education sciences

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Bloom's Taxonomy Student Persona Responses to Blended Learning Methods Employing the Metaverse and Flipped Classroom Tools

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Abstract: The paper aims to identify and analyze the correlation between student personality types and the use of metaverse and flipped classroom blended learning methods (BLMs) and tools by formulating a series of research hypotheses. Using Bloom's Taxonomy, the most influential and standard theory of learning in the education cognitive field and toward this objective, the authors extracted the personality types of students and employed a mixed-methods research methodology JASP software (v.0.17.1) involving both qualitative and quantitative tools. The qualitative component involved direct observation of synchronous classroom teaching to students, while the quantitative aspect utilized structured questionnaires administered to 634 students of the International Hellenic University enrolled to attend the "Human Resource Management" course. The acquired qualitative data were processed using (a) network analysis JASP software (v.0.17.1) software in order to address the student personas through nodes, connections, and centralities and (b) structural equation software in order to identify the correlations between types of students and the variables of the metaverse and flipped classroom methods. The findings reveal that the four types of students identified have a direct and strong correlation with the use of flipped classroom and metaverse teaching methods.

Keywords: blended learning; flipped classroom; metaverse; Bloom's Taxonomy

Citation: Kilipiris, F.; Avdimiotis, S.; Christou, E.; Tragouda, A.; Konstantinidis, I. Bloom's Taxonomy Student Persona Responses to Blended Learning Methods Employing the Metaverse and Flipped Classroom Tools. *Educ. Sci.* **2024**, *14*, 418. https://doi.org/10.3390/educsci14040418

Academic Editors: Carlos Pérez-González and Delfín Ortega-Sánchez

Received: 29 February 2024
Revised: 11 April 2024
Accepted: 12 April 2024
Published: 16 April 2024

1. Introduction

The educational environment has undergone significant changes in recent years. Higher education reforms have highlighted growing concerns about the ability of the existing educational model to equip students with the skills required for their future careers [1]. In this sophisticated domain, the current strategies follow a curriculum, which has a multiplicity of meanings and a multi-layering entity [2]. Therefore, different learning methods have been aligned with dynamic and continuous social changes and scientific and technological developments [3]. The use of teaching–learning platforms, virtual environments, and mobile learning tools are just a few examples of how both teachers and students assimilate new technologies. Learning experience and engagement in an online learning environment have become increasingly important in tertiary education [4]. However, despite continuous pedagogical and technological innovation, in the current university education system, the role of students is mainly passive and does not favor exercise and development in the basic skills required in the work environment [5]. Proposals for the methodological reform of university teaching policies point to the need to review the traditional lecture-based pedagogy [6] and develop activities that help students practice skills that will increase their skills and capabilities [7]. These situations show active methodologies in which the responsibility of learning is shifted to students. Furthermore, educational institutions want to implement methodologies and strategies that allow for the continuity of students'

learning, motivating them to participate more in the teaching–learning process and at the same time creating a balance in the teachers' effort to adapt their courses [8].

In this context, the model of blended teaching can prove to be suitable for this purpose. The flipped classroom is a pedagogical model in which the instructor shares predetermined digital resources with students through a platform outside of the classroom. Relevant content is also taught asynchronously through this external platform. Thus, before attending the course, students interact individually with the educational content. Despite the claimed advantages and positive outcomes of a flipped classroom, Goodwin and Miller [9] point out that the evidence remains insufficient. For this reason, even more engaging learning experiences that promote meaningful learning and allow students to actively participate are widely sought [10]. The metaverse, over the course of its use, seems to align with the participatory and collaborative learning model and, consequently, allows teachers to apply new pedagogical approaches and teaching methods [11] through a synchronous teaching method of virtual depiction through the metaverse of an in- person lecture. When applied to teaching and learning activities, the metaverse has the potential to bring many benefits and positively impact the overall educational process by providing meaningful learning opportunities [12]. As the metaverse is constantly evolving both technically and culturally, it can bring about changes in both e-learning and conventional learning experiences in innovative ways [13]. The main goal of this model is to develop the higher-level skills of Bloom's Taxonomy by requiring students to adopt an active attitude in the learning process [14]. Therefore, the present study explores the dynamics of a mix of learning tools that enhance interest and thus learning outcomes and how these correlates with the specific student personalities that have been identified.

2. Literature Review

The phenomenon of learning, a complex, intellectual, and biological research object of psychologists, educators, and organizational executives is, basically, a behavioral change in people as a result of a new experience. Burns [15] perceives it as a permanent change in individual behavior through observational activities, but also as the internal processes of thinking and feeling. Learning is traceable and contextual, but also historically related to the situation in which knowledge takes place and is used [16]. The field that deals with information processing illustrates a model of brain functionality through a very detailed procedure. This particular processing is also a theory of learning, with a core of the method by which we know things. The identification of learning processes and their evaluation in clear terms creates the need for a classification of teaching objectives. "The harmonization of goal and theory for learning and personality, focuses on the interaction between teachers and students, but also with children as separate individuals and not on the application of a set of hierarchical processes consistent with the functions of human organisms" [17]. In 1956, Bloom [18] felt that there was an increased need to reframe the channels of communication between examiners and teachers, as educators end up making distinctions that psychologists would avoid. This project was framed in three areas: the cognitive, the emotional, and the area of psychomotor skills. In the same year, the group completed its work in the cognitive and first domain by publishing a manual referred to as "Bloom's Taxonomy". It classifies cognitive functions into six levels, with each level demonstrating the students' performance on the previous ones. The lower realm of knowledge represents memory or knowledge that was previously acquired and recalled. Next comes comprehension, which includes most cognitive skills, such as processing new data. In the field of application, a learner applies the information and solves a problem without assistance as a result of the correct interpretation of the information. This is followed by analysis, where learners categorize their ideas and identify the connections between the parts. The synthesis level is also the most creative, as students are able to create new and unique results. The final evaluation includes making decisions about the value of a piece of information or product and evaluating it. The learning objectives of the taxonomy are the description of the students' abilities after the completion of a

teaching unit, the main criteria for planning both the content and the teaching methods, and the more correct evaluation of the teaching results. In the 1990s, Lorin Anderson [19], a former student of Bloom, convened a conference to update the original taxonomy and adapt it to 21st century educators and students. In their revised version, they confirm the original by again mapping the six cognitive processes with further improvements in terminology, structure, and emphasis. In addition, the new structure places the student at its center. The most obvious differences concern the terminology of the two versions, with the main difference being the grammatical change from nouns to verbs. The lowest level is now "Remember", versus "knowledge" of the prototype, and "Synthesis" is replaced by "Create", bringing it to the top of the process [20].

The concept of the metaverse was first heard in the science fiction novel Snow Crash [21], envisioning the successor to the Internet based on virtual reality, and its film version titled Ready Player One [22]. However, when Mark Zuckerberg officially announced the metaverse project in October 2021, many researchers and educators began to provide application scenarios in their teaching practices. However, the term is relatively new and is a combination of the prefix "meta" denoting transcendence combined with the word "universe". Since then, it has been defined based on its collective space in virtuality [23]; its specular quality [23]; the embedded and spatial Internet [24]; an online and social application that incorporates new technologies [25]; the post-reality universe, a persistent and perpetual environment that merges physical reality with virtuality [26]; and the omniverse [23]. Go (2021), as reported by Kye et al. (2021) [27], define the metaverse as "a three-dimensional virtual reality in which daily activities and economic life are conducted through avatars that represent the real itself". It is, therefore, an ecosystem in which both worlds coexist and function.

More and more teachers show confidence in technology for the benefit of learning and use applications in the context of teaching activities [28]. More specifically, the metaverse is gaining ground based on the social value to the new generation Z (Gen Z), eliminating the difference between an offline self and an online self [25,29]. In these environments, users share thoughts, experiences, feelings, and cultural elements [30], resulting in an enhanced social presence and identity within the virtual community, as well as a sense of belonging. Through these learning methods, emotional learning is promoted, social barriers of identities are removed [31], students' "soft skills" increase creativity [32], their communication, interaction [33], and, in general, understanding of a subject is enhanced, and so is academic performance [34]. The reason that use of the metaverse in education is positively received by students lies in the fact that its visualization is likened to a game [35], it improves the skills of users in real-world scenarios [36], and it provides an opportunity to engage in interactive problem-solving activities [37].

The flipped classroom is a blended learning method approach that has been applied in higher education since the mid-1990s, and it has identified a research area related to technology-enhanced learning and teaching [38]. In this context, the flipped classroom, during lectures and outside of them, exchanges the conventional treatment of time, with students being invited to carry out online learning individually and outside of the classroom, pre-dialectically, through asynchronous means of educational material and videos published in a electronic learning management system [LMS]. They then participate in face-to-face and live lectures and synchronous teaching with peers in the classroom [39]. Promoting a self-regulated learning skill to students seems to be a promising resolution to the challenges experienced during individual online learning activities outside of the classroom [40]. These contemporary and asynchronous teaching methods have been adopted in educational settings worldwide [41]. A main feature of the flipped approach compared to the traditional one is the irregular sequence of educational actions before and during the "live" meetings [42]. An analysis by Strelan et al. (2020a) [43] has shown that the flipped classroom had more positive effects on student satisfaction than those of the traditional one. The use of learning information platforms in higher education has been multiplied and continues to be fueled by the expanding accessibility of video recorders and built-in

cameras on computers, tablets, and mobile phones. These digital devices are triggering the emergence of a new learning ecosystem [44]. For these reasons, they have has received increasing attention from both educators and researchers and professionals since the mid-2010s [45]. On a practical level, in order to implement a flipped classroom, one combines: (1) asynchronous learning, i.e., pre-dialectic individual learning through video and digital study materials in the form of "online homework" and (2) synchronous learning i.e., lectures in the form of "face-to-face classwork" [38]. In this way, the knowledge transfer takes place before class, with the support of new technologies, and the construction of the new knowledge takes place inside the classroom, with the support of a teacher and classmates [46]. From an academic point of view, researchers have not yet agreed on a common theoretical definition of this blended learning approach [45]. With this combination, learning outcomes are finer [47], as is academic performance [48].

Research question: Investigating the most appropriate learning mix that most engages students' interest.

To deal with the issue of insufficient design education [49], a combination of teaching in person and online technology is proposed. However, before the pandemic period, meeting tools were limited by technology, leading to a lack of interaction and sharing between teachers and students [50]. A mixture of learning activities enhances student memory, autonomy, and sense of responsibility for learning [51]. According to the same researchers, by leveraging social media, a blended learning strategy provides an additional advantage while combining the strengths of traditional learning approaches with networked learning [52], with teachers playing a guiding, inspiring, and monitoring role in the teaching process.

Secondary research question: What are the main characteristics of student groups in university institutions that increase interest for their participation in the educational process?

Research Hypotheses

Jusuf (2018) has supported the argument that personality represents a person's description of everyday life from a psychological perspective. Such personalities are supposed to influence the ability of students to master their learnt skills [53]. Consequently, students play multiple roles in the process of attaining higher education [54], although the literature lacks valid evidence on this issue since very limited attempts have been made towards categorizing specific student personas. Expectations, needs, and experiences vary according to the role that students adopt. When experiences fail to deliver the expectations of these roles, it leads to dissatisfaction [55]. Only a few researchers have documented the different approaches on service quality in higher education and student learning processes [56,57]. Xu et al. (2018) [54] intend to develop a complete capture of students' multiple characters in higher education. In line with Xu, et al (2018), the study of Kudinov et al. (2018) [58] identifies types of axiological orientations in students' personalities, highlighting the people's types of value–semantic orientations as pragmatic-professional, social-communicative, and individual-egoistic. A personality type could identify associated learning preferences or styles according to various studies, in which have people were observed in different learning situations to understand the way they chose to learn and ascertain that there are types that lean towards distinctive learning style preferences that cannot be clarified by other factors [59]. A study by Dosch (2006) determined an effective approach to teaching clinical dentistry in an attempt to identify the most communal personalities among undergraduate dental students and their learning preferences [60].

Regarding learners, information is represented by personalization parameters through implicit or explicit methods [61], which serve as a personalized learning experience. Learner's personality is one of the parameters [62]. Arockiam and Charles (2013) [63] have emphasized the importance of a learner's personality while designing e-learning interfaces, and El Bachari et al. (2010) [64] also emphasized this while assigning students a learning method or approach. Vasileva-Stojanovska et al. (2015) [65], Caspi et al. (2006) [66], and Pawlowska et al. (2014) [67] have demonstrated a correlation between

a learner's personality and their learning outcomes, academic performance, and, finally, student satisfaction.

Based on the epistemic dialogue and findings of academics and researchers, this study aims to investigate Bloom's Taxonomy student personality (persona) responses to blended methods, and more specifically the metaverse and flipped classroom tools. To address the research question, four primary and four secondary research hypotheses were developed, described as follows:

Research Hypotheses

- 1st research hypothesis: There is a correlation between flipped classroom tools and Bloom's Taxonomy.
- 2nd research hypothesis: There is a correlation between metaverse class tools and Bloom's Taxonomy.
- 3rd research hypothesis: There is a correlation between flipped classroom tools and students' main personalities (as described in the following four sub-hypotheses).
    - 3a research secondary hypothesis: There is a correlation between the tools of the flipped classroom and the personality of "Students focused on educational tools".
    - 3b research secondary hypothesis: There is a correlation between the tools of the flipped classroom and the personality of "Students focused on the skills they develop".
    - 3c research secondary hypothesis: There is a correlation between the tools of the flipped classroom and the personality of "Students with focus on access to learning".
    - 3d research secondary hypothesis: There is a correlation between the tools of the flipped classroom and the personality of "Students dependent on the Professor".
- 4th research hypothesis: There is a correlation between metaverse classroom tools and students' main personalities (as described in the following four sub- hypotheses).
    - 4a research secondary hypothesis: There is a correlation between the tools of the metaverse classroom and the personality of "Students focused on educational tools".
    - 4b research secondary hypothesis: There is a correlation between the tools of the metaverse classroom and the personality of "Students focused on the skills they develop".
    - 4c research secondary hypothesis: There is a correlation between the tools of the metaverse classroom and the personality of "Students with focus on access to learning".
    - 4d research secondary hypothesis: There is a correlation between the tools of the metaverse classroom and the personality of "Students dependent on the Professor".

3. Materials and Methods

It has emerged from the literature review that knowledge transfer through the new technologies of artificial intelligence in higher education institutions is multidimensional, multi-influential, and generally dynamic. For this reason, and as a response to the research questions and hypotheses that were developed, a mixed-methods research design was used, which included: (a) qualitative primary research through which the observation took place during a semestral course and (b) quantitative primary research through a structured questionnaire (see Appendix A) on a census sample of students, through which the adaptation of Bloom's Taxonomy to the educational tools used was observed. The census sample comprised the 634 students of the "Organizations Management, Marketing and Tourism" department of the International University of Greece who enrolled and attended the course "Human Resources Management". More specifically, as shown in Table 1, thirteen (13) synchronous in person lessons were taught, while synchronous and asynchronous educational materials were posted on the digital platform that supports the course, Moodle, including (i) digital oral notes lasting 40–55 min, which the students

listened to before the course; (ii) interviews (podcasts) lasting about 20 min with market practitioners (entrepreneurs), which were used during the course as a reason for discussion; (iii) case studies, which they solved after taking the course.

Table 1. Synchronous and asynchronous learning tools used.

Synchronous Learning Material	Asynchronous Learning Material
13 live teaching lessons 5 distance digital lessons using avatars	13 pre-recorded introductory lessons that students had to access before live lessons (approximately 40–55 min each) 12 podcasts (approximately 20 min duration each) 45 total case studies students had to work on after live lessons

A week before each course, the corresponding digital material (prerecorded introductory material) and the corresponding podcast for each thematic section were "uploaded" to the educational platform, on which executives from the international market answered relevant questions from the course teacher in order to combine the literature theory with successful practical application in real market conditions. In this way, the students were already prepared for the main in person and synchronous lecture, allowing for an in-depth and multifaceted approach to the subject.

Additionally, among the thirteen (13) courses, five (5) additional digital courses of synchronous education were conducted in a metaverse environment through Zoom, a video telephony and video conferencing software platform. With the help of the platform, the teaching professor of the course and the students participated in the digital room as Avatars, thus stimulating the activity of the students through a modernized interaction complementary to the traditional teaching method.

It should also be pointed out that at the end of each course (digital and in person) students received relevant case studies via the Moodle platform to which they had to have to respond, documenting their position.

At the same time, during the processes of the in-person and digital courses, a member of the writing and research team made observations regarding the students' participation in the process (number of presentations) and their intensity (marking the students' questions, observations, conclusions, etc.).

The research tool used after the end of the semester in the quantitative research was a structured questionnaire compiled with scales and questions from previous researchers. It consisted of 44 items divided into four sections (4 sections), (a) 10 items related to the metaverse classroom, (b) 10 items related to the flipped room, (c) 20 items related to Bloom's Taxonomy, and (d) 4 items related to demographic characteristics.

The questionnaire used a five-point Likert scale of agreement. The scale started from "1", corresponding to "strongly disagree" and ended at "5", corresponding to "strongly agree" [68]. In the first section related to the metaverse classroom, a combination of validated questionnaires was applied. It included that of López-Belmonte, J., Pozo-Sánchez, S., Lampropoulos, G., & Moreno-Guerrero, A. J. (2022) [69] on evaluating educational experiences in the metaverse from a holistic approach. Another questionnaire used was that of Talan, T., & Kalinkara, Y, (2022) [70], who, taking into account the experiences of the students, attempt to discover ways to improve the educational metaverse environment and identify at the same time the difficulties of the students while using it. The present research based the avatar-related items on the questionnaire of Gonzalez and Peck (2018) [71], in which the researchers focus on body manipulations and the ways an avatar produces social, behavioral, and perceptual influence to interactors.

In the second section regarding the flipped classroom, the questionnaire of Kanematsu et al. (2009) [72] was also used, whose research seeks to identify the difficulties arising from the use of technology in educational environments, both learning and technical, that need to be addressed.

The questions of the third section of the questionnaire were on Bloom's Taxonomy, and the validated questionnaire of Halawi, McCarthy, and Pires (2009) [73] was used. Given the

importance of validating research and the instrument used, a pilot study was conducted to check the reliability of the questionnaire items and the understanding of the questions. For this reason, it was initially tested on a small sample of students from the International University of Greece, and the index of internal consistency and reliability was checked.

Statistical Methodological Approach

The research process started in October 2022 with the start of the winter semester of studies and it ended in February 2023 with the final exams of the semester. During this time, the questionnaire, used as a quantitative research tool, was delivered to the students so that they could respond before starting their exams. In total, 634 valid questionnaires were collected, and the data analysis process included descriptive and inductive statistical analyses. In the first stage, the reliability index (Cronbach's Alpha) and normality of the distributions (normal distribution) were checked, and in the inductive analysis that followed, an exploratory and confirmatory factor analysis was performed by using SPSS (v.22) and AMOS (v.21) software. Regarding the normality of the values, normality was found in all of the questions that resulted from the observation of the distribution of the Q–Q plot values. Also, the standard deviation as well as the skewness and kurtosis indices were checked in each question.

The inductive analysis involved exploratory factor analysis (EFA) on the Bloom variable, allowing us to detect the number personalities in the sampled students. After the EFA, a network analysis was also carried out using the JASP software (v.0.17.1), from which the centrality, strength, and influence in each factor were indicated, leading to the identification of each student personality with the maximum possible precision. The network analysis was performed to further analyze the key aspects of Bloom's Taxonomy and contribute to a better understanding and validation of the exploratory factor analysis in an effort to reveal the main and common personalities of the students.

Then, through the AMOS software, structural equation analysis (SEM) was conducted on the student personalities that emerged from the exploratory factor analysis. SEM was also conducted on the correlations between the variables of the metaverse and flipped classroom learning tools with the Bloom learning variable and then with the student personalities identified by the factor analysis.

The data analysis method is presented in Figure 1. Primarily, the descriptive analysis was conducted to help us understand the general perspective of the responses, while the normality and validity tests were performed to allow the researchers to use the appropriate statistical methods and tools. The findings are based on the inferential statistical analysis that took place and, more specifically, the course of analysis, which included (a) an exploratory factor analysis on the Bloom's Taxonomy variable, (b) a network analysis with centrality tests, and (c) structural equation model analysis. The analysis results were exploited to spot the main characteristics of the learning personalities that appeared to be factors in the Bloom's Taxonomy variable.

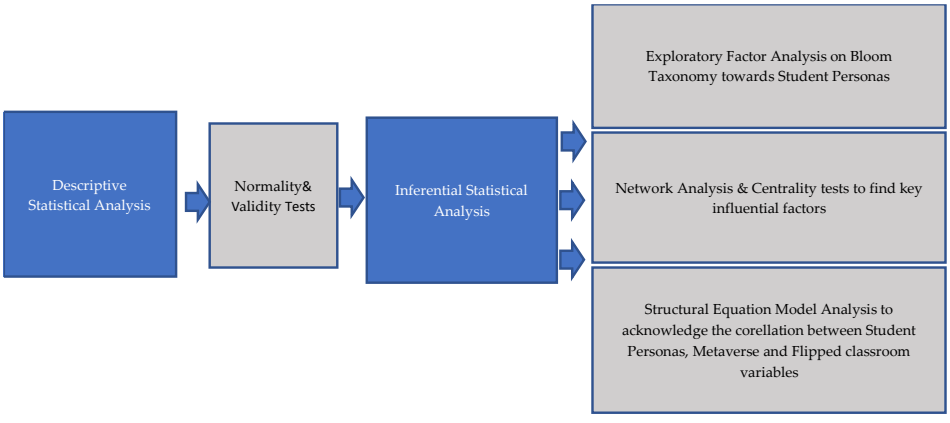

Figure 1. Qualitative analysis method and tools.

4. Results

4.1. Observation Results

As a tool in the present study, the observation research yielded a considerable amount of data for analysis and interpretation, as it was conducted smoothly, consensually, and fruitfully. After the participating students were informed and prepared by the professor responsible for the human resources course, the entry of the observer and his presence in the classroom were received positively by the whole group, resulting in the continuation of the normality of the teaching flow and, therefore, in the clarity of the necessary conclusions. In addition, from the beginning of the semester, the students received information on how to conduct the specific course throughout the winter semester, at the end of which the professor asked the students about each tool that was used. The responses were overwhelmingly positive, with a strong curiosity about the process that followed and how it would prepare them for future opportunities, both professionally and educationally. Their enthusiasm was particularly high for the announcement of the virtual lessons with the use of avatars, mainly for the reason that a so-far entertainment tool would be used as a teaching tool. The young age of the students makes them fully equipped and aware of modern technological means and their uses, which contributed to the friendly treatment of the tools. Mainly, they expressed themselves willingly in favor of the innovation and the evolutionary teaching format of the course in accordance with the most modern standards of the field. As far as the educational platform is concerned, the students were completely in agreement, as in this way they have a constantly upgraded organized database and information at their disposal. In addition, they found it particularly helpful to distinguish the teaching modules and materials into separate files so that they did not have to spend a lot of time finding particular information. The interviews (podcast) with specialized professionals in the field excited the students, who even pointed out that they were looking forward to hearing the next one and that this practice acted as reinforcement in the curriculum, confirming that the bibliographic theories have a tangible result in practice. The case studies showed them ways to identify the correct treatment through knowledge. The degree of participation was proportional to the time and steadily increased each time. The questions and participations were rich in number and concerned both the digital material as an object and a tool to use, with the professor responding in detail to all queries and comments which caused the students to participate more in the dialogue. As a result, students now characterize the metaverse as a multifunctional learning tool in a digital room and have an awareness of it is a technological accessory for the fulfillment and facilitation of human energy and not the opposite, which played an essential role. In this way, we arrive at the combination of the privileges of each tool separately and the convergence of the two worlds, each from its own dimension.

4.2. Quantitative Research Results

The processing of the quantitative data was started by checking the values of internal consistency and reliability using Cronbach's alpha. Then, the normal distribution of the values was checked, which were derived from the values of skewness and kurtosis. More specifically, Cronbach's Alpha indices for each part of the questionnaire were as follows: 0.92 for the Bloom's Taxonomy variable, 0.93 for the metaverse variable, and 0.90 for the flipped classroom variable. In any case, the values are above the threshold of 0.7 [74]. Regarding distribution normality, the values were between the intervals [−2, 2], indicating the symmetry and normality of the values.

Then, exploratory factor analysis was performed on the Bloom's Taxonomy variable to explore possible student personalities and characteristics. Exploratory factor analysis with double varimax rotation [75] revealed four factors. More specifically, the KMO index reached a value of 0.896 (sig < 0.000), while all the loading values of the items had a value greater than 0.6, and for this reason no question was excluded. However, to better determine the factors that make up the personality of each student, a network analysis was applied to each factor that emerged, emphasizing the centrality (closeness, expected

influence, and strength) analysis and more specifically utilizing the indicators of closeness, expected influence, and strength [76]. It should be noted that the estimator EBICglasso was used in all cases.

In the first factor (Figure 2), the analysis produced the figure shown below. Here, the items have positive correlations with the more important questions of 5 and 4, and as a result this factor is named "Students focused on educational methods and tools". In particular, items 5 and 4 referring to "The tools that were used to take the exam were effective" and "The tools that were used in the course were effective" were, respectively, the items that essentially revealed the highlighting factor that determined this student persona. In fact, the betweenness and closeness centrality of questions 4 and 5 were the highest, achieving the values between 0.4 and 1.5, while in strength and expected influence the factors' values were 0.8 and 1.5. The 6th item "Discussions, podcasts, case studies and qiestions were used effectively in the digital course" also yielded a high value (<0.05) in closeness, acting more as a bridge between questions 4 and 5. Based on these outcomes, it can be argued that the set of methods and tools used during the course to evaluate functionality in relation to learning performance was this student persona's primary concern.

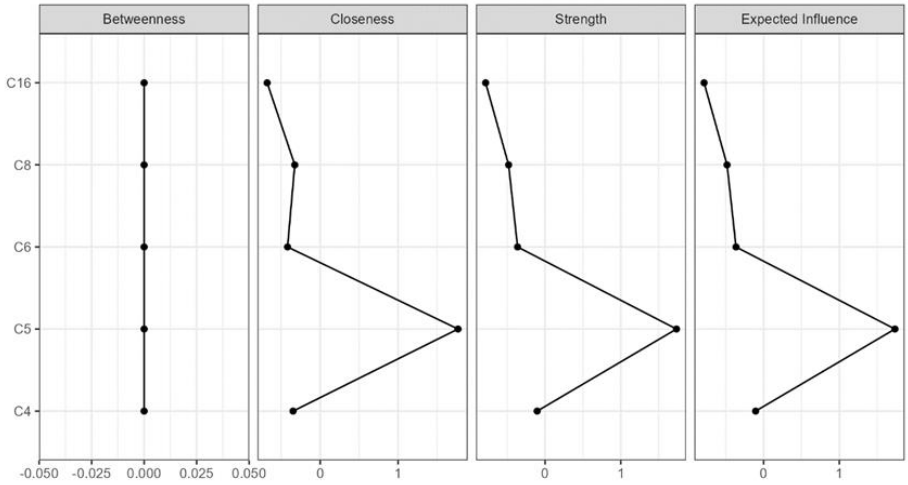

Figure 2. Centrality plots of 1st student type, "Focused on educational methods and tools".

For the 2nd factor (Figure 3), according to the figure, the analysis highlighted questions 15 and 17 as more central and so was called "Students focused on skills development and self-improvement".

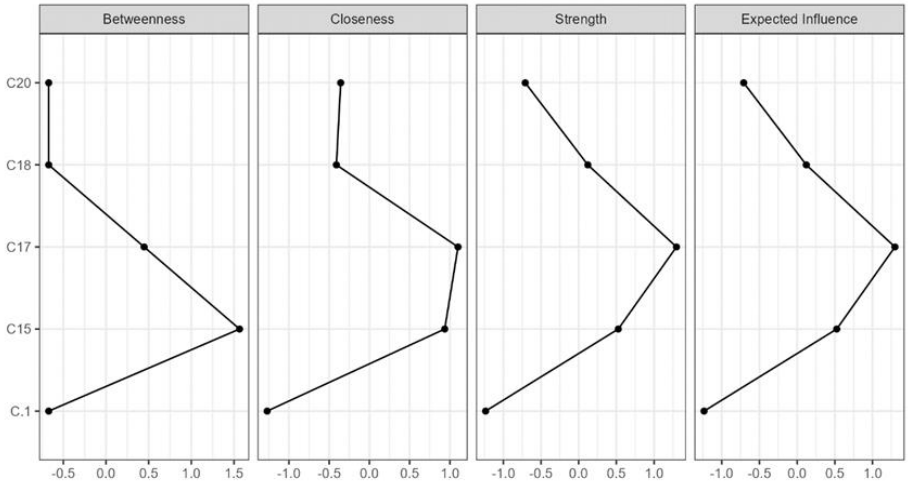

Figure 3. Centrality plots of 2nd student type, "Focused on skills and self-improvement".

The defining items of the questionnaire that determined this student persona were the 15 and 17, as "The use of digital material helped me to develop new skills", and "The use of digital material helped me to improve my computer skills", respectively. In each case, the betweenness, closeness, strength and expected influence values of item 17 scored values of 0.4, 1.1, 1.3, and 1.3, accordingly. Item 15 scored the values of 1.5, 0.9, 0.5, and 0.5 in the same centralities. The focus point in this case is on the individual improvement of each student, with the ultimate goal of their future benefit. They deal with the tools and methods used on the course as qualifications for their personal development and life after studying. In this way, they evaluate their usefulness for the benefit of their self-improvement.

In factor 3, the analysis, according to Figure 4, highlighted question 3 as the most central, acquiring the label "Students with focus on resources and access to learning". Item 3, "I had sufficient electronic resources to use to access my course", indicated a student persona with a commitment to their individual competence so that they can cope with the worthiness of the process. In particular, the values reached for item 3 were as follows: betweenness 1.0; closeness, 0.5; strength 1.1; and expected influence 1.1. This type of student has to make sure that they meet all the required specifications that will grant them contact to both the resource and the information. Such students follow instructions, they are well informed about the conduct of the process, and they are additionally equipped with supplies that will give them access to learning in general.

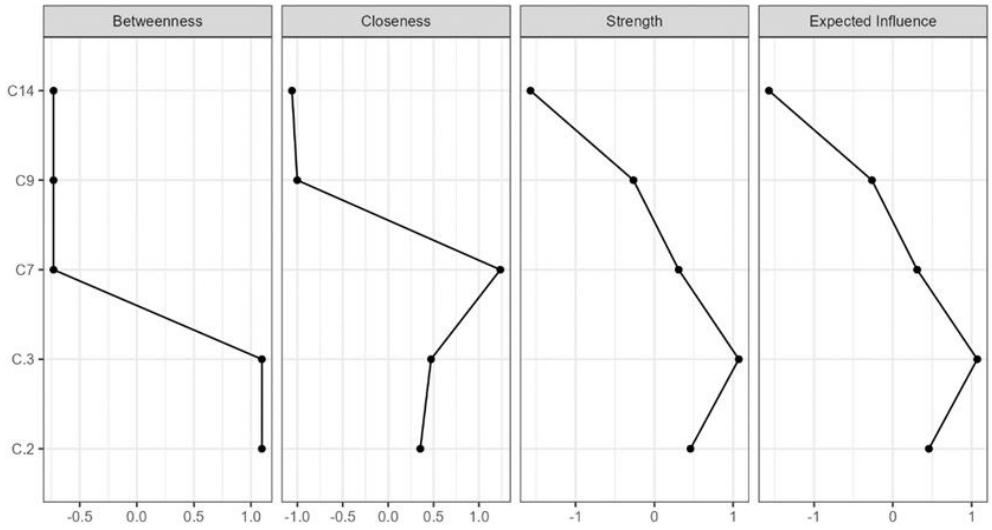

Figure 4. Centrality plots of 3rd student type, "Students with focus on resources and access to learning".

In the 4th factor (Figure 5), according to the figure, the analysis highlighted questions 11 and 12 as the most central, and this factor was called "Students depended on the Professor". Questions 11 and 12, "I was able to get help from the instructor when I needed it" and "I was satisfied with the instructor's teaching method", respectively, indicated a professor-centered type of student. The values item 11 yielded were as follows: betweenness 0.5, closeness 0.5, strength 0.7, and expected influence 0.35. Meanwhile, item 12 scored 1.6, 1.4, 1.35, and 1.58 in the same centralities. This persona focuses on the role of the professor and the extent of participation in the experimental process, which essentially constitute the personal learning process of the student themselves. They connect with the professor in a dependent relationship, showing the need for their support and presence during the delivery of the lesson, and are concerned about being friendly to them. In addition, they consider it necessary to refer to them as a source of information when they need it.

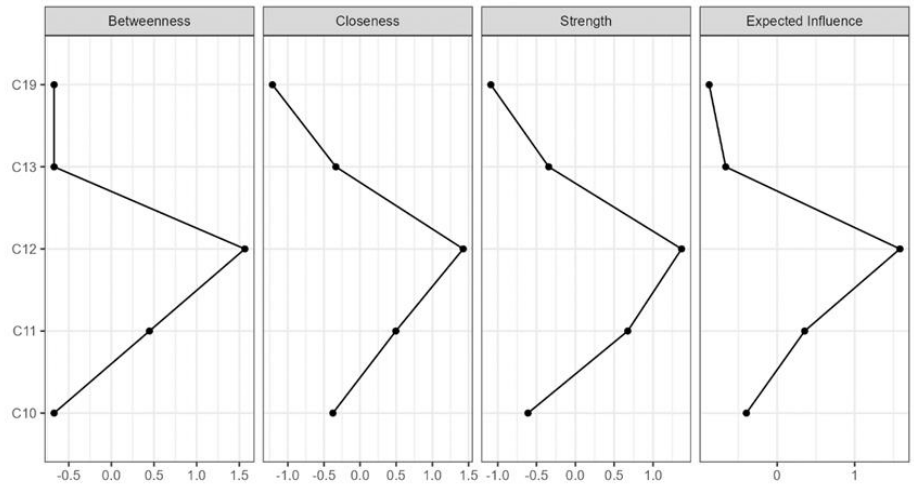

Figure 5. Centrality plots of 4th student type, "Professor Depended students".

4.2.1. Structural Equation Methodology Analysis

To ensure the validity of the theoretical hypothesis, correlations of the variables were carried out by using the statistical analysis of the structural equation model, aiming to understand the correlation relationships between the variables. The SEM analysis was developed in two main stages. In the first stage, the Bloom's Taxonomy variable was correlated with the meta and flipped variables (Figure 6), which showed that there is a strong positive correlation between the dependent variable of Bloom's Taxonomy and the meta/flipped variables. The metric model is described as follows. The C/MIN index is at an acceptable value limit (3.832); the Goodness of Fit Index (GFI) and the Adjusted Goodness of Fit Index (AGFI) values are 0.838 and 0.820, respectively, which confirms the good fit of the model. Regarding the basic comparisons (baseline comparisons), the CFI (comparative fit index), is 0.855 in this case, and similarly the NFI (normed fit index) responds accordingly with a value of 0.814. The PNFI (parsimonious normed fit index) and PCFI (parsimonious comparative fit index) are fit indices that take into account model complexity with acceptable values >0.5, [77] and they have values equal to 0.770 and 0.809, respectively. Finally, the root mean square error of approximation (RMSEA) is within acceptable limits, with a value of 0.067, contributing to the validity of the model.

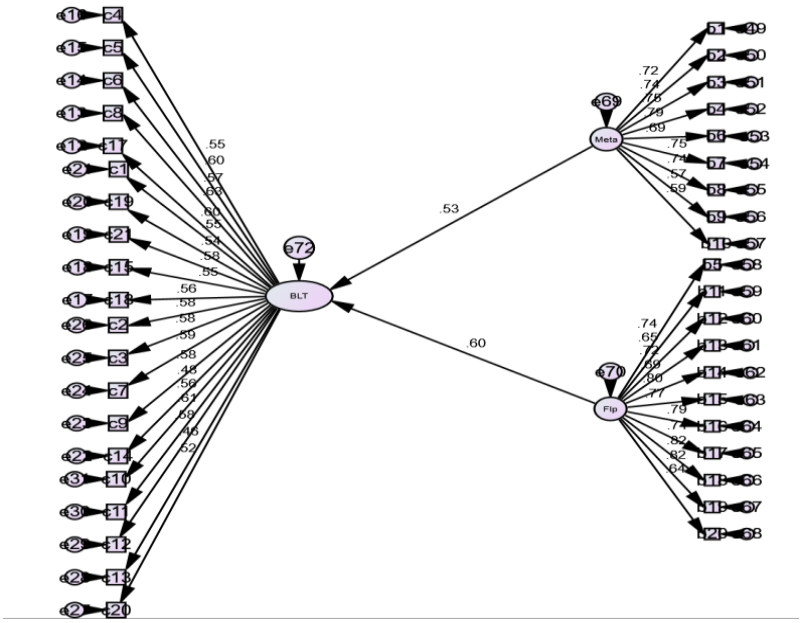

Figure 6. Correlation of the Bloom's Taxonomy factor with the meta and flipped classroom factors.

4.2.2. Student Personas—Meta Classroom

Figure 7 illustrates the model and correlations between student personas resulting from the factor analysis of Bloom's Taxonomy and the meta classroom factor. According to the above literature regarding the acceptable values of the indicators, it follows that the model is valid, as all the values appear to be statistically significant, and the correlations are positive.

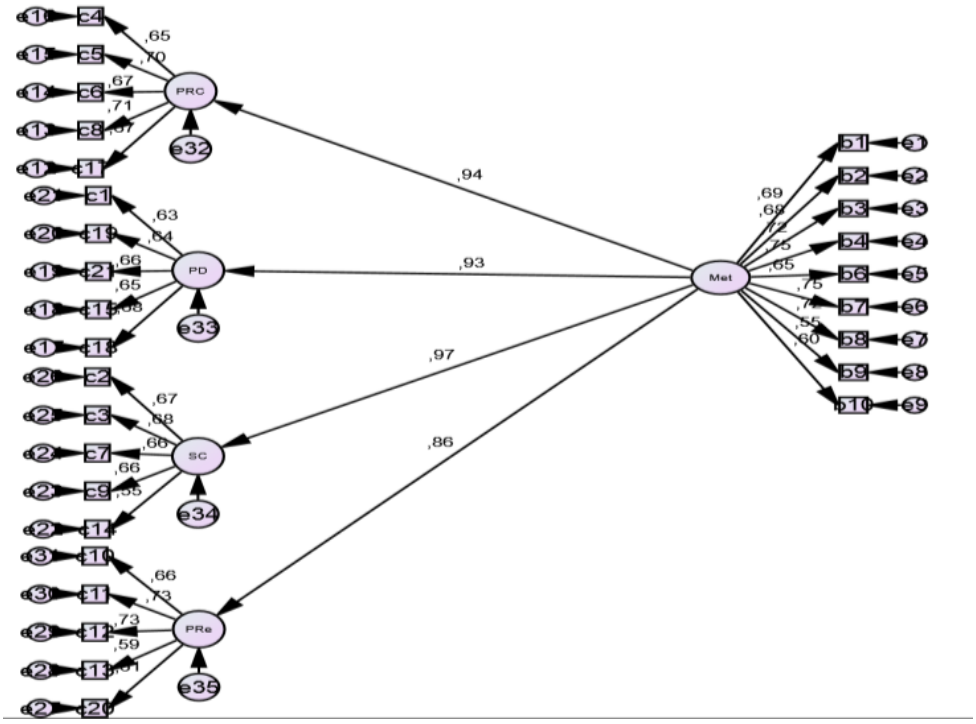

Figure 7. Correlations of student personas with meta classroom.

Regarding the individual statistical reliability indices, the Cmin/df index has a value of 3.645, the GFI and AGFI indices reach a value of 0.833, the CFI exceeds a value of 0.89, and the NFI touches values close to 0.90. The PNFI and PCFI indices are 0.785 and 0.817, respectively, while the RMSEA index is 0.065, confirming that the model is statistically significant and that the four student personas are positively correlated with the meta-learning environment. The findings show that the meta classroom correlates with students' personalities as an independent variable as follows:

- Students focused on educational tools and methods reached a correlation intensity of 0.94;
- Students focused on the skills and self-improvement they develop scored a correlation intensity of 0.93;
- Students with focus on resources and access to learning reached a correlation intensity of 0.91;
- Students dependent on the professor scored a correlation intensity of 0.86.

Figure 8 illustrates the model and the correlations between student personalities that emerged from the factor analysis of Bloom's Taxonomy and the flipped classroom factor. According to the above literature regarding the acceptable values of the indicators, it follows that the model of Figure 8 is valid, as all the values appear to be statistically significant, and the correlations are positive.

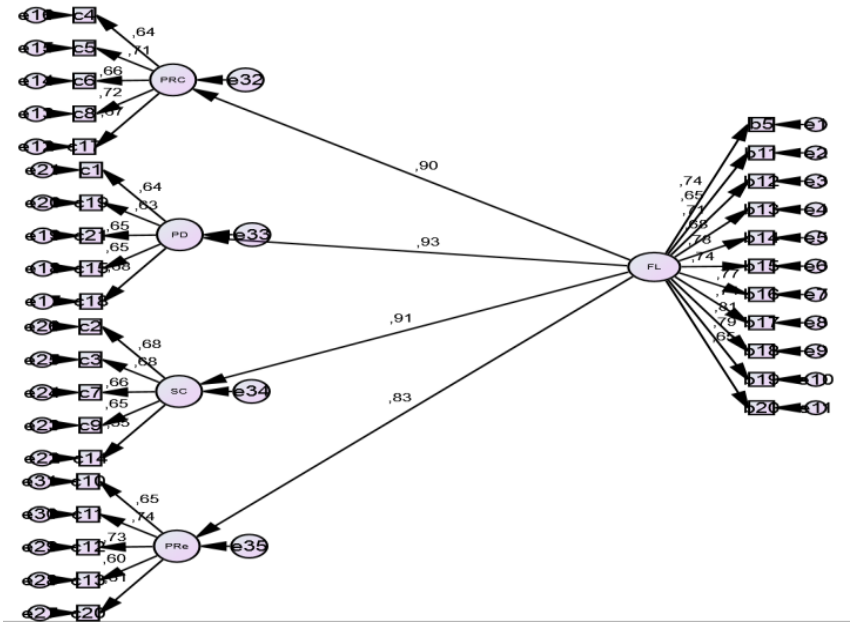

Figure 8. Correlating student personas with flipped classroom.

In this case, the individual statistical reliability indices are as follows: the Cmin/df index has a value of 3.835, the GFI and AGFI indices reach a value of 0.840, the CFI exceeds the value of 0.81, and the NFI touches a value close to 0.90. The PNFI and PCFI indices are 0.787 and 0.818, respectively, while the RMSEA index is 0.067, statistically confirming that the model is statistically significant and that the four student personas are positively correlated with the flipped learning environment. The findings show that the flipped classroom correlates with student personas as an independent variable as follows:

- Students focused on educational tools and methods reached a correlation intensity of 0.90 was achieved;
- Students focused on the skills and self-improvement they develop reached a correlation intensity of 0.93;
- Students with focus on resources and access to learning reached a correlation intensity of 0.91;
- Students dependent on the Professor reached a correlation intensity of 0.83.

Taking into consideration the aforementioned research findings, we conclude that all of the research hypotheses are supported and confirmed, as demonstrated:

1st research hypothesis: There is a correlation between the flipped classroom tools and Bloom's Taxonomy (SUPPORTED);
2nd research hypothesis: There is a correlation between the metaverse class tools and Bloom's Taxonomy (SUPPORTED);
3rd research hypothesis: There is a correlation between the flipped classroom tools and students' main personalities (SUPPORTED);

3a research hypothesis: There is a correlation between the tools of the flipped classroom and the personality of the "Students focused on educational tools and methods" type. (SUPPORTED);
3b research hypothesis: There is a correlation between the tools of the flipped classroom and the personality of the "Students focused on the skills and self- improvement" type. (SUPPORTED);
3c research hypothesis: There is a correlation between the tools of the flipped classroom and the personality of the "Students with focus on resources and access to learning" type (SUPPORTED);
3d research hypothesis: There is a correlation between the tools of the flipped classroom and the personality of the "Students depended on the Professor" type. (SUPPORTED);

4th research hypothesis: There is a correlation between metaverse classroom tools and students' main personalities (SUPPORTED);

4a research hypothesis: There is a correlation between the tools of the metaverse classroom and the personality of the "Students focused on educational tools" type. (SUPPORTED);
4b research hypothesis: There is a correlation between the tools of the metaverse classroom and the personality of the "Students focused on the skills they develop" type. (SUPPORTED);
4c research hypothesis: There is a correlation between the tools of the metaverse classroom and the personality of the "Students with focus on resources and access to learning" type. (SUPPORTED);
4d research hypothesis: There is a correlation between the tools of the metaverse classroom and the personality of the "Students depended on the Professor" type. (SUPPORTED).

5. Discussion and Conclusions

This paper presents a Blended Learning Method (BLM), which was undertaken in the context of combining the appropriate educational tools so as to captivate students' interest towards learning. The implications of this study are multifaceted, primarily suggesting that the Blended Learning Method (BLM) can serve as an effective educational approach to enhancing learning outcomes, inventiveness, creativity, and mostly interest among university students, encompassing both theoretical and practical reflections. Theoretically, this study contributes to the expanding body of scientific literature on the mixed educational style of teaching, a field that is disposed for exploration and further exploitation. It addresses the need to adapt teaching practices and learning processes to the rapid evolution of technology, leveraging its techno-pedagogical potential. Practically, this study climaxes with the construction of a validated and reliable instrument for evaluating educational experiences and perceptions through this experimental framework.

Passing through the semester and following a timeline on a mix of educational tools and methods, the students are driven by a perpetual multi-stimulation condition which equips them with the incentives to foster their learning challenge. The constant alternation of the synchronous in person teaching with the asynchronous method of individual study during a personal and self-selected time, as well as the synchronous online interaction through the metaverse covered by the virtuality of avatars as a playful and entertaining depiction of characters within the virtual classroom, has collectively assisted in facilitating learning, especially for students who face challenges absorbing or following traditional teaching due to certain constraints. This synchronization of meta and flipped classrooms with the simultaneous use of both environments' methods and tools, synchronous and asynchronous, has covered a diversity of personal characteristics and the wide range of subjective functions of each student persona. It also encourages the utilization of digital resources that promote attention to diversity, which are particularly beneficial for those student personalities with specific abilities in interacting, although focused on the tools they use and their effectiveness.

Bloom's Taxonomy consists of six stages which, for years now, have successfully been used to describe. the learning process at the individual level. This has led the researcher to utilize this taxonomy from the perspective of numerous groups of people and to identify some categories within them. Not treating students as a single entity but distinguishing them into separate personalities provides a major personalized teaching service in education that demonstrates respect of their human multiplicity and ends up stimulating and raising students' interest. In this way, this research tries to identify the most suitable tool or even the best combination of tools that arouse the interest of students' different personalities, with the aim of delivering the finest learning results and, finally, improvement in their performance. This study also indicates that within blended learning contexts, such activities can positively influence students' competency in technology, personal development, self-efficacy, and advanced thinking skills, satisfying the student persona that is mainly focused on the skills acquired as future supplies. In particular, we meet a student persona mainly

focused on educational tools, representing in this way a more modernized side of students, who trust the new technological achievements and their possibilities; at the same time, we meet a more humanized persona, who still depends on their teacher through the traditional role and continuous contribution to the process. This confirms the success of the amalgamation of the two environments, the real and the virtual one, satisfying both personas. Further, those students who focus on the skills they develop are proved to be more ambitious and visionary than those who aim for personal development, which is also evident through their responses in evaluating themselves and how they react to the use of the tools and not the tools themselves. Likewise, the persona focused on access to learning rated questions that are addressed in the first person higher, and they essentially evaluated themselves and how they coped with the whole process. They stay true to the last question, following the timeline and making sure that they are adequately equipped to reach their ultimate goal of own access to learning so that they can benefit from it. In conclusion, the multiplicity of the characteristics of each persona makes the need for a diversified treatment of the students as separate entities clear, even when each individual can combine two or more personas within their personality. This means that throughout the multi-stimulus process, the student is entirely satisfied.

Regarding the observation, the students seemed to be completely in agreement with the constantly updated digital platform, as in this way they had organized information and a database at their disposal, which they could refer to whenever they considered it necessary. Therefore they, in turn, felt that they had to reciprocate with a corresponding contribution to the procedure. The interviews (podcast) with specialized professionals in the field excited the students and acted as a reinforcement in the curriculum, confirming that the bibliographic theories have a tangible result in practice. The case studies showed them ways to identify the correct treatment through knowledge. The fact that the digital lessons started after the third live lesson gave the professor the time to prepare all of the students for the alternative experimental process with the complex use of modern and interactive teaching methods and, consequently, the importance of the functionality of digital classroom and its educational use. As a result, students now characterize the metaverse as a multifunctional learning tool in a digital room; they have awareness that it is a technological accessory for the fulfillment and facilitation of human energy and not the opposite. In this way, we can form conclusion on the combination of the privileges of each tool separately and the convergence of the two worlds, each from its own dimension.

Moreover, this research underscores the potential of BLM to improve both higher-order and lower-order learning outcomes across Bloom's Taxonomy, even within traditional teacher-centered classroom contexts, for those personas which acknowledge the professor as their core source of information and interaction. The findings also reveal that BLM can significantly impact students' divergent thinking, which suggests that the implementation of BLM in education can lead to a measurable improvement in the actual learning among students, something that was proved by the preparedness and adequacy of the appropriate equipment, which facilitated their access to learning. The positive correlations between the meta and flipped classroom with each student persona have not only confirmed the research hypotheses but have additionally demonstrated the beneficial outcomes of this multi-functional educational approach.

However, the limitations of current study must be acknowledged, such as the complexity of the technology and the mixed educational methods, especially the metaverse, which still balances in the exploratory phase of research within this field. Furthermore, the population of this research, although sufficient in number, was specific in its characteristics.

Despite these limitations, this study delivers novel standpoints for understanding the impact of blended knowledge activities and provides a foundation for future research to further explore and refine such educational lines. Working on a specific timeline has proved to be a focus point of success, meaning that its enrichment with more empirical tools and methodologies would intrigue students even further. Future research is encouraged to employ other tools, such as tracking students' motivations for energetic activity, to gain

a deeper, comprehensive perception of the effects of BLM in tertiary public institutions. The complexity of a blended method necessitates a detailed analysis of its effectiveness and suitability to address such a multifaceted issue. The undefined and obscure nature of the human brain, which one themselves may not be able to identify through conventional research means, demands the use of tools that examine brain functions, such as electroencephalography equipment (EEG), that will result in more thorough measurements of human reactions. And, what better way to measure the human reaction to the use of technology, than the technology itself? In conclusion, a customized toolbox should be created with the appropriate tools for each student persona. Additionally, this research calls for a broader holistic investigation by expanding the sample sizes and their diversity in order to explore other possible influencing factors based on the distinct characteristics of each student personality.

Author Contributions: Conceptualization, A.T.; methodology, S.A., I.K. and A.T.; validation, S.A. and A.T.; formal analysis, S.A. and I.K.; investigation, A.T.; data curation, S.A.; writing—original draft preparation, A.T.; writing—review and editing, S.A., I.K. and A.T.; supervision, F.K., E.C. and S.A.; All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: No ethical approval was required. No biomedical experiment was conducted.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. All students who were asked to fulfill the questionnaire had been thoroughly informed and a consent form was also given.

Data Availability Statement: Data are unavailable. The datasets presented in this article are not readily available because the PhD thesis is still on going. Requests to access the datasets should be directed to Andreanna Tragouda after the fulfilment of the thesis.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Questionnaire (Demographics Excluded)

Appendix A.1. Metaverse Classroom

A.1 Avatars in the metaverse are likely to resemble my image in real life.
A.2 The metaverse is fun.
A.3 There is a sense of realism in the metaverse.
A.4 There is a sense in the metaverse that (physical) space is being abolished.
A.5 One could consider the metaverse as a multifunctional learning tool in a digital room.
A.6 The metaverse university is something I would like to see happen in the future.
A.7 To create the metaverse University it is necessary to develop new technological infrastructures that will support design and interaction.
A.8 To create the metaverse University it is necessary to acquaint users with the virtual environment.
A.9 I feel safer communicating through the avatar image.
A.10 By using the avatar I do not worry about my appearance and the environment of my room.

Appendix A.2. Flipped Classroom I

B.1 At some point in the future the digital worlds are likely to merge.
B.2 There is a sense of emotional absorption in the digital room.
B.3 I would like to join a fully functional digital room.
B.4 My participation in a fully digital room is interesting.
B.5 In a digital classroom the course content becomes more interesting for me.
B.6 In the digital room I learn from the teacher as much as from real teaching.

B.7 In the digital room, two-way communication is achieved between students and the teacher.
B.8 I would like the course to be done exclusively in a digital environment in the future.
B.9 In the digital environment I feel that I communicate better with the professor.
B.10 I prefer a mixed teaching system of digital and physical teaching.

Appendix A.3. Blooms Taxonomy

C.1 Using digital materials in this course has changed the way I learn.
C.2 I had a strong desire to attend this course.
C.3 I had sufficient online resources to use to access my course.
C.4 The tools used in the course were effective.
C.5 The tools used to take the exam were effective.
C.6 Discussions, podcasts, case studies and questions were used effectively in the digital course.
C.7 I actively participated in the learning process.
C.8 The digital classroom worked effectively.
C.9 I followed the guidelines for using digital materials for this lesson.
C.10 The instructor answered my questions in a reasonable amount of time.
C.11 I could get help from the instructor when I needed it.
C.12 I was satisfied with the instructor's teaching method.
C.13 The instructor seemed to know the subject well.
C.14 My computer skills were sufficient to perform the functions required by the digital classroom.
C.15 Using digital materials helped me develop new skills.
C.16 Using digital materials helped me understand the course content faster.
C.17 Using digital materials has helped me improve my computer skills.
C.18 I feel that I will be able to apply what I learned in this class in my life afterwards.
C.19 The delivery method was user friendly.
C.20 The content of the digital material and its use has made me a better citizen.

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