Initial Perception of Virtual World Users: A Study about Impacts of Learning Styles and Digital Experience

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Abstract
Virtual Worlds emerge as three-dimensional environments that have the potential to stimulate advances in the educational field by promoting interactivity, freedom and autonomy for students. However, its effective adoption in educational institutions is still considered very limited, and few studies have so far sought to identify more specific causes for such limitation. This research aims to contribute to the theme through a preliminary study about the impact of individual characteristics of learning styles and digital experience on users' initial perception about 3D Virtual Worlds. An experiment was conducted with a sample consisting of potential influencers in the decision making process for adoption of this type of approach, being composed by professionals from educational area that experimented a 3D virtual laboratory for the first time. As a result, some insights about the mentioned characteristics' influence on user first impression are identified and some potential adjustments necessary to better fit different profiles are suggested, envisioning to disseminate theuse of Virtual Worlds in Education.
Keywords: *virtual worlds, learning styles, new users, digital experience, education.*

1. Introduction
Virtual Worlds (VWs) may be characterized as three-dimensional digital environments in which users are represented by virtual bodies or avatars and can interact with objects, with the environment itself and with other avatars (Lowe; Clark, 2008). They offer new opportunities in immersive and creative spaces (Gregory et al., 2015) and, according to Allison et al. (2012), are currently being used in several areas, including Education, where they have been research interest since the availability of Second Life VW as an Internet service for more than ten years.

Several researches have already been published regarding the potential of VWs for learning improvement (Dickey, 2015; Lowe; Clark, 2008;Zaharias et al., 2010). However, its effective adoption has not occurred more broadly as predicted by some experts (Yoon; George, 2013, Gregory et al., 2015). At the same time, few researches aiming to understand the causes of this fact are carried out, and the existent publications are limited to studying organizational or technical issues. Dudeney and Ramsay (2009), for example, reported technical difficulties of the organizations to keep systems working for a significant number of students. Muñoz-Cristobal et al. (2015), in a complementary way, present four limitations to the use of VWs in educational practices, being: a) scarcity of access to resources; b) absence of authoring tools for teachers; c) the non-possibility of reuse of learning objects on other platforms; d) the isolation of the VWs in relation to other technologies.

The analysis of the causes for this slowness in the adoption of VWs as a toolfor teaching in institutions seems to request to the investigation of not only objective but also of subjective factors. In this sense, Dias and ArrudaFilho (2013) highlight the existence of negative feelings when people are facing a new technological product, generating resistance in its use. According to Billeter et al. (2011), several researches have already shown that the level of adoption of a new technological product depends on First-Time User Experience (FTUE). Considering that the use of VWs for educational purposes is something new for most institutions, we assume that it is appropriate to check the FTUE, especially from teachers

and education professional users, who will be judging whether or not to adopt the new resource:these should be the first to be convinced, otherwise, the product will probably not reach the students.
The aim of this research is to investigate and obtain insights about the FTUE in an educational VW, testing the general hypothesis that individual aspects may influence the first impression or initial obtainedperception. Thus the following research question landmarks the study:

- **What is the impact of user profile on the quality of its first experience in educational VWs?**

Aiming to find answers to the question, users Learning Style (LS) and Digital Experience Level (DEL) characteristics were considered, seeking to analyze how these aspects may influence the FTUE in VWs and, consequently, make some individuals more susceptible to the adoption of this type of educational resource than others.
The article is organized in the following way: in section 2 the VWs in the educational area are approached; section 3 is intended to present the aspects of LS and DEL considered in this research; section 4 outlines the research method, detailing its steps; in section 5 the results are analyzed and discussed, finalizing in section 6 with the conclusion and final considerations.

2. Virtual Worlds in Education

Studies have shown that interaction with VWs can be highly stimulating to students and usually attracts their interest and enthusiasm. Although it does not seem to be able to replace more traditional educational means, the introduction of this technological paradigm in education has the potential to improve the global learning experience (Zaharias et al., 2010).
VWs can provide experiential learning,as Kolb (1984) describes when theoretical knowledge is confronted, compared, magnified and reflected. In the VW the student can have contact and interact with 3D objects that together present an experiment or simulation of scientific phenomena, concrete or abstract. This kind of environment also stands out for the characteristic of freedom, where the user has a certain power of choice that privileges exploration and learning by discovery.
Given that this relatively new media of content presentation, interaction, and communication has significant differences compared to traditional teaching paradigms, researchers try to study their effects on learning outcomes by identifying the circumstances and preconditions under which VWs should be used. An example is detailed in the paper by Nunes et al. (2014), in which it was found that students would have realized that the VW allows to visualize “in practice” what is described in theory, besides consideringit an exciting and with a great degree of interactivity.
However, it is perceived that many users have as frustrated their initial experiences in these environments (Eno et al., 2011), which may be derived from several issues related to their individual characteristics, such as previous experiences with digital technologies or Digital Experience Level (DEL) and ways of learning or Learning Style (LS), instigating the need to analyze these aspects.

3. Learning Styles and Digital Experience Level

Learning Styles are defined as the individuals preferred methods for perceiving general information or tendencies to process them in different ways (Kolb, 1984). According to Zaharias et al. (2010), it describes students’ preferences and strengths in psychological and cognitive processes that are used during learning, relating to their behavior in interaction with an educational environment.In this sense, the literature suggests that students with a strong preference for a specific LS may encounter difficulties if the teaching style does not match their own LS (Felder and Silverman, 1988). Due to these differences, there may be a favorable trend of some students for some courses (Kolb, 1984).
Dias and ArrudaFilho (2013) warn that, as new technologies are inserted in the educational sector, it is necessary to study the behavior of its users, analyzing which factors influence the acceptance processes. The authors analyze the use behavior given acceptance theories such as Technology Acceptance Model

(TAM) (Davis, 1986), identifying the influence of hedonic and utilitarian factors and the relation of previous experience with technological products.
In order to diagnose the aspects of LS and DEL with the users, an online questionnaire (Questionnaire 1) that compiles two main instruments was elaborated:

1) Index of Learning Styles (ILS): an online instrument used to evaluate the preferences of an individual in four dimensions (Active / Reflective, Sensorial / Intuitive, Visual / Verbal and Sequential / Global) formulated by Felder and Silverman (1988) and developed by Felder and Soloman (1997) from North Carolina State University. In our research all 44 original closed questions were used to measure participants'LS. The questions were translated into thelocal language (Portuguese) by the authors.
The choice of ILS was made firstly due to its relation with the experiential learning model of Kolb (1984), used as pedagogical reference for the construction of the environment used in the experiment. For example, when defining "Active / Reflective" style dimension, the authors Felder and Silverman (1988) were based on Kolb's (1984) concepts of "active experimentation" and "reflexive observation". Secondly, because it is a widely used taxonomy in academia, with a diagnostic tool (online form) available for free on the internet.
In this model, individuals are classified according to their preference for one of the opposing characteristics for each dimension, as shown in Table 1, standing on a scale ranging from -11 to 11, so the individual can be classified as a strong (-11, -9, 9, 11), moderate (-7, -5, 5, 7) or weak trend (-3, -1, 1, 3).

Table 1. Dimensions of Learning Styles (Felder; Silverman, 1988).

SENSING	INTUITIVE
Concrete, practical, fact-oriented and procedure-oriented thinker.	Abstract thinker, innovative, oriented to theories and underlying meanings.
VISUAL	**VERBAL**
It prefers visual representations such as tables, diagrams, flowcharts, etc.	Prefer written and spoken explanations.
ACTIVE	**REFLECTIVE**
Learn by judgment, enjoy working in group.	Learn by thinking things through, preferring to work alone or with a single family partner.
SEQUENTIAL	**GLOBAL**
Notice the step-by-step information.	It has a global perspective of the information presented.

Parameters of learning styles considered in this study.

2) Adaptation of Bolzan et al. (2013):this instrument supports the analysis of behavior and development of skills in the use of information and communication technologies, assigning weights to each of the questions. The response options are a four point Likert scale, with the alternatives "never", "rarely", "often" or "always". Only 8 out of 40 closed questions of the instrument were used, aiming at not overloading the participant cognitively, taking into account only those considered more relevant by the authors in relation to the researched context (questions 2, 5, 18, 32, 33, 34, 38, 39).
The following section presents the research method used to analyze data from theexperiment with the mentioned parameters.

4. Research Method

As for the technical procedures, this study have an exploratory qualitative approach. This type of research can be used to explore unstructured issues, territories not yet mapped, unexplored horizons, problems involving actors, contexts and processes (Ensslin;Viana, 2008).
In order to investigate the research hypothesis, a VW space was modeled and implemented on OpenSimulator (OpenSim) platform. The steps occurred between August and December 2016, and are described as follows.

4.1. Step 1 - Defining scope

Initially, research gaps were identified and the theoretical framework was constructed, where it can be mentioned Zaharias et al. (2010) as the main correlate work, which also used Felder and Silverman's (1988) Learning Styles model. This research differs from the mentioned study by adding the issue of DEL and for addressing only beginner users, that is, individuals that have never made use of 3D VW, either in a pedagogical approach or not. In addition, the work presented here focuses on the initial perception of the user, aiming to identify what aspects, characteristics and features more satisfied them in theirFirst Time User Experience (FTUE). Zaharias et al. (2010), in turn, focused on student learning performance.

Regarding the sample, a universe of users whosesocioeconomic profile resembles a potential opinion-maker concerning the adoption or not of a new technological resource for educational purposes was considered as the scope of this research: professionals with experience of acting in education.

4.2. Step 2 - Creating the 3D virtual environment

OpenSim, being an open source project that uses the same protocol of Second Life, has in recent years replaced it as a platform for the development of immersive environments in Education. It is compatible with Second Life programming viewers and scripts, but offers solutions to many of the drawbacks found in it, such as cost, content sharing and backup (Allison et al., 2012). Therefore, it is the platform used in the context of the authors' AVATAR project (seehttp://ufrgs.br/avatar), which focuses on teaching physics. Within this VW it was created a virtual building entitled "WavesLaboratory", where there are four main rooms that deal with a topic of the subject: the study of Electromagnetic Waves, which is part of Physics for secondary educationcurriculum in the authors' country (Brazil).

This being a very abstract subject, in this environment students have the opportunity to visualize the practical side of concepts that are part of their daily life but which are impossible or very difficult to be seen in reality. Within this virtual laboratory the following characteristics and functionalities have been modeled, which seek to bring dynamicity and interactivity to the teaching-learning process and incite the continuous cycle of Kolb (1984):

A) Multimodal didactic resources: aiming at knowledge acquisition it was made available around the environment materials such as videos, slides, images, texts, animated digital media, audios and materials embedded in QR Code. These resources were identified as to their type through a luminous plaque inserted in the upper part of each item. It can be related with "concrete experience" Kolb's (1984) phase, where the student have contact with the content.

B) Gamification aspects: objects with challenges in the form of objective questions about the virtual laboratory subject were arranged by the environment. This aspect can be related with the "abstract conceptualization" Kolb's (1984) phase, where the student see what s/he have learned.

C) Non-Player Character (NPC):an avatar that supportsthe student in its journey and has a text conversion property via integration with the chatterbot O-Program application, where bases were created in AIML (Artificial Intelligence Markup Language). This NPC has a female physical form and is called "Athena Tutor", having an ability to answer direct questions, such as "what are electromagnetic waves?". The user can interact with the NPC by typing in the conversation bar of the VW viewer. This functionality can be associated with "reflective observation" Kolb's (1984) phase, where the student has to reflect about what s/he have learned.

D) Simulations: Two animated simulations about the subject were created and made available with objects of the OpenSim itself, activated by the user through scripts. They can be associated with "active experimentation" Kolb's (1984) phase, where the student can apply what s/he have learned.

Figure 1 shows two screen captures containing some of the mentionedfeatures, especially regarding A and C aspects.

Figure 1. Features A and C available in the virtual laboratory.

Figure 2 shows screen captures with each of the simulations created in the virtual laboratory (feature D), being on the left about AM and FM radio waves and on the right about wave phenomena. Each one has buttons for users to trigger what they want to see.

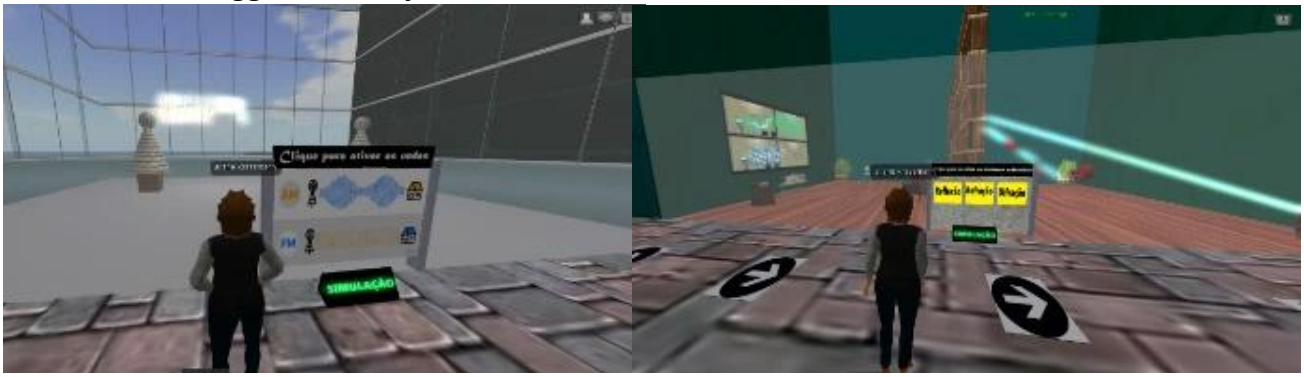


Figure 2. Simulations running in the Waves Laboratory (feature D).

With this variety of features and resources it was sought to contemplate students specificities, who may differ in their preferences, as already mentioned in section 3, as well as to expand opportunities for interaction and content presentation. The estimated time for a user familiar with the environment walk through the lab and visit all of its resources (without delving into the content) is approximately 20 minutes.

4.3 Step 3 - Application of the experiment

4.3.1 Sample profile

For the experiment application, the following objective criteria for participants' recruitment (evaluators) were initially defined, aligned with the researchscope:

A) No previous experience with 3D VWs or had it superficially (logged in or accessed it just once). In this sense it was clarified what kind of platforms and open 3D environments can be considered as Virtual Worlds, like The Sims, The Palace and Second Life.

B) Higher education degree (completed or in progress): individuals who have already been exposed to the virtual laboratory contents in their basic formations, thus mitigating possible difficulties regarding the subject addressed.

C) Professional experience in educational area: to have acted in teaching for a minimum period of one year.

In order to enhance the data analysis, additionally to the instruments presented in section 3 for identification of LS and DEL, three diagnostic questions were included in Questionnaire 1, aiming at identifying sex, age and schooling level of the participants.

Considering the availability of people willing to participate in the experiment and the recruitment criteria previously established, a total of 19 individuals were selected, being 11 women and 8 men, who composed the sample. The mean age of the participants was 33.4 years and the level of education ranged between postgraduate (complete or in progress) with 11 participants, complete higher education with 5, and incomplete higher education (in progress) with 3 participants.

Regarding DEL, the evaluators were divided into two groups of very close amounts: medium level (n = 10) and high level (n = 9) of digital experience. It was observed when crossing DEL with the evaluators'sex that all males were classified in the high digital experience group, contrasting with the fact that only one female evaluator was classified in this level of digital experience. Figure 3 shows demographic and DEL data ofexperiment participants.

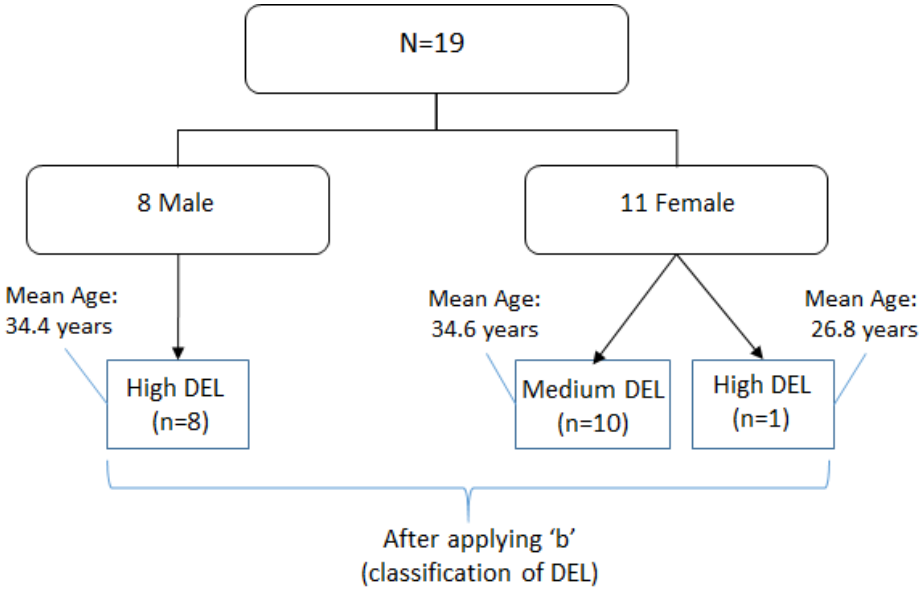


Figure 3.Demographic and DEL data ofthe sample (experiment participants).

Each of the evaluators was also classified regarding LS, following the methodology of Felder and Silverman (1988) and Felder and Soloman (1997). With the diagnosis' results it was verified the majority of evaluators (approximately 57%) with scores between "-3" and "+3" in some dimensions, classified as weak preference or "Neutrals". In this research these participants were defined as No Preferential Style (NPS).

Figure 4 shows the allocation of the 19 participants in each of the four dimensions of LS. Each dot means one participant preference in each particular dimension, thus being four dots per participant (total of 76 dots).

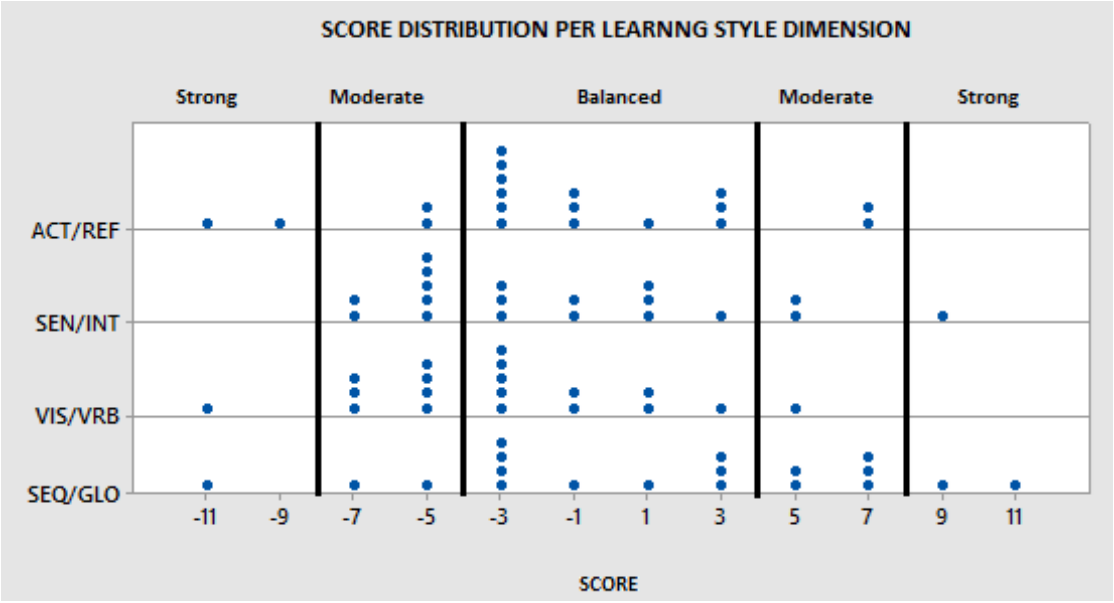


Figure 4. Dot plot of participants preferences per LS dimension.

For analysispurposes, in this research the users with predominant preferences were grouped, such as "Moderate Active" and "Strong Active" were grouped into "Active".

The evaluators, after signing the Term of Free and Informed Consent (TFIC), received Questionnaire 1 by e-mail. Then, an individual meet was scheduled for each of them to make use of the Waves Laboratory in the researchers'computers. This prevented participants from having to deal with VW installations and configurations.

During the experiment, participants were invited to freely navigate the environment and interact with the various resources available, putting themselves in the place of a student using VW in the educational context for the first time. A fixed itinerary was not established, and there was no definition of minimum or maximum participation time, leaving the user free to choose the way forward and the time destined to visit the virtual laboratory. Each participant took, on average, approximately 25 minutes in this activity.

For the post-experiment, in order to record users' perception regarding the approach and to obtain the primary data, an instrument was created by the authors, containing18 closed and one open question, defined as Questionnaire 2 and also made available online. From the closed questions, 15 received a Likert scale response of five points and three were of multiple choice. The open question aimed to capture general comments from the evaluators about the VW.

Questionnaire 2 included four constructs: General Perception, Usability, Resources and Utility. It was inspired by TAM model of Davis (1986), which used the Perceived Ease of Use and Perceived Usefulness constructs, which, according to the author, influence in the acceptance of a given technology imposed on the user. Participants also received Questionnaire 2 by e-mail and responded it within two hours after the experiment.

The following section covers the performed data analysis.

5. Data analysis

In this section, the analysis of the data obtained through the cross-checking of the pre and post experiment questionnaires (Questionnaires 1 and 2, respectively) is presented, seeking to relate each group of evaluators with their impression in relation to the VW.

For this purpose, Mann-Whitney statistical tests and Fisher's proportions test were used with a predefined confidence level of 95%. Although the number of evaluators was relatively low (n = 19), the tests were able to indicate some significant differences among groups of participants, making it possible to

extrapolate them to the population of VW users, with due caution to consider those with a socioeconomic profile similar to the study sample.

Table 2 summarizes the statistical tests results, highlighting the cases in which the difference was considered significant, that is, when the null hypothesis of equality between the medians was rejected. For example, when comparing Active LS with NPS (No Preferential Style) users in the Active / Reflective dimension (first column of Table 2), it was verified a significant difference in Q3, Q14 and Q15 questions responses. In this case, individuals with Active LS were more positive in the evaluation of Q3 (highest median), while NPS users were more positive on questions Q14 and Q15. Table 2 also shows the cases in which the test could not be performed, dueto the minimum quantity requirement unfilled.

Table 2. Results of tests indicating some statistical differences.

Constructs		LS - Dimension 1			LS - Dimension 2			LS - Dimension 3			LS - Dimension 4			DEL
		ACT x NPS	ACT x REF	REF x NPS	SEN x NPS	SEN x INT	INT x NPS	VIS x SEP	VIS x VRB	VRB x NPS	SEQ x NPS	SEQ x GLO	GLO x NPS	HIGH x MEDIUM
General erception	Q1								(1)	(1)				
	Q2								(1)	(1)				
	Q13								(1)	(1)				
	Q12		(1)	(1)		(1)	(1)	VIS	(1)	(1)	NPS	(1)	(1)	
Usability	Q3	ACT					NPS		(1)	(1)				
	Q4								(1)	(1)				
	Q5			NPS	SEN		INT		(1)	(1)				HIGH
	Q6								(1)	(1)				MEDIUM
esources	Q7								(1)	(1)				
	Q8		(1)	(1)		(1)	(1)	NPS	(1)	(1)		(1)	(1)	
	Q9		(1)	(1)		(1)	(1)		(1)	(1)		(1)	(1)	
	Q11								(1)	(1)				
Utility	Q10				NPS			VIS	(1)	(1)				
	Q14	NPS			<S>				(1)	(1)				
	Q15	NPS		NPS					(1)	(1)				
	Q16				NPS				(1)	(1)				

Legend:
- LS or DEL with more positive response in the comparison(p-value < 0,05)
- H_o not rejected, 95% of confidence (p-value > 0,05)
- (1) Test was not possible to carry out due to small 'n' of cartegory

Questions where the alternative hypothesis was accepted are marked, highlightingsome discrepancies.

The data wereanalyzed according to Questionnaire 2 constructs, as follows. The numbering scheme of the questions followed the order arranged in the online form. The most relevant findings are highlighted.

5.1 General Perception

The evaluators general firstperceptions wererevealed througha 5-point Likert scale for the following questions: Q1 (“Was the Virtual World a pleasant environment?”), Q2 (“Did you feel transported to the Virtual World as if you’re in it?”) and Q13 (“Do you think the sounds triggered in the environment helped on creating a feeling of immersion?”).

In general it was observed that the VW was considered pleasant by the participants, since 10 of 19 assigned Q1 with value “5” (Strongly Agree) and the other 9 with value “4” (Agree).

On Figure 5the evaluations of questions Q1, Q2 and Q13 are presented on interval plots, grouped by LS and DEL classifications.The plots also represent the medians of each group (circumferences), making it easier to compare the different groups. Statistical analysis with the non-parametric Mann-Whitney test did not indicate a significant difference onthe medians in comparison among different groups, since for all tests performed the *p* parameter was greater than 0.05. In this way, the results evaluation of such questions should be carried out carefully, restricting the conclusions to the experiment sample.

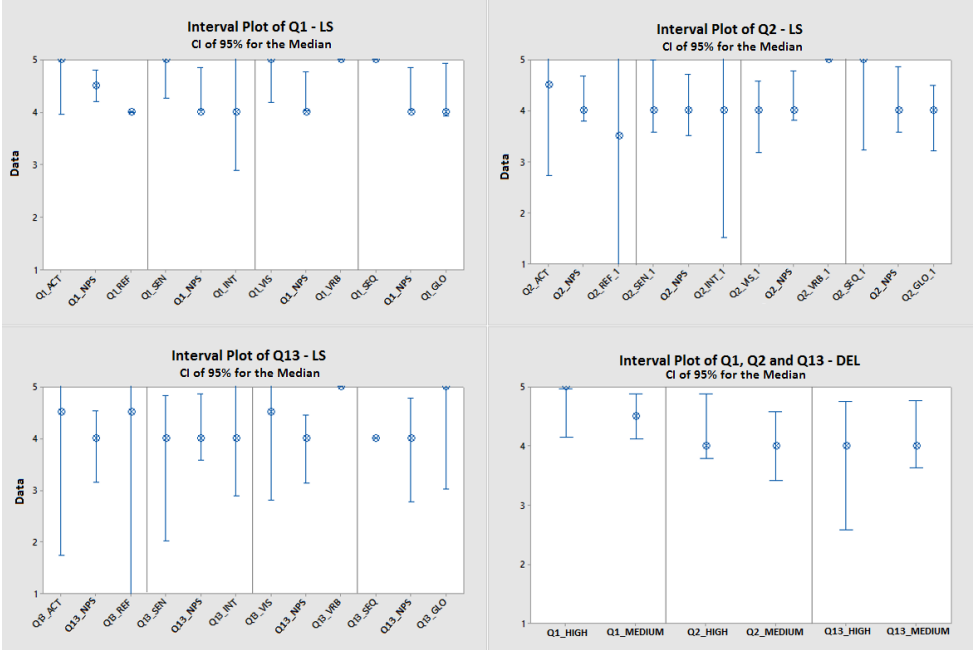


Figure 5.Interval plotsfor the responses of Q1, Q2 and Q13 (LS and DEL).

Regarding Sensing / Intuitive dimension, the majority of participants with Sensing LS (71%) rated Q1 with a score of “5”, while 67% of Intuitive users rated “4”, indicating a more positive perception of Sensing users about considering the VW nice. In the Sequential / Global dimension, 57% of Globals indicated the score “4”, while almost all Sequentials’ scores were“5”, showing a slightly more positive perception of these.

It was also observed that individuals with Sequential LS made a more positive evaluation concerning Q2. The “5” score was given by only 14% of the Globals and by 67% of the Sequentials, making it possible to verify that they felt more transported to the VW, that is, they obtained a greater sensation of immersion.

For the question that evaluated the sounds in the VW (Q13), 73% of the general evaluations were “4” or “5”, and the remaining 27% were “1”, “2”or“3”. This question was the one that had the less positive evaluation in this construct, showing how the sound aspect may have displeased the participants a little. However, it was not possible to establish any discrepancy depending on LS or DEL.

Q12 listed eightof the VWkey features as response options. The proportion of evaluators with Visual LS who indicated preference for “accessing educational resources in a 3D graphical environment” was significantly higher than the NPSusers in the Visual / Verbal dimension, with $p = 0.003$ in Fisher’s Test. The NPS users, in turn, indicated preference for “animations with demonstration of avatar emotions”.

Still on Q12, in the Sequential / Global dimension it was found that individuals with moderate or strong trend did not consider the characteristic “to access educational resources in a 3D graphical environment” as the one that most caught their attention, contrary to the NPS that in good part did so (67%).

The Mann-Whitney test was also applied in relation to DEL and no direct relationship was identified.

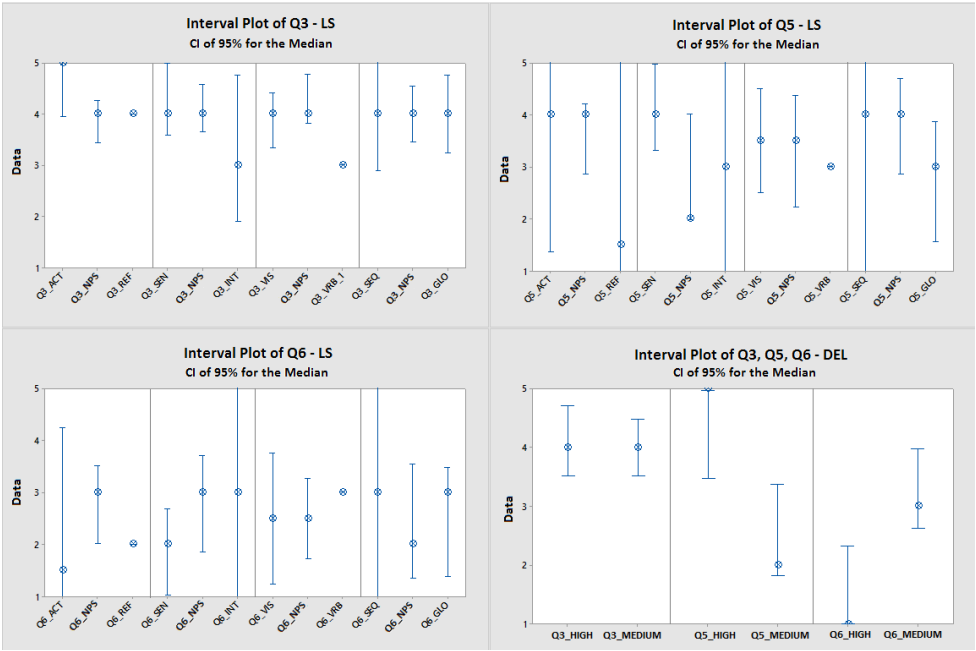
5.2 Usability

The evaluators'usabilityfirst impression was manifested by the 5-point Likert scale forthe following questions: Q3 ("Was the navigation in the Virtual World is easy, intuitive?"), Q4 ("Have you easily learned to move around and use the resources of the Virtual World?"), Q5 ("Do you consider the level of digital experience decisive in the ability to explore the environment?") and Q6 ("Did you need help to use the Virtual World?").

In general, 79% of the evaluators considered Q3 in the scores "4" or "5", and the remaining 21% in "3". The most positive evaluation among all questions (including those of other constructs) was Q4: 100% of the participants rated it as "5" (Strongly Agree). This suggests that all of the participants considered navigating in the environment easy and were able to use its resources without difficulty.

Figure 6 shows the interval charts for Q3, Q5 and Q6 evaluations regardingLS and DEL groups. Evaluations of Q4 were not plotted, since 100% of respondents rated this question as "5".

Regarding Active / Reflective dimension in the Q3evaluation it was found that evaluators of Active LS were more positive in relation to Reflectives and NPS: while 75% rated it as"5", all Reflectives rated it as "4". Among NPS users, 31% evaluated Q3 in "3" (neutral). Thus, it is possible to verify that there was a greater ease of navigation by the Actives and a certain difficulty fromNPSindividuals. In the Mann-Whitney statistical test the alternative hypothesis was accepted that the responses'median of Active



LSusers is higher than NPS users, with $p = 0.019$.

Figure 6. Intervalplotsfor Q3, Q5 and Q6 responses (LS and DEL).

Still in relation to Q3, in the Sensing / Intuitive dimension, while 67% of the participants with Intuitive LS assigned a score of "3", only 14% of the evaluators with SensingLS and 20% of the NPS considered it in that same score. The difference between Intuitive and NPS was considered significant in the Mann-Whitney test, making it possible to accept the alternative hypothesis that responses'median of NPS users is greater than Intuitive ones. This shows a greater neutrality regarding the ease of navigation by Intuitives, which might indicate that they had greater difficulty in the VWexploration.

In Q5 the statistical test pointed out a significant difference between users classified with medium and high DEL (p = 0.0032). Participants with average DEL did not consider that their digital experience would have impacted their ability to exploit the environment. On the other hand, those classified with high DEL considered that it did. Regarding the Learning Styles, it was verified, in the Active / Reflective dimension, that the Reflectives also disagreed with this DELinfluence, given scores equally divided between "1" and "2". Activeand NPS users have agreed more with that. However, in the statistical testthe comparison did not indicate a significant difference (p = 0.076).

In the Sensing / Intuitive dimension it was possible to identify differences in relation to Q5: while 71% of the Sensing considered their DEL to be decisive for the environment exploration (scores "4" or "5"), only 1/3 of NPS and Intuitivesevaluated in these scores. In the statistical test the null hypothesis was rejected when comparing Intuitive with NPS (p = 0.0395) and Sensing with NPS (p = 0.0172), indicating a significant difference between the perception of these groups.

When evaluating Q6 results, a significant discrepancy was found between those classified with medium and high DEL (p = 0.0018), suggesting that individuals with a high level of digital experience needed less help and vice versa. There were no significant differences in relation to LSgroups.

5.3 Resources

The participants expressed their first perceptions regarding the quality of the didactic resources available in the VW, answering the following questions: Q7 ("Were the resources available in the Virtual World interesting?"), Q8 ("Which of these resources did you like themost?"), Q9 ("Which of these resources didyou likethe least?") and Q11 ("Was the arrangement of resources in the Virtual World pleasant for you?"). The interval graphs of Q7 and Q11 are shown in Figure 7, since questions Q8 and Q9 did not use Likert scale, but rather eight response alternatives.

In general, most evaluators (79%) considered Q7 at "5", while the remaining 21% at "4" score, suggesting that participants considered the available resources to be very interesting.

Regarding the Learning Styles, in the Active / Reflective dimension while 75% of the Actives rated it at "5", only 50% of the Reflectives indicated this score, showing a slightly more positive perception of the Actives in relation to consider the resources available in the VW interesting. In the Sensing / Intuitive dimension it was possible to perceive a more positive evaluation from the No Preferential Style (NPS) users. However, the statistical tests did not identify significant differences among the medians of these groups.

When analyzing preferences by types of resources (Q8 and Q9), 52% of the evaluators in general indicated that "Simulation" was the most interesting one, followed by "Animated digital media" with 26%. Among the less interesting resources the evaluation was practically divided between "Text" and "QR Code".For these questions only in Q8 the Fisher test detected a significant difference between LS groups. In the Visual / Verbal dimension the null hypothesis was rejected, with p = 0.0230, proving a discrepancy between Visual and NPS participants who preferred the "Simulation"resource (NPShave preferred more).

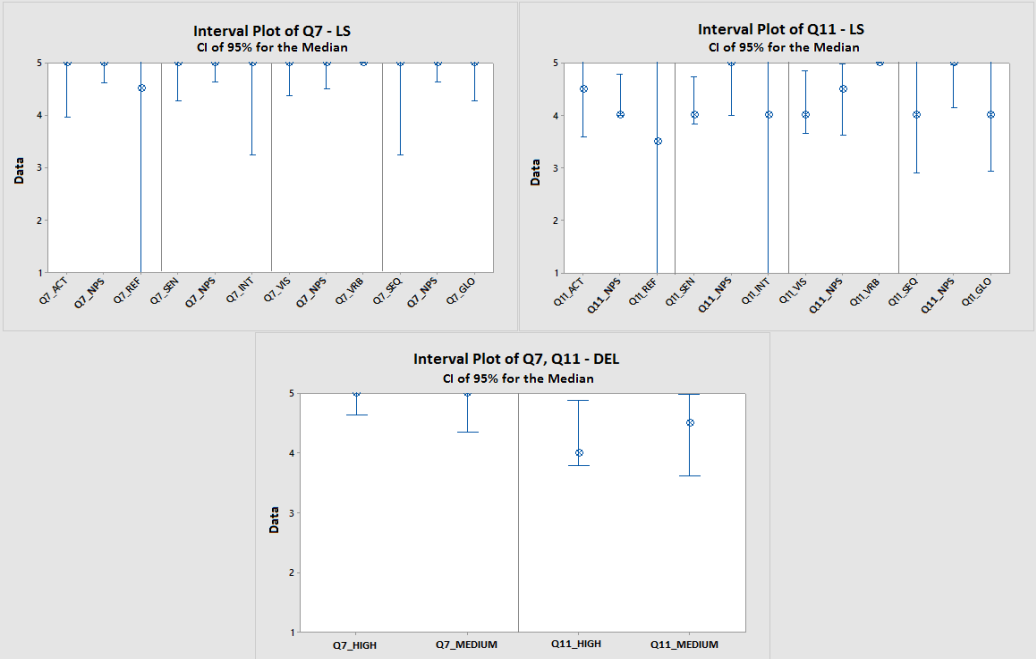


Figure 7.Interval plots for Q7 and Q11 responses (LS and DEL).

Regarding Q11, about 90% of the total number of evaluators attributed “4” or “5” scores, which shows that participants in general liked the disposition of resources in the environment. In the Sensing / Intuitive dimension it was possible to verify that individuals with moderate or strong tendencies gave less positive scores than NPS: while approximately 70% of NPS gave scores “5”, only 30% of the evaluators with Sensing or Intuitive LSassigned that same score, suggesting that NPS participants considered the resources disposition in the VW in a more pleasant way.

5.4 Utility

The participants indicated their first impressions regarding the VWutility through a5-point Likert scale for the following questions: Q10 (“Could the use of Virtual World resources beuseful for your learning?”), Q14 (“DidAthena tutor answer your doubts appropriately?”), Q15 (“Would you learn better if you used Virtual Worlds like this in your education?”) and Q16 (“Would you access again or recommend to somebody else this Virtual World?”). The overall results are illustrated in Figure 8. For this construct it was possible to obtain the largest number of statistically proven differences between LS groups.

In relation to Q10, all the participants indicated scores “4” or “5”, presenting a very positive general evaluation about the resources’usefulness. However, in the Sensing / Intuitive dimension it was observed that individuals with Sensing LS were less positive, with 85% of them evaluating it in “4”score, while 67% of NPS and Intuitive users evaluated it in “5”, suggesting that they perceived the VW utility better for learning. The Mann-Whitney test indicated a significant difference between the responses’ medians of SensingLS in relation to NPS users, with $p = 0.0246$.

Regarding Visual / Verbal dimension, the NPS participants were less positive in Q10 assessment: while 80% indicated a “4” score (Agree), only 25% of Visuals attributed this score. The alternative hypothesis that individuals with Visual LSconsidered the VW resources’ utility for learning more positively than NPS was accepted with statistical confirmation ($p = 0.0133$).

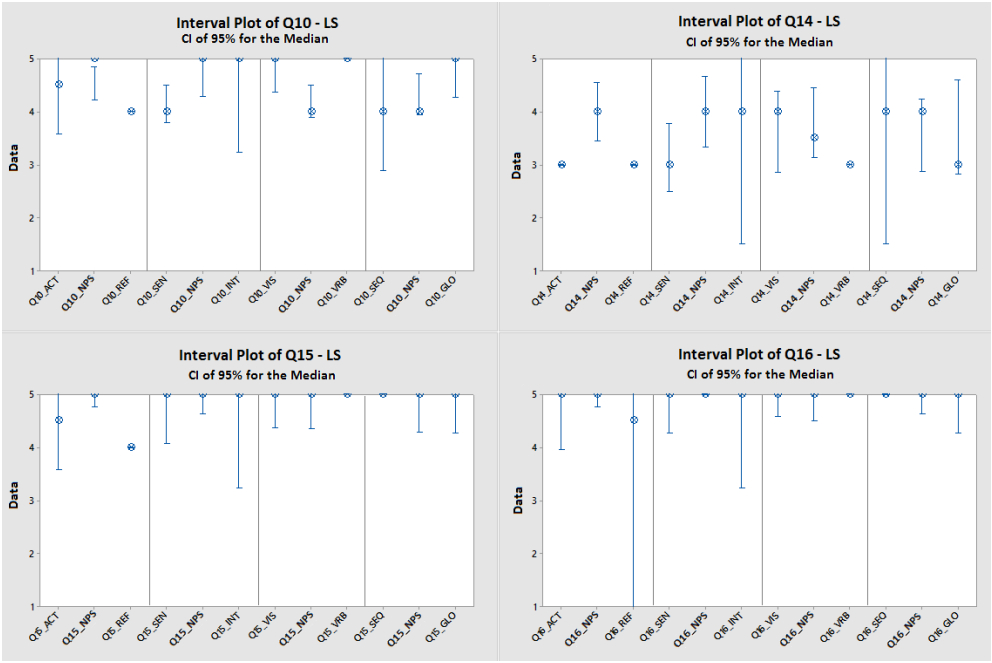


Figure 8. Interval plots for Q10, Q14, Q15 and Q16 responses(LS).

The Q14 evaluation was not as positive, since the scoresmode was "3", demonstrating participants neutrality when assessing whether the Athena Tutor answered their questions adequately. In any case, only one participant evaluated it negatively ("2" - Disagree), and practically half of the evaluations ranged between "4" and "5"scores.

Still in relation to Q14, for the Active / Reflective dimension, all individuals with moderate or strong tendencies indicated an intermediate score ("3"), while 76% of NPS were more positive, scoring "4" or "5". In the Sensing / Intuitive dimension it was found that users of Sensing LS were more negative, since 71% of them attributed "2" or "3" scores. The statistical tests showed discrepancies between Actives and NPS (p = 0.0185), and Sensing and NPS (p = 0.0357).

The best evaluations in this construct were those of questions Q15 and Q16, where most of the participants scored in "5", indicating that, in general, users understood that they would learn better with VWs and showed interest in accessing it again or in recommending it for another person, possibly recognizing its potential in relation to other educational resources. Regarding the Active / Reflective dimension it was observed that users classified as NPSevaluated Q15 more positively: 92% indicated a score of "5", while 50% of Actives and none ofReflectives indicated this same score. Mann-Whitney statistical tests confirmed the difference between Active LS and NPS (p = 0.0361), and Reflective LS and NPS (p = 0.0025) groups.

In Q16 analysis it was observed that, in the Sensing / Intuitive dimension, NPS participants evaluated it more positively than the others, suggesting that individuals with moderate or strong tendencies in this dimension were more critical about accessing it again or recommending it toanother person. The statistical test proved the discrepancies between users of Sensing LS and NPS, with p = 0.0436.

5.6 General comments from participants

In the last question of Questionnaire 2 an open space for general comments of the participants was left. The main manifestations are summarized in this subsection.

In general, comments were obtained that the environment was very didactic and pleasant, and that the experience was productive. Many have reported as the main positive aspect the possibility of seeing representations of abstract concepts and "in practice" what is learned in theory, underpinning the greater

approval of the "Simulation" feature. Some highlighted the characteristic of freedom and that, therefore, the environment would contribute to their learning.

The participants affirmed that they liked the VWorganization, highlighting the inserted markings for pathorientation. In addition, they noted that the environment made it possible to "disconnect" from other things they were doing so that they were focused, generating curiosity to continue exploring. Some excerpts from participants' comments are transcribed below:

User # 5: "I felt safe to explore it more another time."

User # 7: "If I had made more time available to explore the environment, my learning would be even more significant than it was."

User # 15: "(…) a unique and rich experience of learning, which enabled me to leave the real world and enter into a totally different reality."

User # 15: "I had no way of opening other windows or distracting myself with things other than the lab, which I think is very cool especially for us adults who normally do a thousand things at once."

Among the evaluators suggestions it was found the correction of minor flaws and improvements in the environment sounds. It was possible to observe that some participants may have felt uncomfortable with the triggered sounds, which may be related, according to the data analysis, to individuals of Sensing LS, who gave the lowest scores when asked about this aspect. Sensing individuals consider the senses very much and do not like surprises or complications (Felder; Silverman, 1988), which might have influenced them in this evaluation. There were also reports of the need to map the costs on implementing a VW in an educational institution, in order to emphasize its benefits and encourage its use, as well as about the importance of articulating it with processes of people with special needs inclusion, integrating assistive technologies to the environment.

Regarding the educational aspect, the evaluators reported that the VW can become a different and creative tool of student immersion in the universe of the content, and that this possibility must be more and more perfected and made available in the spaces of Education.

The main results of this study are discussed and synthesized in the next section, reaching to some conclusions.

6. Results discussion

In this exploratory study it was possible to verify that, in general, the acceptance of the beginner users in the VW was very positive for most of profiles, where the questions that aimed to identify if it would be better learning with VWs and if the evaluators would access it again or recommend it to another person obtained the best evaluations.

Most of the participants highlighted the possibility of "accessing educational resources in a 3D graphic environment" as the most relevant one, emphasizingthepotential for the educational field. Statistical tests indicated that this feature was best perceived by users of Visual Learning Style. Evaluators also considered the "Simulation" feature to be the most interesting, underlining the possibility of constructing experiments as a differential of VWs in relation to the most common educational platforms in web format.

The perception of Athena Tutor in the environment was not very positive, since a good part of participants considered that she did not answer their questions properly. In the experiment application also the lack of a bigger social base of the chatterbot was observed, because the evaluators often sought an informal conversation with the tutor. Users also reported that they would like her to take the initiative instead of just answering direct questions.

Some participants also informally mentioned that they would prefer to have anitinerary for the VW visiting from the beginning, rather than having the freedom to choose the way forward. In a way, the freedom provided to the user can cause him a certain responsibility of having to decide what to do, leading to a possible discomfort in certain individuals. This aspect seems to be related to Reflective and

NPS users in the Active / Reflective dimension, since these were more negative concerningenvironment'snavigation.

Regarding the dimensions of LS and DEL specifically, it was detected differences in the perception of VW among some groups of evaluators. The main findings are summarized below, associating them with some suggestions on how aspects can be improved.

A) Findings on the Active / Reflective dimension:

There was, in general, a more positive First Time User Experience (FTUE) on the part of participants classified with Active LS, who considered the navigation easier and the resources more interesting. None of the Reflective LS participants strongly agreed that they would learn better with VWs. Thus, it is observed that, in a certain way, the environment, as presenting itself as a more active approach, did not please Reflective users so much. This is in disagreement with Silva (2006), regarding the complementarity of Learning Styles in teaching to have positive results. The author concluded that the best performances took place when the discipline was Active and the student Reflective, based on the fact that Reflectives end up being forced to actively experience already understood knowledge, closing Kolb's(1984) cycle of experiential learning.

However, in statistical tests performed, only Q3 ("The navigation of the virtual world is easy, intuitive") has shown a more positive view of Active LS. In all other cases with statistical evidence, the most positive evaluation camefrom theNPS users.

B) Findings on the Sensing / Intuitive dimension:

A more positive perception of Sensing LS was observed in regard to considering VW a pleasant environment: while they considered navigation easy, most Intuitives showed some neutrality in this aspect. As a proposal for improvement, it seems to be necessary to instrumentalize more appropriately or give special attention to Intuitive students concerning the functionalities of the VW.

However, for users with Sensing LS the use of VW resources was not considered so useful for learning. By assuming that Sensing individuals learn more from experimentation, it is observed that, despite the simulations available in the environment, this aspect might not have been fully contemplated in the VW. It was also found that the participants with Sensing LS were more negative in the evaluation of the Athena Tutor and when considering that the sounds triggered in the environment helped to create a feeling of immersion. It is assumed that users of this style do not deal very well with more complex features, which would lead to the fact that the flaws in the sounds and the chatterbot limitations could have caused more disapproval from these. This suggests that it may be preferable to refer these users to simpler versions of the environment than to submit them to complex or error-prone versions.

However, in the Sensing / Intuitive dimension, it was possible to observe a better FTUE of the No Preferential Style (NPS) users, since individuals with moderate or strong tendencies were more critical.

C) Findings on the Visual / Verbal dimension:

It could be expected that participants with Visual LS would had a more positive experience than the others, in consonance with the predominant language of the environment. However, Visuals were more critical about the ease of navigation in the VW and about considering interesting the features available. This aspect emphasizes the need to apply instructional design techniques to suit the environment to different user profiles. Further research is advisable to investigate in depth how to facilitate navigation and make the environment more interesting especially for Visual and Intuitive learners, as also identified in the previous item. It can be concluded, also in the Visual / Verbal dimension, that NPS users had a more positive FTUE.

D) Findings on the Sequential / Global dimension:

Evaluators with Sequential LS reported feeling more transported to the VW than Global ones. Also, they were more positive about accessing it again or recommending it to someone else. The Global users, on the other hand, considered the VW navigation a little more difficult. These clues contradict the non-linear

aspect of the environment, which supposedly could please individuals with Global LS, but corroborates Silva's (2006) research on the complementarity of Learning Styles.

In general, a slightly more positive evaluation of NPS users was observed in relation to individuals with moderate or strong tendencies in this dimension. Again, a good FTUE of the Virtual World by individuals classified in the balanced range of LS is emphasized.

E) Findings on the Digital ExperienceLevel:

Regarding DEL, questions related to usability were the ones that indicated a significant difference between groups of evaluators, where participants with high DEL considered that their digital experience impacted on their ability to explore the environment. This result may be tied to the fact that they are more accustomed to digital tools, being more critical because they know its more complex levels. However, in general, it was observed that individuals with medium level of digital experience also viewed this initial exploration easily or intuitively.

7. Final Considerations

Based on the theoretical references and the primary data obtained, it is suggested that educational agents, institution leaders and educators, when designing their teaching methods, learning plans and pedagogical policies towards modelling Virtual Worlds, should attend to procedures that consider the cyclical nature of experiential learning, as proposed by Kolb (1984), and create learning opportunities in a balanced way for all Learning Styles. The use of adaptive technologies to promote personalization of 3D environments as VWs becomes a differential factor for the adequate care of students and, essentially, of professionals that will be making the adoption of this resource.

It is possible to conclude that, even with the low number of participants in the sample, the influence of the user profile on the quality of their FTUE in the VW may be proportional to the strength of the individual's tendency in the dimensions of Learning Style. That is, the more "strong" the presence of a LS feature in an individual, the greater the impact on their initial perception of the VW approach. Thus, it is suggested that users with a predominant dimension of LSmight find it more difficult to use a standard and equal for all 3D environment.

Consequently, a second conclusion allowed is that VWs, like the one used in this research, can, in a certain way, benefit user profiles which are more flexible regarding LS dimensions: those with a weak tendency or in an equilibrium range (No Preferential Style) adapt better because they do not suffer too much from aspects that do not fully address certain dimensions.

Considering the above, the research hypothesis that the beginner user perception in 3D VWs can be related to LS and DEL is confirmed, emphasizing that these aspects must be taken into account in the design of these environments, allowing the adaptations and customizations necessary to the different audiences that make up the educational scenario. In addition, it become evident that the profile of the individual with decision-making power in educational institutions can influence the adoption of this type of approach, making it important that VWs adapt to include, in the first instance, teachers and educational leaders.

As limitations of the research it can be mentioned the fact that it was applied to a small sample set, with 53% composed of individuals with no predominant preference for LS (No Preferential Style). Increasing the number of participants as well as the time of VW use is presented as future work, aiming to obtain a larger number of representatives (moderate and strong) from each LS. In this way, it might be possible to obtain a greater number of significant statistical differences between groups of users. It is also necessary to apply the research in a context of onservice teachers, with an alignment to a curricular discipline, bringing greater reliability to the educational proposal.

As an additional contribution, this research has raised some ideas about characteristics and aspects that can be used as parameters for personalization and adaptation of 3D Virtual Worlds to different profile of individuals, aiming to bring this tool to the mainstream of educational technologies and enhance its use.

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