ | No |

**Table 5.** *Cont.*

| Hypothesis | Path Coefficients | *p* Value | Support |
|---|---|---|---|
| H7: Extraversion → Ease of use | 0.301 | $p < 0.05$ * | Yes |
| H8: Agreeableness → Usefulness | −0.002 | $p > 0.05$ | No |
| H9: Agreeableness → Ease of use | 0.088 | $p > 0.05$ | No |
| H10: Conscientiousness → Usefulness | 0.057 | $p > 0.05$ | No |
| H11: Conscientiousness → Ease of use | −0.144 | $p > 0.05$ | No |
| H12: Neuroticism → Usefulness | −0.317 | $p < 0.05$ * | Yes |
| H13: Neuroticism → Ease of use | 0.087 | $p > 0.05$ | No |
| H14: Openness → Usefulness | −0.257 | $p > 0.05$ | No |
| H15: Openness → Ease of use | −0.120 | $p > 0.05$ | No |
| H16: Openness → Attitude toward using | 0.144 | $p < 0.05$ * | Yes |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

## 6. Discussion

This study investigated the relationships between students' personality traits and their intention to use a gamified learning environment. The model proposed in this study not only contributes to examining the influence of external factors, but also helps researchers and practitioners gain a better understanding of students' behaviors in gamified learning environments, since any intention is the immediate antecedent of behavior [82]. The results of the empirical analysis provide strong support for 6 out of 16 hypotheses. With respect to each hypothesis, we offer the following insights into TAM, and personality traits, respectively.

According to the empirical results shown in Table 5, the perceived ease of use did not impact the perceived usefulness and behavioral attitude toward using the gamified learning environment (H1 and H2). This finding is contrary to the existing work that found the ease of use to be significantly related to usefulness [20,50]. This may be explained by participants' familiarity with the Moodle platform, so they did not find any difficulty while using the gamified learning environment. This finding further implies that students' earlier experiences are an indicator of their behaviors in gamified learning environments.

Additionally, it can be seen that perceived usefulness is a critical factor affecting the attitude toward and intention to use gamified learning environments (H3 and H4). These results are in line with other studies reporting that perceived usefulness had a positive statistical significance on students' behavioral attitudes and intention to use MOOCs [50]. Therefore, in order to strengthen the continuance intention to use gamified learning environments, the factor of usefulness becomes crucial in improving gamified learning environments.

Moreover, it is found that behavioral attitude positively affects intention to use gamified learning environments (H5), which is similar to the findings of Davis et al. [52]. Specifically, on the basis of these results, it can be seen that behavioral attitude toward using and perceived usefulness were positively associated with the intention to use gamified learning environments. This result indicates that perceived usefulness had a significantly positive effect on the intention to use gamified learning environments, which is in line with the notion of technology acceptance as advocated by Davis et al. [52]. From the perspective of online learning, this might indicate that students own learning needs and their perception regarding the learning environment explains their behaviors. In particular, attitude functioned as a crucial mediating variable between perceived usefulness on intention to use gamified learning environments, because the indirect effect of perceived usefulness on intention to use via the attitude toward using gamification in a learning environment was found to be apparent.

Regarding the effect of personality traits on continuous intention to use gamified learning environments, the results showed that only extraversion, neuroticism, and openness

personality traits affected students' perception of TAM, whereas no effects of agreeableness and conscientiousness were found on TAM. Specifically, it was found that extraversion positively affected students' perception of ease of use (H7), which means that students high in extraversion tend to find the gamified learning environment easier to use than students low in extraversion. This result is in line with several studies in the literature highlighting the positive influence of extraversion, which is considered a very important dimension of personality, on the perception of ease of use [21,83,84]. For instance, Sindermann et al. [21] found that users with high extraversion had a higher perception of ease of use of smart-phones than users low in extraversion. Additionally, users high in extraversion have perceived higher ease of use of social media than users low in extraversion [22,84].

In accordance with previous studies, the results showed that neuroticism had a significant negative effect on intention to use (H12) [22,84]. This result indicates that students low in neuroticism, who tend to be more emotionally stable, are more likely to perceive high usefulness of the gamified learning environment than students' high in neuroticism. In particular, the results showed that neuroticism had a significant negative effect on perceived usefulness, which functioned as a crucial mediating variable between perceived usefulness on behavioral attitude toward, because the indirect effect of low neuroticism on behavioral attitude toward via perceived usefulness of gamification in learning environment was found to be apparent. Finally, as discussed above in the TAM results, behavioral attitudes had a positive effect on the intention to use gamified learning environments.

The results of this study further indicate that openness has a significant positive effect on behavioral attitude toward gamified learning environments (H16); however, no effect was found on perceived usefulness and ease of use. This result indicates that students high in openness perceived higher behavioral attitudes toward using gamified learning environments than students low in openness. Hence, they may have higher intention to use gamified learning environments. This result is consistent with prior research conducted by Dezdar [82], where it was found that openness influenced the acceptance of green Information Technology use. This may be explained by the fact that students high in openness are more open to new experiences so they may be more motivated to try and understand new things that they are unfamiliar with [60].

## 7. Conclusions, Implications and Future Directions

This study investigated the effect of personality, based on FFM, on students' acceptance of a gamified learning environment and their continuance intention to use it. In particular, this study used TAM to explore the factors affecting students' intention to use gamified learning environments. The results showed that the research model for integrating TAM for adoption and FFM for personality provides a comprehensive understanding of the behaviors related to this context: (1) usefulness is the most influential factor toward intention to use gamified learning environments; (2) extraversion affects students' perceived ease of use of gamified learning environments; (3) neuroticism affects students' perceived usefulness of gamified learning environments; (4) openness affects students' behavioral attitudes toward using of gamified learning environments; and, (5) unexpectedly, perceived ease of use has no significant effect on perceived usefulness and behavioral attitudes toward gamified learning environments.

These findings contribute to the research field of educational gamification, where researchers and practitioners must be aware that continuance intention depends not only on attitude toward gamified learning environment but also on perceived usefulness. Additionally, the findings contribute to the research field of Human–Computer Interaction (HCI) by providing researchers and practitioners with insights into how to motivate different students' personality characteristics to continue using gamified learning environments for each personality trait group. This can contribute to the enhancement of the learning experience.

This study also has some limitations that should be acknowledged for further studies. For example, the sample size was limited. In addition, all the students were majoring in computer science and were familiar with Moodle; hence, they may have perceived higher

ease of use for the technology. Thus, to generalize our results, further investigations will be conducted with students from other majors (e.g., mathematics). Moreover, this study did not cover all the factors that may affect the intention to use gamified learning environments, such as gender and ICT level. Furthermore, students reported their intention to use the proposed gamified learning environment with particular game design elements as they were implemented in this study, whereas there are different implementations and designs for each game design element. For instance, the badge design in Moodle may look different in other learning environments. Therefore, more research is needed to further generalize the results.

Future work could focus on (1) trying to generalize our findings by investigating the effect of personality on students' acceptance of other gamified learning environments, i.e., using online environments other than Moodle and with different designs of game design elements; (2) investigating the effect of other factors on students' adoption of gamified learning environments; and (3) collect and analyze the students' learning behaviors to investigate how the intention of using gamified learning systems might impact their learning behaviors. In this context, several studies reported that analyzing students' gaming behaviors can be very informative in an educational context [85].

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## References

1. Deterding, S.; Sicart, M.; Nacke, L.; O'Hara, K.; Dixon, D. Gamification: Using game-design elements in non-gaming contexts. In Proceedings of the CHI 2011, Vancouver, BC, Canada, 7–12 May 2011.
2. Kopcha, T.J.; Ding, L.; Neumann, K.L.; Choi, I. Teaching Technology Integration to K-12 Educators: A 'Gamified' Approach. *TechTrends* **2016**, *60*, 62–69. [CrossRef]
3. Buckley, P.; Doyle, E. Individualising gamification: An investigation of the impact of learning styles and personality traits on the efficacy of gamification using a prediction market. *Comput. Educ.* **2017**, *106*, 43–55. [CrossRef]
4. Hallifax, S.; Lavoué, E.; Serna, A. To Tailor or Not to Tailor Gamification? An Analysis of the Impact of Tailored Game Ele-ments on Learners' Behaviours and Motivation. In *Artificial Intelligence in Education*, 2nd ed.; Bittencourt, I., Cukurova, M., Muldner, K., Luckin, R., Millán, E., Eds.; Springer: Cham, Switzerland, 2020; Volume 12163, pp. 216–227.
5. Mekler, E.D.; Brühlmann, F.; Tuch, A.N.; Opwis, K. Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. *Comput. Hum. Behav.* **2015**, *71*, 525–534. [CrossRef]
6. Almiawi, M.W.E.; Adaletey, E.J.; Phung, S.P. Impact of Gamification on Higher Education; A Case Study on Lim-kokwing University of Creative Technology Campus in Cyberjaya, Malaysia. *TEST Eng. Manag.* **2020**, *83*, 16337–16346.
7. Ab Rahman, R.; Ahmad, S.; Hashim, U.R. Ab Rahman, R.; Ahmad, S.; Hashim, U.R. A Study on Gamification for Higher Education Students' Engagement Towards Education 4.0. In *Intelligent and Interactive Computing*, 2nd ed.; Piuri, V., Balas, V., Borah, S., Syed Ahmad, S., Eds.; Springer: Singapore, 2019; Volume 67, pp. 491–502.
8. Andrade, F.R.H.; Mizoguchi, R.; Isotani, S. The bright and dark sides of gamification. In *Intelligent Tutoring Systems*, 2nd ed.; Micarelli, A., Stamper, J., Panourgia, K., Eds.; Springer: Cham, Switzerland, 2016; Volume 9684, pp. 176–186.

9. Toda, A.M.; Valle, P.H.; Isotani, S. The dark side of gamification: An overview of negative effects of gamification in education. In *Higher Education for All. From Challenges to Novel Technology-Enhanced Solutions*, 2nd ed.; Cristea, A., Bit-tencourt, I., Lima, F., Eds.; Springer: Cham, Switzerland, 2017; Volume 832, pp. 143–156.
10. Mekler, E.D.; Brühlmann, F.; Opwis, K.; Tuch, A.N. Do points, levels and leaderboards harm intrinsic motivation? An empirical analysis of common gamification elements. In Proceedings of the International Conference on Gameful Design, Research, and Applications, Toronto, ON, Canada, 2–4 October 2013. [CrossRef]
11. Mert, Y.; Samur, Y. Students' Opinions Toward Game Elements Used in Gamification Application. *Turk. Online J. Qual. Inq.* **2018**, *9*, 70–101. [CrossRef]
12. Kapp, K.M. *The Gamification of Learning and Instruction: Game-Based Methods and Strategies for Training and Education*; John Wiley and Sons: Hoboken, NJ, USA, 2012.
13. Werbach, K.; Hunter, D. *For the Win: How Game Thinking Can Revolutionize Your Business*; Wharton Digital Press: Philadelphia, PA, USA, 2012.
14. Rahman, R.A.; Ahmad, S.; Hashim, U.R. The effectiveness of gamification technique for higher education students engagement in polytechnic Muadzam Shah Pahang, Malaysia. *Int. J. Educ. Technol. High. Educ.* **2018**, *15*, 41. [CrossRef]
15. Panagiotarou, A.; Stamatiou, Y.C.; Pierrakeas, C.J.; Kameas, A. Gamification Acceptance for Learners with Different E-Skills. *Int. J. Learn. Teach. Educ. Res.* **2020**, *19*, 263–278. [CrossRef]
16. Venkatesh, V.; Davis, F.D. A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Manag. Sci.* **2000**, *46*, 186–204. [CrossRef]
17. Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, F.D. User Acceptance of Information Technology: Toward a Unified View. *MIS Q.* **2003**, *27*, 425–478. [CrossRef]
18. Davis, F.D. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Q.* **1989**, *13*, 319–340. [CrossRef]
19. Nayanajith, G.; Damunupola, K.A.; Ventayen, R.J. Impact of innovation and perceived ease of use on e-learning adoption. *Asian J. Bus. Technol. Stud.* **2019**, *2*, 19–27.
20. Wang, S.; Tlili, A.; Zhu, L.; Yang, J. Do Playfulness and University Support Facilitate the Adoption of Online Education in a Crisis? COVID-19 as a Case Study Based on the Technology Acceptance Model. *Sustainability* **2021**, *13*, 9104. [CrossRef]
21. Sindermann, C.; Riedl, R.; Montag, C. Investigating the Relationship between Personality and Technology Acceptance with a Focus on the Smartphone from a Gender Perspective: Results of an Exploratory Survey Study. *Future Internet* **2020**, *12*, 110. [CrossRef]
22. Svendsen, G.B.; Johnsen, J.-A.K.; Almås-Sørensen, L.; Vittersø, J. Personality and technology acceptance: The influence of personality factors on the core constructs of the Technology Acceptance Model. *Behav. Inf. Technol.* **2013**, *32*, 323–334. [CrossRef]
23. Mouakket, S.; Sun, Y. Investigating the Impact of Personality Traits of Social Network Sites Users on Information Disclosure in China: The Moderating Role of Gender. *Inf. Syst. Front.* **2019**, *22*, 1305–1321. [CrossRef]
24. Harb, Y.; Alhayajneh, S. Intention to use BI tools: Integrating technology acceptance model (TAM) and personality trait model. In Proceedings of the International Joint Conference on Electrical Engineering and Information Technology, Amman, Jordan, 9–11 April 2019. [CrossRef]
25. Punnoose, A.C. Determinants of Intention to Use eLearning Based on the Technology Acceptance Model. *J. Inf. Technol. Educ. Res.* **2012**, *11*, 301–337. [CrossRef]
26. Nov, O.; Ye, C. Personality and Technology Acceptance: Personal Innovativeness in IT, Openness and Resistance to Change. In Proceedings of the HICSS, Waikoloa, HI, USA, 7–10 January 2008. [CrossRef]
27. Ackerman, C.E. Big Five Personality Traits: The OCEAN Model Explained. Available online: https://positivepsychologyprogram.com/big-five-personality-theory/ (accessed on 7 November 2020).
28. DeYoung, C.G.; Quilty, L.C.; Peterson, J.B. Between facets and domains: 10 aspects of the Big Five. *J. Pers. Soc. Psychol.* **2007**, *93*, 880–896. [CrossRef]
29. Ashton, M.C. *Individual Differences and Personality*; Academic Press: Cambridge, MA, USA, 2013.
30. Spanellis, A.; Dörfler, V.; MacBryde, J. Investigating the potential for using gamification to empower knowledge workers. *Expert Syst. Appl.* **2020**, *160*, 113694. [CrossRef]
31. Denden, M.; Tlili, A.; Essalmi, F.; Jemni, M. Students' learning performance in a gamified and self-determined learning environment. In Proceedings of the OCTA, Tunis, Tunisia, 6–8 February 2020.
32. Kaufmann, D. Reflection: Benefits of gamification in online higher education. *J. Instr. Res.* **2018**, *7*, 125–132. [CrossRef]
33. Ahmad, A.; Zeshan, F.; Khan, M.S.; Marriam, R.; Ali, A.; Samreen, A. The Impact of Gamification on Learning Outcomes of Computer Science Majors. *ACM Trans. Comput. Educ.* **2020**, *20*, 1–25. [CrossRef]
34. Çakıroğlu, Ü.; Başıbüyük, B.; Güler, M.; Atabay, M.; Memiş, B.Y. Gamifying an ICT course: Influences on engagement and academic performance. *Comput. Hum. Behav.* **2017**, *69*, 98–107. [CrossRef]
35. Hamari, J. Do badges increase user activity? A field experiment on the effects of gamification. *Comput. Hum. Behav.* **2017**, *71*, 469–478. [CrossRef]
36. Collan, M. *Lazy User Behavior*; MPRA Paper: Munich, Germany, 2007.
37. Behl, A.; Jayawardena, N.; Ishizaka, A.; Gupta, M.; Shankar, A. Gamification and gigification: A multidimensional theoretical approach. *J. Bus. Res.* **2021**, *139*, 1378–1393. [CrossRef]

38. Varannai, I.; Sasvári, P.L.; Urbanovics, A. The use of gamification in higher education: An empirical study. *Int. J. Adv. Comput. Sci. Appl.* **2017**, *8*, 1–6. [CrossRef]
39. Ferianda, M.R.; Herdiani, A.; Sardi, I.L. Increasing Students Interaction in Distance Education Using Gamification. In Proceedings of the ICoICT, Bandung, Indonesia, 3–5 May 2018. [CrossRef]
40. Maican, C.I.; Cazan, A.-M.; Lixandroiu, R.C.; Dovleac, L. A study on academic staff personality and technology acceptance: The case of communication and collaboration applications. *Comput. Educ.* **2018**, *128*, 113–131. [CrossRef]
41. Oluwajana, D.; Vanduhe, V.; Idowu, A.; Cemal Nat, M.; Fadiya, S. The Adoption of Students' Hedonic Motivation System Model to Gamified Learning Environment. *Educ. Technol. Soc.* **2019**, *17*, 291–307. [CrossRef]
42. Vanduhe, V.Z.; Nat, M.; Hasan, H.F. Continuance intentions to use gamification for training in higher education: Integrating the technology acceptance model (TAM), social motivation, and task technology fit (TTF). *IEEE Access* **2020**, *8*, 21473–21484. [CrossRef]
43. Saucier, G.; Srivastava, S. What makes a good structural model of personality? Evaluating the big five and alternatives. In *Handbook of Personality and Social Psychology*; American Psychological Association: Washington, DC, USA, 2015; pp. 283–305. [CrossRef]
44. John, O.P.; Srivastava, S. The Big-Five trait taxonomy: History, measurement, and theoretical perspectives. In *Handbook of Personality: Theory and Research*, 2nd ed.; Pervin, L.A., John, O.P., Eds.; Guilford Press: New York, NY, USA, 1999; Volume 2, pp. 102–138.
45. Tlili, A.; Essalmi, F.; Jemni, M. Metric-Based Approach for Selecting the Game Genre to Model Personality. In *State-of-the-Art and Future Directions of Smart Learning*; Springer: Singapore, 2016; pp. 275–279. [CrossRef]
46. Tlili, A.; Denden, M.; Essalmi, F.; Jemni, M.; Huang, R.; Chang, T.-W. Personality Effects on Students' Intrinsic Motivation in a Gamified Learning Environment. In Proceedings of the ICALT, Maceio, Brazil, 15–18 July 2019. [CrossRef]
47. Denden, M.; Tlili, A.; Essalmi, F.; Jemni, M.; Chen, N.S.; Burgos, D. Effects of gender and personality differences on students' perception of game design elements in educational gamification. *Int. J. Hum.-Comput. Stud.* **2021**, *154*, 102674. [CrossRef]
48. Codish, D.; Ravid, G. Personality based gamification: How different personalities perceive gamification. In *ECIS*; The Open University of Israel: Ra'anana, Israel, 2014.
49. Bayne, R. *Psychological Types at Work: An MBTI Perspective: Psychology@Work Series*; International Thomson Business: London, UK, 2004.
50. Wu, B.; Chen, X. Continuance intention to use MOOCs: Integrating the technology acceptance model (TAM) and task technology fit (TTF) model. *Comput. Hum. Behav.* **2017**, *67*, 221–232. [CrossRef]
51. Wu, B.; Zhang, C. Empirical study on continuance intentions towards E-Learning 2.0 systems. *Behav. Inf. Technol.* **2014**, *33*, 1027–1038. [CrossRef]
52. Davis, F.D.; Bagozzi, R.P.; Warshaw, P.R. User acceptance of computer technology: A comparison of two theoretical models. *Manag. Sci.* **1989**, *35*, 982–1003. [CrossRef]
53. Huang, R.-T.; Hsiao, C.-H.; Tang, T.-W.; Lien, T.-C. Exploring the moderating role of perceived flexibility advantages in mobile learning continuance intention (MLCI). *Int. Rev. Res. Open Distrib. Learn.* **2014**, *15*, 140–157. [CrossRef]
54. Teo, T.; Zhou, M. Explaining the intention to use technology among university students: A structural equation modeling approach. *J. Comput. High. Educ.* **2014**, *26*, 124–142. [CrossRef]
55. Devaraj, S.; Easley, R.F.; Crant, J.M. Research Note—How Does Personality Matter? Relating the Five-Factor Model to Technology Acceptance and Use. *Inf. Syst. Res.* **2008**, *19*, 93–105. [CrossRef]
56. Walczuch, R.; Lemmink, J.; Streukens, S. The effect of service employees' technology readiness on technology acceptance. *Inf. Manag.* **2007**, *44*, 206–215. [CrossRef]
57. Mouakket, S. The role of personality traits in motivating users' continuance intention towards Facebook: Gender differences. *J. High Technol. Manag. Res.* **2018**, *29*, 124–140. [CrossRef]
58. McElroy, J.C.; Hendrickson, A.; Townsend, A.M.; DeMarie, S.M. Dispositional Factors in Internet Use: Personality versus Cognitive Style. *MIS Q.* **2007**, *31*, 809–820. [CrossRef]
59. McCrae, R.R.; Costa, P.T. Conceptions and Correlates of Openness to Experience. In *Handbook of Personality Psychology*; Academic Press: Cambridge, MA, USA, 1997; pp. 825–847. [CrossRef]
60. Chittaranjan, G.; Blom, J.; Gatica-Perez, D. Who's who with big-five: Analyzing and classifying personality traits with smartphones. In Proceedings of the ISWC, San Francisco, CA, USA, 12–15 June 2011.
61. Lombriser, P.; Dalpiaz, F.; Lucassen, G.; Brinkkemper, S. *Gamified Requirements Engineering: Model and Experimentation*; Springer Verlag: Berlin/Heidelberg, Germany, 2016.
62. Sailer, M.; Hense, J.U.; Mayr, S.K.; Mandl, H. How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Comput. Hum. Behav.* **2017**, *69*, 371–380. [CrossRef]
63. Przybylski, A.K.; Rigby, C.S.; Ryan, R.M. A Motivational Model of Video Game Engagement. *Rev. Gen. Psychol.* **2010**, *14*, 154–166. [CrossRef]
64. Rigby, C.S.; Ryan, R.M. *Glued to Games: How Video Games Draw Us in and Hold Us Spellbound*; Praeger: Santa Barbara, CA, USA, 2011.
65. Vansteenkiste, M.; Ryan, R.M. On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *J. Psychother. Integr.* **2013**, *23*, 263–280. [CrossRef]

66. Vansteenkiste, M.; Williams, G.C.; Resnicow, K. Toward systematic integration between self-determination theory and motivational interviewing as examples of top-down and bottom-up intervention development: Autonomy or volition as a fundamental theoretical principle. *Int. J. Behav. Nutr. Phys. Act.* **2012**, *9*, 23. [CrossRef] [PubMed]
67. Deci, E.L.; Vansteenkiste, M. Self-determination theory and basic need satisfaction: Understanding human development in positive psychology. *Ric. Psicol.* **2004**, *27*, 23–40.
68. Marczewski, A. *Gamification: A Simple Introduction*; Amazon Digital Services, Inc.: Seattle, WA, USA, 2012.
69. Zichermann, G.; Cunningham, C. *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps*; O'Reilly Media: Sebastopol, CA, USA, 2011.
70. Simões, J.; Redondo, R.D.; Vilas, A.F. A social gamification framework for a K-6 learning platform. *Comput. Hum. Behav.* **2012**, *29*, 345–353. [CrossRef]
71. Enders, B.; Kapp, K. *Gamification, Games, and Learning: What Managers and Practitioners Need to Know*; The eLearning Guild: Santa Rosa, CA, USA, 2013.
72. Dunn, R.A.; Guadagno, R.E. My avatar and me—Gender and personality predictors of avatar-self discrepancy. *Comput. Hum. Behav.* **2012**, *28*, 97–106. [CrossRef]
73. Alaswad, Z.; Nadolny, L. Designing for Game-Based Learning: The Effective Integration of Technology to Support Learning. *J. Educ. Technol. Syst.* **2015**, *43*, 389–402. [CrossRef]
74. Edmondson, A. Psychological Safety and Learning Behavior in Work Teams. *Adm. Sci. Q.* **1999**, *44*, 350–383. [CrossRef]
75. O'Donovan, S. Gamification of the games course. *Acessoem* **2012**, *17*, 1–8.
76. Hou, H.T.; Wu, S.Y. Analyzing the social knowledge construction behavioral patterns of an online synchronous collaborative discussion instructional activity using an instant messaging tool: A case study. *Comput. Educ.* **2011**, *57*, 1459–1468. [CrossRef]
77. Zatarain Cabada, R.; Barrón Estrada, M.L.; Ríos Félix, J.M.; Alor Hernández, G. A virtual environment for learning computer coding using gamification and emotion recognition. *Interact. Learn. Environ.* **2020**, *28*, 1048–1063. [CrossRef]
78. Teo, T. Modelling technology acceptance in education: A study of pre-service teachers. *Comput. Educ.* **2009**, *52*, 302–312. [CrossRef]
79. Chin, W.W.; Newsted, P.R. Structural equation modeling analysis with small samples using partial least squares. In *Statistical Strategies for Small Sample Research*, 2nd ed.; Hoyle, R., Ed.; SAGE: Thousand Oaks, CA, USA, 1999; pp. 307–341.
80. Ringle, C.M.; Sarstedt, M.; Straub, D.W. Editor's Comments: A Critical Look at the Use of PLS-SEM in "MIS Quarterly". *MIS Q.* **2012**, *36*, Iii–xiv. [CrossRef]
81. Wang, C.-S.; Huang, Y.-M.; Hsu, K.-S. Developing a mobile game to support students in learning color mixing in design education. *Adv. Mech. Eng.* **2017**, *9*, 1687814016685226. [CrossRef]
82. Dezdar, S. Green information technology adoption: Influencing factors and extension of theory of planned behavior. *Soc. Responsib. J.* **2017**, *13*, 292–306. [CrossRef]
83. Rosen, P.A.; Kluemper, D.H. The impact of the big five personality traits on the acceptance of social networking website. In Proceedings of the AMCIS, Toronto, ON, Canada, 14–17 August 2008.
84. Williams, I. Personality and ICT Adoption: The call for more research. In *Gender Gaps and the Social Inclusion Movement in ICT*; IGI Global: Hershey, PA, USA, 2019; pp. 104–129. [CrossRef]
85. Denden, M.; Tlili, A.; Essalmi, F.; Jemni, M. Implicit modeling of learners' personalities in a game-based learning environment using their gaming behaviors. *Smart Learn. Environ.* **2018**, *5*, 1–19. [CrossRef]