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Modeling Educational Usage of Cloud-Based Tools in Virtual Learning Environments

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ABSTRACT In recent years, cloud computing has motivated new learning tools based on the cloud to collaborate and share content with a large number of students. Thus, the main objective of this paper is to propose structural equation modeling explaining the educational usage of cloud-based tools (CBTs) in terms of their adoption and application in learning activities within a virtual course. The data analysis used a representative sample from Galileo University, Guatemala. The results of the study revealed that usefulness is one of the main reasons for the rapid adoption of CBTs. The study also showed that in terms of educational usage, there is a greater correlation with lower order thinking skills than that with higher order thinking skills of Bloom's taxonomy. Finally, the evidence from this study suggests that from a student perception, peer-to-peer communication and collaboration can be a strong motivation to use CBTs on learning activities.

INDEX TERMS Educational technology, structural equation model, virtual learning environment, e-learning technologies.

I. INTRODUCTION

Nowadays, cloud computing is one of the new technological trends with an important impact on teaching and learning environments [1]. Cloud computing promotes a change in the way of learning, both inside and outside the classroom, revolutionizing the teacher's role and his attributions, providing new resources and tools for the development of enhanced learning situations, and significantly transforming the way we communicate, collaborate, and build knowledge. Cloud-based tools (CBTs), such as Google Drive,[1] Genial.ly,[2] Educaplay[3] and Mindmeister,[4] are highly interactive tools with sharing, collaborating, and producing content characteristics that use cloud computing, and can reach a large number of students [2]. These tools are accessible through the web, from any Internet-enabled device, without having to worry about their maintenance or hosting [3]. Many of these tools are free and offer a diversity of features that can be used for education.

[1]https://gsuite.google.com/
[2] https://www.genial.ly/
[3]https://www.educaplay.com/
[4]https://www.mindmeister.com/

CBTs have the potential to support, enhance and transform the learning experience through the exchange of ideas, comments, resources and content reuse in learning environments that are managed by teachers and students themselves [4]. The added value of CBTs to the teaching process (through the design of learning activities that make appropriate use of them) can be meaningful [5]. CBTs can improve learners' communication and motivation, promote team work, increase positive interactions between group members and enrich the overall learning experience [6]. Another important aspect to note of CBTs is that they can be typically integrated into learning environments through their application programming interfaces, facilitating their tailoring to different learning situations.

However, the implementation process of learning activities that include CBTs involves several challenges. For example, this process requires a considerable investment of time and resources by the teacher who, in many cases, does not have the necessary basic knowledge about how to use these tools, and how to apply them to the teaching-learning process; in other words, the teacher is not always aware of the impact

CBTs could achieve in terms of motivation, adoption, and skill development in students, and how to reach this impact. Moreover, the choice of the CBTs, and the definition of didactic objectives in the design of the learning activity, become a difficult task to tackle. The teacher, in order to face all these challenges in an effective way, needs to understand the Learning Orchestration (LO) process. LO is defined [7] as the process in charge of productively coordinating interventions from learners across multiple learning activities. LO is mainly based on teacher's responsibilities, such as defining activities, workload and evaluation rubrics, among others [8]. The success of implementing activities that make use of CBTs depends on a clear definition of learning objectives that take into account the potential and purposes of the CBTs chosen.

In this context, the application of Bloom's taxonomy takes a leading role. Bloom's taxonomy was developed by Dr. Benjamin Bloom [9] to promote higher forms of thinking in education, such as analyzing and evaluating concepts, processes and principles, rather than just remembering facts. Bloom's taxonomy provides a framework to focus on what we expect students to learn because of instruction.

Considering the above-mentioned context, the central research questions (RQs) of this work are:

- (RQ1) What are the main factors that determine the adoption of a CBT?
- (RQ2) What is the impact of using CBTs in the design of learning activities and applying Bloom's taxonomy to define learning objectives?
- (RQ3) How does the use of CBTs influence the improvement of communication and collaboration between teacher-student, student-student and student-teacher?

This paper presents and analyzes a structural equation modeling (SEM) that explains the educational usage of CBTs in terms of their adoption and application for learning activities development. This SEM is associated with lower-order thinking skills (LOTS) and higher-order thinking skills (HOTS) from Bloom's taxonomy, and the relational coordination affected by communication and collaboration. The study is organized as follows: Section 2 is a review of the literature on CBTs, and the main aspects to consider in their implementation in educational scenarios, such as adoption and educational usage. Section 3 defines the SEM and hypotheses on which it is based. Section 4 presents the research method, and the data collection instruments and techniques. Section 5 analyzes the data and discusses the results. Finally, conclusions and future work are presented in the last section.

II. LITERATURE REVIEW

According to [5], the potential of CBTs in teaching and learning environments has caught the attention in higher education. Universities are increasingly using a wide range of useful CBTs to support teaching, learning and assessment methods [10]. The study by ECAR [6] on the use of technology by university students at the beginning of this decade showed that 25% of students in all types of institutions were already using CBTs, such as wikis, blogs, and social bookmarking tools, among others. Some students had decided to use these tools by themselves, whereas others used them upon request of their teachers. The study showed that some students were using this kind of tools for entertainment or for socializing, but a growing number of students were applying these tools for educational activities, especially those students who were in favor of collaborating among peers.

A. ADOPTION OF CLOUD BASED TOOLS IN HIGHER EDUCATION

An important aspect to consider of CBTs is their acceptance and adoption by the main stakeholders of the teaching-learning processes, such as universities and educational institutions of middle and higher levels [11]. From the students' perspective, the adoption of CBTs can be measured in accordance with the following factors: motivation, usage, utility and compatibility [12]–[14]. Students use CBTs because these technologies are perceived as a positive factor, which adds value to their teaching and learning activities [15]. According to Ibrahim and Huang, other factors that affect the use of this type of technology are: the expectation of effort, social influence, conditions of use, perceived learning, collaboration and commitment [16], [17].

Usluel and Mazman [13] and Mazman and Usluel [18] examined different theories and models that explain the acceptance, adoption, and use of a technology. Some of these theories and models were focused on the internal decision-making processes of individuals, such as the theories of reasoned action and planned behavior. Other authors emphasized on the main characteristics of innovation, such as the unified theory of acceptance and usage theory [18] and also on models such as the Technology Acceptance Models I and II (TAM) [19], [20] which predict the acceptance and future use of a technology through the perception of its easiness of use and utility.

B. EDUCATIONAL USAGE OF CLOUD BASED TOOLS

For this study, we evaluate the educational usage of CBTs and their impact in learning and teaching environments, when these tools are part of the learning activities; CBTs, and the definition of learning outcomes based on Bloom's taxonomy, become the core of the learning activity. Bloom classifies the cognitive knowledge operations into six levels through a hierarchy and assumes that students must master the lower levels of the hierarchy before advancing to a higher level. Anderson and Krathwohl made two changes in the original taxonomy [9], [21]: the use of verbs, rather than nouns, for each category; and the sequence of verbs within the taxonomy. The new terms in the revised taxonomy, according to Anderson & Krathwohl are enumerated from 1 (LOTS) to 6 (HOTS). 1) *Remembering* is defined as retrieving, recalling, and recognizing knowledge from memory; it is used to produce definitions, facts, or lists, or to recite or retrieve material. 2) *Understanding* builds relationships and links knowledge;

students understand the processes and concepts and are able to explain or describe these. 3) *Applying* is defined as carrying out or using a procedure through implementing it; applying is related and refers to situations where learned material is used through products, such as models, presentations, interviews, and simulations. 4) *Analyzing* is defined as breaking material or concepts into parts, determining how the parts interrelate to one another; it also includes making inferences and finding evidence to an overall structure. 5) *Evaluating* means making judgments based on criteria and standards through checking and reviewing; it entails that students must be able to present and defend opinions based on a set of criteria. Finally, 6) *Creating* is defined as putting the elements together to form a coherent or functional whole; it includes reorganizing elements into a new pattern or structure through generating, planning, or producing. For our research, the educational use of CBTs was associated with the development of learning activities designed for instructional purposes that may be associated with LOTS or HOTS in Bloom's taxonomy [9].

Moreover, we consider the theory of relational coordination which states that the relationship between peers is more effective if carried out through frequent, high quality communication. From an educational perspective, we propose that communication between students and teachers, when using CBTs during the learning process, should be frequent, timely and accurate. Additionally, the collaboration between people is influenced by the quality of their relationships, in particular of shared goals, shared knowledge and mutual respect coordination [5], [6].

III. RESEARCH MODEL AND HYPOTHESES

This paper investigates the relationship of dependencies between the adoption and the educational usage of CBTs using a structural equation modeling (SEM) to estimate multivariate relations and direct and indirect effects of the variables under study. SEM encourages confirmatory rather than exploratory modeling; it usually starts with a hypothesis, represents it as a model, operationalizes the constructs of interest with a measurement instrument, and tests the model [22].

For this purpose, we propose a model (see Fig. 1), which consists of 4 latent variable (η) and 13 observable variables (**y**). We consider that the latent variable $\eta\mathbf{1}$ =***Adoption*** is influenced by five observable variables, which are: *y1* = *usefulness*, *y2* = *usability*, *y3* = *facilitating conditions*, *y4* = *community identification*, and *y5* = *motivation*.

Moreover, we consider that the **educational usage** is determined by three latent variables: $\eta\mathbf{2}$ = *Higher − Order Thinking Skills* (*Bloom_B*), $\eta\mathbf{3}$ = *Lower − Order Thinking Skills* (*Bloom_A*), and $\eta\mathbf{4}$ = *Relational Coordination* (*RC*). These three latent variables are explained by eight observable variables: *y6* = *remembering*, *y7* = *understanding* and *y8* = *applying*(for $\eta 3$), *y9* = *analyzing*, *y10* = *evaluating* and *y11* = *creating* (for $\eta 2$) and *y12* = *communication* and *y13* = *collaboration* (for $\eta 4$). The first six observable variables are related with Bloom's taxonomy and represent the different thinking skills that can be promoted

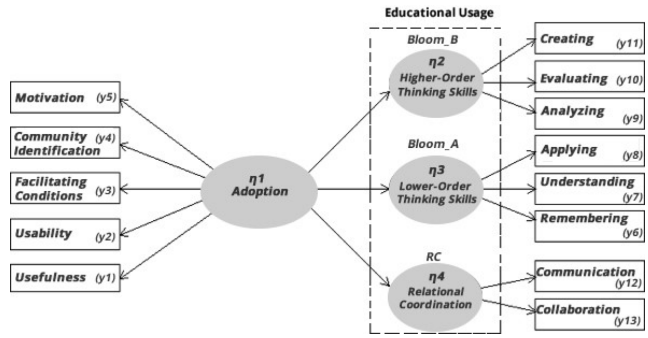

FIGURE 1. **Proposed model.**

with the use of CBTs for learning. The last two observable variables are related with relational coordination [23] and represent the fact that CBTs can contribute to have more effective relationships between peers through high quality communication and collaboration. The proposed model is represented in Fig. 1.

According to the aim of this study, the following hypotheses are proposed and will be tested:

- H1: Observable variables y1-y5 have a significant influence on students' adoption of CBTs ($\eta 1$).
- H2: Latent variable "Bloom_A" ($\eta 3$) is influenced by observable variables y6-y8, which have a significant influence on educational usage of CBTs.
- H3: Latent variable "Bloom_B" ($\eta 2$) is influenced by observable variables y9-y11, which have a significant influence on educational usage of CBTs.
- H4: Latent variable "RC" ($\eta 4$) is influenced by observable variables y12-y13, which have a significant influence on educational usage of CBTs.
- H5: Latent variable "Bloom_B" ($\eta 2$) is influenced by latent variable "Adoption" ($\eta 1$).
- H6: Latent variable "Bloom_A" ($\eta 3$) is influenced by latent variable "Adoption" ($\eta 1$).
- H7: Latent variable "RC" ($\eta 4$) is influenced by latent variable "Adoption" ($\eta 1$).
- H8: Latent variable "Bloom_B" ($\eta 2$) is influenced by latent variable "Bloom_A" ($\eta 3$).
- H9: Observable variable "Motivation" (y5) has a significant influence on latent variable "Bloom_B" ($\eta 2$).
- H10: Observable variable "Motivation" (y5) has a significant influence on latent variable "RC" ($\eta 4$).

All hypotheses are depicted in Fig. 2.

IV. RESEARCH METHOD

A. INSTRUMENT

Our data analysis is based on an online survey, which evaluated the different learning activities supported with CBTs into virtual learning environment proposed for the educational innovation program implemented at the Galileo University (for the collaboration, information exchange and knowledge construction we used CBTs such as Xtranormal, Goanimate,

TABLE 1. The web-based questionnaire structure.

Section	*Purpose*	*Number of items/questions*	*Scale*
1	The first section evaluated several of learning activities where CBTs are used, such as: Xtranormal[5], GoAnimate[6], MindMeister[7], Issuu[8], etc.	10 items	-
2	The second section collected students' views on the adoption of CBTs in an educational context and related them to Bloom's revised taxonomy.	14 questions	5-point Likert scale
3	The third section consisted of measuring motivational aspects	5 questions	5-point Likert scale
4	The fourth section evaluated communication and collaboration aspects	6 questions	10-point Likert scale
5	The fifth section consisted of measuring usability aspects	5 questions	5-point Likert scale
6	The sixth section consisted of measuring usefulness, facilitating conditions, and community identification	9 questions	5-point Likert scale
7	The last section consisted of demographic questions	4 questions	Closed-ended question (Multiple Choice)

[5] www.xtranormal.com
[6] www.goanimate.com
[7] www.mindmeister.com
[8] www.issuu.com

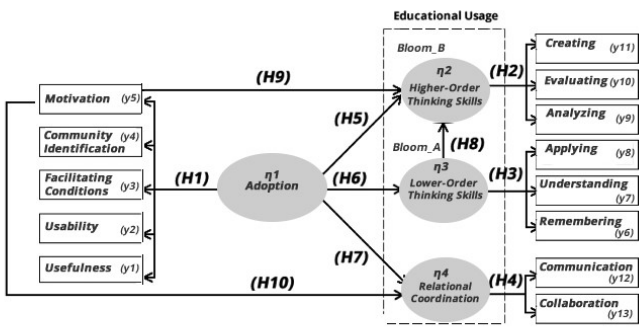

FIGURE 2. Hypotheses model.

MindMeister and Issuu, among others). The survey consisted of 7 sections (see Table 1).

The first section included a personal evaluation of the learning effort required to use the CBTs for the assigned learning activities, the time spent to perform the activity (to learn to use the CBT and the collaborative work with peers), personal opinions about CBTs implemented, and open questions about the learning experience.

The second section contained a set of 14 statements related to Bloom's revised taxonomy to be assessed using a 5-point Likert scale (from strongly disagree to strongly agree).

The third section focused on measuring motivational aspects, these depending on many personal factors (personality, education, etc.), family, and social context in which the learning process is conducted (teaching methods, teachers, etc.). Motivation is essential for learning, and progress is inherent in the possibility of giving meaning and significance to knowledge. This section contained 5 statements to be assessed on a 5-point Likert scale from very unmotivated to very motivated.

The fourth sections focused on communication and collaboration, and contained 6 statements to be assessed with a 10-point Likert scale. These section aimed to measure the relevance of these resources in the teaching-learning processes. Students in courses that include CBTs usually tend to work more in collaboration, exchanging ideas, sharing information and working with people who have common interests.

The fifth section had 5 questions and a 5-point Likert scale for usability measures. Usability is a relevant factor in the adoption of CBTs, as the user may need some technical skills.

The sixth section focused on usefulness, facilitating conditions, and community identification. This section had 9 statements to be assessed with a 5-point Likert scale (from strongly disagree to strongly agree). These statements examined the main factors that influence student intentions to utilize CBTs in their courses. The seventh section collected demographic data from the users.

To validate the instrument, we used three parameters. (1) Content Validity reflects whether the items on the instrument adequately cover the entire topics should be covered. Therefore, professional e-Learning instructional designers' opinions were obtained to verify if the questions were appropriate and understandable. (2) Criterion Validity reflects how well an instrument is related to other instruments that measure similar variables. Experts were consulted to validate whether there were previous studies where a similar instrument had already been used. (3) Construct Validity is concerned about whether the instrument measures properly construct. Also, experts were consulted on whether these questions could be used to measure the research questions.

The web-based questionnaire was also tested with a focus group of 15 randomly selected students; this focus group included a visual verification of students' performance (there was no interaction or support with the students), and a written report of the experience, by the surveyor. Based on the feedback received from the experts, the online survey was modified, considering standardized instruments to

TABLE 2. Demographic and descriptive statistics of the surveyors.

Item		*Frequency*	*Percentage*
Gender	Female	157	48.5%
	Male	167	51.5%
Age	10–18	13	4.01%
	19–27	169	52.16%
	28–36	95	29.32%
	37–45	31	9.57%
	46–54	13	4.01%
	55+	3	0.93%
Educational Level	Graduate Student	286	86.27%
	Post-graduate Student	38	11.73%
Internet Access	No	114	35.19%
	Yes	210	64.81%

measure this experience: perceived usefulness, attitude, intention and behavior [13], [18], [20], the System Usability Scale (SUS) [8], and the motivational aspects [12]''.

Afterward, an explanatory and confirmatory analysis was conducted to identify the relation between factors and factor loads. A preliminary scale of 19 items was prepared to investigate the adoption of CBTs; the Cronbach's alpha coefficient of this scale was 0.945, which guarantees the internal consistency of the instrument. Second order confirmatory factor analyses were conducted on the remaining 18 items. The Factor loads of confirmatory factor analyzed results are presented in the Appendix.

B. PROCEDURE AND DATA COLLECTION

The study was conducted at the participants of the educational innovation program offered by the Galileo University in online format. This program is composed of 5 modules (4 weeks duration each module) designed in learning units that usually last for one week each unit having a diversity of learning resources such as videos, podcasts, animations, interactive contents, and a wide diversity of learning activities specially designed with CTBs supported. 324 students completed the questionnaire. Table 2 summarizes the demographic profile of the participants, including their age, gender, educational level, and internet access (this refers only to internet access from home). As can be observed in Table 2, the numbers of females and males were nearly equal, the age range with more participants in the study was between 19 and 27 years old, and most individuals were graduate students.

V. DATA ANALYSIS

A. STRUCTURAL EQUATION MODELING

The aim of this model is to analyze the educational usage of CBTs depending on their adoption and educational usage, considering Bloom's revised taxonomy and the Relational Coordination (RC).

Our structural model allows combining a factor analysis with regression analysis, thus explaining the correlation and variance between observable variables and latent

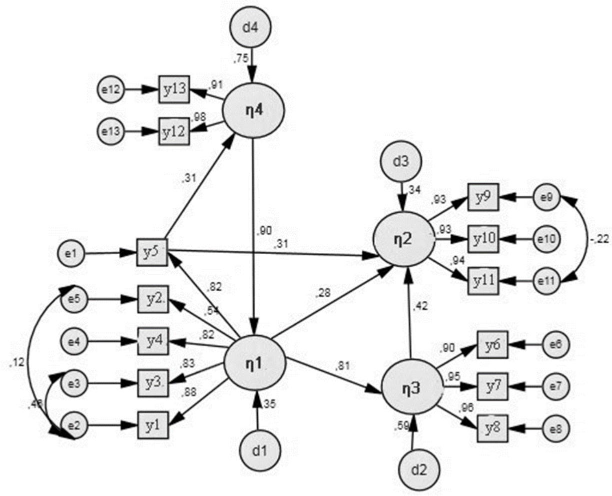

FIGURE 3. The result of SEM (standardized coefficients).

TABLE 3. Model fit indexes for the measurement model [24].

Fit indexes	Good fit	Accepted values	Model results
RMSEA	0 < RMSEA < 0.05	0.05 < RMSEA < 0.08	0.078
IFI	0.95 < IFI < 1	0.90 < IFI < 0.95	0.972
NNFI	0.97 < NNFI < 1	0.95 < NNFI < 0.97	0.961
CFI	0.97 < CFI < 1	0.95 < CFI < 0.97	0.971
GFI	0.95 < GFI < 1	0.90 < GFI < 0.95	0.913
AGFI	0.0 < AGFI < 1	0.85 < AGFI < 0.90	0.858
X^2/df	$X^2/df < 3$	$3 < X^2/df < 5$	3.69

TABLE 4. Covariance matrix of latent variables.

	Bloom_A	*Bloom_B*	*CR*	*Adoption*
Bloom_A	1.00			
Bloom_B	0.42	1.00		
RC	0	0	1.00	
Adoption	0.81	0.28	0.90	1.00

variables (unobservable). To create the model, IBM ©SPSS AMOS 21.0 and SPSS Statistics 21.0 program was used. Fig. 3 explains how CBTs for learning would be used.

For testing the structural model the fit indices for the measurement model are the Root Mean Square Error of Approximation (RMSEA), Incremental Fit Index (IFI), Non-Normed Fit Index (NNFI), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), and X^2/df (chi-square)/df (degree of freedom) [24].

Table 3 shows the values for these indexes.

As shown in Table 3, all the fit indexes are satisfactory, demonstrating that the measurement model exhibited a good fit. Standard path coefficients of structural equation model are given in Fig. 3. Covariance matrix of latent variables is presented in Table 4.

B. MODEL RESULTS

All the coefficients between ''Adoption'' ($\eta 1$) and its observable variables are found to be significant ($p < .005$ or t > 1.96). Results show that the five observed variables, namely usefulness (y1), usability (y2), facilitating conditions (y3), community identity (y4), and motivation (y5), have significant positive influences on adoption ($\eta 1$) ($\beta = 0.88$, $\beta = 0.54$, $\beta = 0.83$, $\beta = 0.82$, $\beta = 0.82$); this allows accepting hypothesis H1.

All the coefficients between educational usage of CBTs, "Bloom_A" ($\eta 3$), "Bloom_B" ($\eta 2$), "RC" ($\eta 4$) and its observable variables are also significant (p < .005 or t > 1.96). This result supported that the three observable variables namely remembering (y6), understanding (y7), and applying (y8), have a significant positive effect on "Bloom_A" ($\eta 3$) ($\beta = 0.90$, $\beta = 0.95$, $\beta = 0.96$); this allows accepting hypothesis H2. In addition to this, it is found that latent variable "Bloom_A" ($\eta 3$) is also correlated with the latent variable "Adoption" ($\eta 1$) ($\gamma = 0.81$); this allows accepting hypothesis H6.

Regarding latent variable "Bloom_B" ($\eta 2$), the three observable variables namely analyzing (y9), evaluating (y10) and creating (y11), have a significant positive effect ($\beta = 0.93$, $\beta = 0.93$, $\beta = 0.94$). Although with a lower correlation index there is a relationship between latent variable "Bloom_B" ($\eta 2$), and latent variable "Adoption" ($\eta 1$) ($\gamma = 0.28$); all this allows accepting hypotheses H3 and H5. In addition, the study evidenced that latent variable "Bloom_A" ($\eta 3$) has a significant positive effect on "Bloom_B" ($\eta 2$) ($\beta = 0.42$), which allows accepting hypothesis H8.

This model has also found that two observable variables related with latent variable "RC" ($\eta 4$) namely communication (y12), and collaboration (y13), have a significant positive effect on "RC" ($\eta 4$) ($\beta = 0.98$, $\beta = 0.91$); this allows accepting hypothesis H4. The latent variable "RC" ($\eta 4$) is related to the "Adoption" ($\eta 1$) ($\gamma = 0.90$), however, it is in opposite direction, and that is because the "Adoption" ($\eta 1$) does not explain the collaboration or communication when using a CBTs. Hence, "RC" ($\eta 4$) is an independent variable, due the fact that the adoption of a CBTs ($\eta 1$) does not have influence on the type of communication and collaboration that the student will have. This allows accepting hypothesis H7.

Analyzing the behavior of the observable variable "motivation" (y5), a significant influence on latent variable "Bloom_B" ($\eta 2$) is found ($\beta = 0.31$), which allows accepting hypothesis H9. Nevertheless, there is no evidence that observable variable "motivation" (y5) has an influence on latent variable "RC" ($\eta 4$) ($\beta = 0.31$) (because it is not significant for the model), which leads to the rejection of hypothesis H10.

C. FINDINGS AND DISCUSSION

In this study, the SEM explains the educational usage of CBTs directly from the student's adoption perspective. The results show that the latent variable "Adoption" ($\eta 1$) has a significant positive relationship with usefulness (y1), usability (y2), facilitating conditions (y3), community identification (y4), and motivation (y5), with the usefulness (y1) variable being the highest of the observable variables (see Table 5). Therefore, from the users' perception, usefulness (y1) is one of the main reasons for the rapid adoption of CBTs.

TABLE 5. Path coefficients.

Variables	*Observed Variable*	*Path Coefficients*
Adoption (η1)	Usefulness (y1)	0.88
	Usability (y2)	0.54
	Facilitating Conditions (y3)	0.83
	Community Identification (y4)	0.82
	Motivation (y5)	0.82
Bloom_A (η3)	Remembering (y6)	0.90
	Understanding (y7)	0.95
	Applying (y8)	0.96
Bloom_B (η2)	Analyzing (y9)	0.93
	Evaluating (y10)	0.93
	Creating (y11)	0.94
RC (η4)	Communication (y12)	0.98
	Collaboration (y13)	0.91

Adoption can also be explained in terms of facilitating conditions; CBTs are of easy access, can be found online, do not require installing software, and many of them are free or have free versions under some circumstances. Community identification and motivation also present high values indicating that both are relevant for the adoption of a CBT. It is important to be aware that 81.48% of participants are between the ages of 19 and 36 years old (Table 1). Extrapolating this result, one could argue that this is a new generation of students, which is more used to virtual environments and social networks. It is relevant to mention that, the variable of usability received the lowest score in the adoption test, although it still has an acceptable rate; this could be explained by the fact that many of these CBTs were new to the students surveyed.

With the help of this SEM, the educational use of CBTs is examined according to two dimensions of Bloom's revised taxonomy (remembering, understanding, applying, analyzing, evaluating and creating) and the Relational Coordination (communication and collaboration). In Bloom's revised taxonomy case, we found that students more closely associate the use of these tools to "Bloom_A" ($\eta 3$) ($\gamma = 0.81$), which explains Lower-Order Thinking Skills. This finding shows that students who were surveyed are conditioned to an educational environment which normally promotes Lower-Order Thinking Skills, because professors' purposes when creating learning activities (using CBTs) have a powerful relation with memorization of concepts and do not focus on activities that allow students learning by doing. In addition, it is found that "Bloom_B" ($\eta 2$), which explains Higher-Order Thinking Skills (analyzing, evaluating and creating), has a lower correlation to the latent variable "Adoption" ($\eta 1$) (0.28). For our research this value is still acceptable due the fact that the educational environment of the students is known to lack of enough learning activities that promote Higher-Order Thinking Skills, such as design, planning, production, experimentation, critical thinking, problem solving

TABLE 6. Factor loads.

Constructs	Items	Factor loads
Usefulness	UTI1	.714
	UTI2	.702
	UTI3	.665
Ease of Use /Usability	USA1	.460
	USA2	.385
	USA3	.373
	USA4	.659
	USA5	.537
Facilitating Conditions	FAC1	.702
	FAC2	.668
	FAC3	.630
Community Identification	COMI1	.786
	COMI2	.769
	COMI3	.759
Motivation	MOT1	.819
	MOT2	.795
	MOT3	.746
	MOT4	.751
	MOT5	.604
Remembering	REM1	.849
	REM2	.857
Understanding	UND1	.827
	UND2	.878
Applying	APP1	.883
	APP2	.862
Analyzing	ANA1	.805
	ANA2	.787
Evaluating	EVA1	.813
	EVA2	.716
Creating	CRE1	.786
	CRE2	.800
Communication	COM1	.641
	COM2	.619
	COM3	.650
	COM4	.633
Collaboration	COL1	.664
	COL2	.636

and others. This opens an opportunity to use CBTs for such educational purpose.

Finally, it is also found that "RC" (η4) is influenced by latent variable "Adoption". This finding shows that from student perception, peer-to-peer communication and collaboration could be an educational use for CBTs. After reviewing and analyzing data collected from the fourth section of our web questionnaire, using a 10-point Likert scale, from totally disagree to totally agree, the responses for "Do you consider that the CBTs presented contribute to establishing communication among classmates?" returned a M = 7.93 SD = 2.45 for the statement. The responses for "Do you consider these tools contribute to better teacher-student communication? Returned a M = 4.52 SD = 3.31. It can be suggested that the perception of students regarding this type of tools does not represent a benefit to improve communication between teacher and student.

VI. CONCLUSIONS

The "Adoption" of CBTs for educational usage is demonstrated in this SEM. The evidence from this study suggests that people use CBTs to apply knowledge and to develop skills in different learning environments. The inclusion of these types of tools in the teaching-learning process is of benefit to both, the student and the teacher. It can be suggested that a large amount of the population is interested in using innovative, multimedia, highly visual, and attractive tools for learning especially the ones they can manipulate as part of their learning activities. Further work on a unified educational environment is required, to create an environment where all these cloud services can be orchestrated and managed to create learning activities that are innovative and simple to use at the same time. Also, studies on cognitive learning strategies, further motivation insights, emotions and usability need to be evaluated whereas performing any learning process using such CBTs. Finally, how to best interoperate such tools in a way that the legacy systems can incorporate these tools seamlessly, without large maintenance costs, is a concern to the technical short and large term viability of this new educational environment.

APPENDIX

See Table 6.

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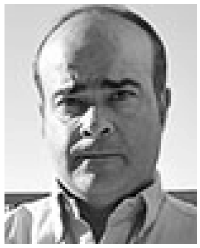

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