Cloud-based Learning Environments: Investigating Learning Activities Experiences from Motivation, Usability and Emotional Perspective

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Abstract: Cloud education environments consider all the cloud services, such as Web 2.0 applications, content, or infrastructure services. These services form an e-learning ecosystem which can be built upon the learning objectives and the preferences of the learner group. A great variety of existing cloud services might be re-purposed for educational activities and it can be taken advantage from already widely used services without steep learning curves on their adoption. In this article is presented the design, deployment and evaluation of learning activities using cloud applications and services. The experiences presented here are from Galileo University in Guatemala with students from three different countries in Central America and Spain. This study reports findings from motivational attitudes, emotional aspects and usability perception. Selected cloud-based tools were used for the different learning activities in three courses in various application domains. These activities include collaboration, knowledge representation, storytelling activities and social networking. Experimentation results obtained aim to demonstrate that students are eager to use and have new and more interactive ways of learning, which challenges their creativity and group organization skills, while professors have a growing interest on using new tools and resources that are easy to use, mix and reuse. Thus, future research should focus on incentives for motivating participation as well as on providing systems with high usability, accessibility and interoperability that are capable of doing learning orchestration.

1 INTRODUCTION

Trends for modern Virtual Learning Environments (VLE) indicate a movement from a monolithic paradigm to a distributed paradigm. Dagger et. al. (2007) and Chao-Chunk and Skwu-Ching (2011) call it the next generation of e-Learning environments. It is clear that Virtual Learning Environments need to be more scalable and improve the real innovation they bring to education through flexibility, due the increasing requirements that higher institutions have. Actual work in Cloud Computing has a focus on infrastructure layer rather than application layer as shown in the work of Al-Zoube et. al. (2010) and Chandran and Kempegowda (2010). Still VLE is in many cases a simple conversion of classroom-based content to an electronic format, retaining its traditional knowledge-centric structure as stated by Teo et. al. (2006).

There is great potential in the use of multiple cloud-based tools for learning activities and to create a different learning environment, with new diversity of tools driving to possibly enrich learning experiences. There is a quest to create a Cloud Education Environment, where a vast amount of possible tools and services can be used, connected and in the future orchestrated for learning and teaching (Mikroyannidis, 2012).

Cloud computing application technologies are a major technological trend that is shifting business models and application paradigms; the cloud can provide on-demand services through applications served over the Internet for multiple set of devices in a dynamic and very scalable environment (Sedayao, 2008). Thus, the significance of the technology for

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this study lies not only in cloud computing, but in the application that reside in the cloud that can be used for learning purposes, although as it will be presented, many of them have not been intended for learning in the first place, the applications presented in this experience are actually used for learning. Cloud-based tools have the potential to interoperate with other systems; therefore it is possible to systematically orchestrate a learning activity through multiple cloud-based tools. The cloud-based tools are normally seen as traditional and standalone web 2.0 tools, but now it can create integrated learning experiences. This paper does not focus on the cloud-computing infrastructure but rather on the findings of using the existing cloud-based tools for learning. Likewise social networking technologies provide easy pathways for sharing these kinds of cloud applications, related data, activities and for socializing while at the same time enhancing the collaborative experiences (Mazman and Kocak, 2010).

This paper is organized as follows: first we will describe the test-beds used for this experience, the learning activities designed and the learning scenarios. Thereafter we will give a detailed description of the instruments used, the methodology description and results of our study, in which students were asked to perform learning activities individually and in groups using different type of Cloud-based tools. Finally we will discuss our findings, conclusions and some ideas of future research.

2 THE EXPERIMENT

2.1 The Galileo University Test-bed

In this section we present a cloud-based learning experience in Latin-American countries following other successful learning experiences by Dagger et al. (2007) and Chao-Chunk and Skwu-Ching (2011). The learning experience happens in the Institute Von Neumann (IVN) of Galileo University, Guatemala. IVN is an online higher education institute. It delivers online educational programs across the country and those programs are open for other countries.

The student population at IVN is mostly part-time students; this is something quite common in the entire University students. The courses are similar to any other University course; most of the students do their learning during the evening or in weekends because of work.

It is a complete online learning degree, the topic of the course is an e-Learning certification that consists in several modules that specializes the students into e-Learning from an instructional design reference. The course does not have formal synchronous sessions, although the use of chat with professor and other peers is possible. Also the students are expected to work 10 hours/week on their studies, learning activities and collaborative activities. The courses within the e-Learning certification are designed in learning units that usually last for 1 week each unit having a diversity of online material such as video, audio, animations, interactive content, forums, assignments and a wide diversity of learning activities specially designed for enhancing learning acquisition. The course uses the institutional LMS that currently is .LRN LMS (www.dotlrn.org), although some module are alternative provided in Moodle LMS (www.moodle.org). The students have the advice and help from professional instructional designers to build their online course. The Certification is targeted to university professors, e-Learning consultants, instructors that want to enhance their knowledge about teaching with technology.

The presented learning experience has two groups of more than 60 students, most of them university professors, from different countries: Guatemala, Honduras, El Salvador and Spain. The courses titles are: course 2: Introduction to e-Learning; course 3: e-Moderation and course 4: Online activities design.

The first group (A) with 36 students from Guatemala and Spain was evaluated with activities prepared within courses 2 and 3. The second group (B) with 30 students with students from universities in Guatemala, Honduras and El Salvador was evaluated with activities prepared within courses 3 and 4, thus the course 3: “e-Moderation” as common course for all groups is used for comparative analysis.

In this experience, students were assigned to cloud-based learning activities for the first time, most of them were not very familiar with related technologies, but they had a preliminary course that introduced them into the use of the institutional LMS and related technologies.

The course professor introduced the cloud-based learning activities as *innovative and powerful tools for learning*, with the objective to elaborate all the

benefits that can create mind-set change, guiding the students through the benefits that these type of activities will have in their learning process (Chao-Chun and Shwu-Ching 2011), something that proved to be very helpful to avoid resistance and possible fear to new and seen as complex tools. We collected information form students in a pre-test and post-test through an online survey from an exploratory approach. Each group did two four-week courses, between the courses there was a one-week off that we used to do telephone interviews and gather further information about the experience.

2.2 Learning Activities and Scenarios

We designed learning activities based on instructional objectives, using as a base the past standard non-cloud-based activities from previous editions of the courses, and transforming them to leverage the potential of the cloud ecosystem. The designed and tested activities are presented, it is important to mention that each activity was carefully designed using a custom made instructional design template that contains all activity related information such as: learning objectives, instructions, classification using Bloom's revised taxonomy (Anderson and Krathwohl 2001) and grading. Each single step on the activity has a clear and explicit grading. With a clear design of the activity, the professor and instructional designer proceed to select the most suitable tool based on previous knowledge and experience with the tool, in the presented experience most of the proposed tool has been already used for other learning activities in other courses, the three courses were:

Course 2 "*Introduction to e-Learning*", had the following learning activities:

- *Activity 2.1*: Students had to do a research of a given topic, and then write collaboratively an essay in groups of four students each. This activity was prepared with a control group setting for comparison, where we divided the whole group (A) of students in three segments with nine groups (three groups per segment), first two segments using cloud-based learning activities and the third one using traditional desktop applications. The first two segments were asked to use cloud services: Google Docs (Google Docs-Page 2012) and Wiki Spaces (Wiki Spaces-Page 2012) and the other segment of three groups used traditional word processor. Then students were invited to represent the information with a time-line tool, the cloud-based time-line tools used were Dipity (Dipity-Page 2012) and Timetoast (Figure 2) (Timetoast-Page 2012) and the traditional tool was Power Point for segment three. Finally students had to comment and discuss other groups' results in the LMS online discussion forums. A summary of the tools used by groups are presented in Table 1.
- *Activity 2.2*: Students (individually) had to do a research and present knowledge gained through mind map tools, the cloud application for this activity was MindMeister (MindMeister-Page 2012) and Cacoo (Cacoo-Page 2012) (Figure 2). Finally they were invited to discuss about other peer contributions on the LMS discussion forum. A comparison setting is presented in Table 2.

Table 1: Comparison setting for Activity 2.1.

Segment	Tools used for the learning activity
1 (3 groups)	Google Docs and Dipity
2 (3 groups)	Wiki Spaces and Timetoast
3 (3 groups)	Word Processor and PowerPoint

Table 2: Comparison setting for Activity 2.2.

No. of Students	Tools used for the learning activity
10	Cacoo
10	Mindmeister
16	PowerPoint

Figure 1: Screenshot of Timetoast time-line example.

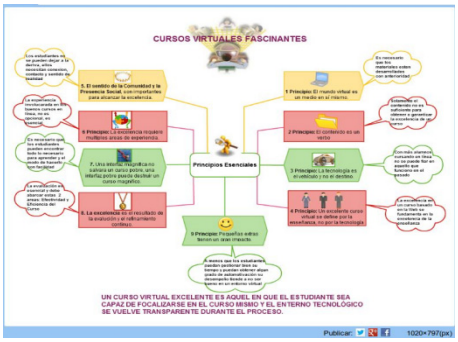

Figure 2: Screenshot of Cacoo mind map example.

Course 3: "*e-Moderation*", had the following activities:

- *Activity 3.1*: Students had to synthesize information learned in the course and publish it using the cloud-tool Issuu (Issuu-Page 2012). Then discuss on LMS forums.
- *Activity 3.2*: Students had to do a research, create a storytelling script and present it using one of the following cloud-based tools: GoAnimate (GoAnimate-Page 2012) (Figure 3), Xtranormal (Xtranormal-Page 2012), Pixton (Pixton-Page 2012). Publish it in the social network Facebook and comment other peers' contributions.

Course 4: "*Online activities design*", had the following learning activities:

- *Activity 4.1*: the group (B) of students had to build collaboratively bookmarks based on a research assignment using a base taxonomy provided by the professor to classify the links provided by the students. The Delicious bookmarking site (Delicious-Page 2012) was used for the activity.
- *Activity 4.2*: Students had to create online satisfaction survey for courses, synthesize a method and requirements for these types of surveys using a mind-mapping tool and publish a sample survey using Google forms (Google Docs-Page 2012).
- *Activity 4.3*: The learning activity focused on modelling a process for creating visually attractive digital posters with educational intentions, first by using a mind-mapping to elaborate the concepts, and then reflect them in an cloud-based tool called Gloster (Gloster-Page 2012). In all activities, students were required to learn about the tool in order to perform their assignments.

Figure 3: Screenshot of Go-Animate storytelling example.

2.3 Research Methodology

We used standardized instruments by Fishbein and Ajzen (1975) and Davis (1989) to measure this experience; we also use the System Usability Scale SUS by Brooke (1996) and the Computer Emotions Scale (CES by Kay & Loverock, 2008). Through online tests sent to the students with a pre-test and post-test it were measured emotional aspects, usability perception and performance, opinions and motivation about the tools and cloud-based learning activities. Pre and post-test were evaluated with instructional designers, professors and students, to observe and verify its validity for students; some enhancements were introduced after a first review.

The initial test included a section of learning preferences and previous online learning experiences, a survey about the cloud-based tools that were to be used for the experience and their personal perceptions, then a motivation section and finally an emotional aspects gathering section. The post-test included personal evaluation of learning effort using the cloud-based tools for the assigned activities, personal opinions of the experience, motivational aspects, usability and emotional aspects, and open questions about the experience. Since each class of students did two courses, the pre-test was done before starting the first course, then between first and second course, an random telephone interview was conducted, and finally after finishing the second course the post-test was sent to students.

The CES instrument developed to measure emotions related to learning new computer software, by Kay and Loverock (2008), was quite instrumental for this study and includes the following emotions: satisfied, anxious, irritable, excited, dispirited, helpless, frustrated, curious, nervous, disheartened, angry and insecure. The questions were like "When I used the cloud-based tool (and the names of the tools were used) during the learning activity assignment (and each of the assignment's name were cited), I felt ..." Answers used a four point Likert scale from (1) none of the time to (4) All of the time.

The System Usability Scale (SUS) instrument by Brooke (1996) contains 10 items regarding the usability of cloud-based tools used for learning activities. the answers were given on the 5-point Likert scale, so that students could state their level of agreement or disagreement. High mean values indicate positive attitudes and tool evaluations.

The 10 items that composed the SUS questions are:

1. I would use this tool regularly
2. I found it unnecessarily complex

3. It was easy to use
4. I would need help to use it
5. The various part of the tool worked well together
6. Too much inconsistency
7. I think others would find it easy to use
8. I found it very cumbersome to use
9. I felt very confident using the tool
10. I needed to understand how it worked in order to get going.

According to Brooke (1996), SUS has proved to be a valuable and reliable evaluation tool. It correlates well with other subjective measures of usability (eg. the general usability subscale of the SUMI Software Usability Measurement Inventory).

Some of the main standards related to the accessibility that can be applied in cloud-based learning environments are presented in Amado et. al. (2012). It is important to notice that tools and learning activities prepared with cloud-based learning environments should follow international standards (e.g. W3C WCAG2.0, W3C WAI-ARIA) to allow accessibility and usability to all the students, including people with disabilities. The research methodology includes the evaluation of accessibility issues related to the cloud-based learning activities.

Finally, telephone interviews were done with some students and professors randomly selected and only the ones that gave consent to participate on it. Interviewers were instructed to ask about personal opinions regarding the cloud-based tools and the related learning activities, the conversations were audio recorded and transcripts were written.

Using these instruments, the study is presented as an exploratory approach with the aim to demonstrate that students are eager to use and have new and more interactive ways of learning.

3 RESULTS AND DISCUSSION OF THE EXPERIENCE

From a total of 66 students from both groups, 45 of the students gave their consent to participate in the study by filling out at least one out of the two presented questionnaires. Participation were equally distributed with 48% of female and 52% of male participants, (age average M=37, σ=14).

Participants were asked in the post-test and telephone interviews about the experience. Some of the more interesting positive and negative impressions are presented with the emotional aspects evaluation:

Positive impressions:

- "I liked to know new activities and tools in the web for more interaction with the student"
- "I learned about many great tools that will help me with my teaching activities, the experience showed me that the activities can be very interactive and innovative"
- "The use of new tools for learning was fun and can be applied with creativity to teach scientific content."
- "What I liked is that I started using the tools in my current courses."
- "I liked that the activities awaken creativity and obtained interesting results and products."
- "The activities promote meaningful learning, learning by doing so you will not forget, allows flexibility in learning and I feel very satisfying to achieve something new and different."
- "The tools used for the activities are pretty dynamic and will make courses more interactive."

Negative impressions:

- "I needed more time to get to know the tools and how to use it"
- "The work load was increased for activities within the new tools with an overhead with learning the tools"
- "I needed a lot of more time to achieve the results with tools like *Gloster*, and I felt frustrated"
- "The instructions were not clear"
- "With some of the tools you need to purchase a membership to upgrade and enable some functionality"
- "Some of the tools are not accessible and you can't use it in all operating systems, e.g. Flash based tools"

Some of the main results of the post-test were:

- 95% of the participants liked the idea to use innovative learning online tools to represent new knowledge.
- 35% of the participants think that it was difficult to complete the learning activities
- 50% of the participants think that they would need more information and instructions to complete the learning activities.
- Only 10% of the participants expressed the learning activities were boring.
- 70% of the participants considered that the time for the activity was appropriate.
- 80% of the participants were positive about the

expression that sharing results within groups and comments about other participants helps to learn new concepts related to the activity.

The learning experience presents the impressions from participants, which indicates evidence of the interest in learning activities highlighting the interaction, innovation, flexibility and creativity, capabilities that these cloud-based tools seem to easily enable for the participants. The results obtained appear to demonstrate that students are eager to use and have new and more interactive ways of learning, which challenges their creativity and group organization skills.

The following subsections will present related results from an Emotional, Motivation and Usability perspective.

3.1 Emotional Aspects

From an emotional aspect perspective, the instrument was based on the Computer Emotion Scale (4pt. scale) developed by Kay and Loverock (2008) to measure emotions related to learning new computer software/learning tools in general, then the post-test measured the emotions after using the tool proposed for the learning activities with the comparison in Table 3.

Research by Kay and Loverock (2008) in CES showed 12 items describing four emotions:

- Happiness (When I used the tool, I felt *satisfied/excited/curious*.?);
- Sadness (When I used the tool, I felt *disheartened/dispirited*.?);
- Anxiety (When I used the tool, I felt *anxious/insecure/helpless/nervous*.?);
- Anger (When I used the tool, I felt *irritable/frustrated/angry*.?).

The summary with the four variables of the CES scale for groups A and B is presented in Table 4.
The evaluation of emotional aspects from the participants shows little difference in the results between pre-test and post-test measures. In this sense cloud-learning activities and instructor's motivation should focus on improve results looking for students with high level of emotions related to Happiness (e.g. satisfied, excited) and reduce emotions related to Anger or Anxiety (e.g. frustrated, helpless). Results with a 4pt. scale show a positive reaction to "Happiness" and levels of "Sadness", "Anxiety" and "Anger" to improve while working with cloud-based tools used for learning activities.

Table 3: Computer Emotional Scale Comparison.

Emotion	Pre-test results	Post-test results
Satisfied	2.50 (σ = 0.65)	2.48 (σ = 0.65)
Anxious	1.42 (σ = 0.97)	1.24 (σ = 0.78)
Irritable	0.28 (σ = 0.45)	0.44 (σ = 0.51)
Excited	2.33 (σ = 0.72)	2.16 (σ = 0.85)
Dispirited	0.31 (σ = 0.47)	0.28 (σ = 0.46)
Helpless	0.47 (σ = 0.56)	0.52 (σ = 0.65)
Frustrated	0.39 (σ = 0.55)	0.32 (σ = 0.56)
Curious	2.33 (σ = 0.68)	2.12 (σ = 0.83)
Nervous	0.47 (σ = 0.56)	0.60 (σ = 0.65)
Disheartened	0.32 (σ = 0.42)	0.35 (σ = 0.46)
Angry	0.19 (σ = 0.40)	0.32 (σ = 0.48)
Insecure	0.47 (σ = 0.70)	0.40 (σ = 0.58)

Table 4: Summary CES-Scale Comparison.

Emotion (4pt. scale)	Pre-test results	Post-test results	Reliability
Happiness	2.39	2.25	r = 0.75
Sadness	0.30	0.28	r = 0.57
Anxiety	0.71	0.69	r = 0.71
Anger	0.29	0.36	r = 0.78

3.2 Motivational Aspects

Deci et. al. (1991) promotes self-determination and motivation that leads to the types of learning outcomes that are beneficial to the student. According to Deci et. al. (1991), intrinsically motivated students engage in the learning process without the necessity of reward or constraints. Extrinsic motivation, on the other hand, provides student with engagement in the learning process as a means to an end, such as feedback or a grade. For this study and adapted scale based on the work of Tseng and Tsai (2010) was used. The scale by Tseng and Tsai (2010) is used to measure motivations in online peer assessment learning environments. For this study, the instrument measures general attitudes with two subscales for extrinsic and intrinsic motivation. Intrinsic motivation is composed of seven items and extrinsic motivation is composed of four items. A single result is composed for each subscale from the participant answers. Results from the instrument and comparison between the two groups (A, B) using course 3 (e-Moderation), are presented in Tables 5 & 6. Results show a positive measure of individual intrinsic motivation and a regular measure of extrinsic motivation from the point of view of the student related to the perceived motivation from peers.

Table 5: Summary from intrinsic motivation for both groups, means and t-Test results.

Group	M	Σ	*F*	*T*	*Df*
A	76.87	14.43	0.43	-1.58	43
B	84.16	16.13			

Table 6: Summary from extrinsic motivation for both groups, means and t-Test results.

Group	M	Σ	*F*	*T*	*Df*
A	64.97	17.43	0.33	-1.82	42
B	74.97	18.93			

The comparison of Table 5&6, shows an interesting higher value for intrinsic compared with extrinsic motivation when being part of cloud based learning activities.

3.3 Usability Aspects

Students were asked about SUS instrument items regarding usability, in general within the tools used (GoAnimate, Dipity, Timetoast, Gloster, Mindmeister, Cacoo, etc.). Respondents were asked to record their immediate response to each item. Results from the instrument are presented in Table 7 & 8.

Table 7: Summary from SUS instrument for both groups in the experience, reliability and Levene's test results.

Group	R	*F*	*Sign*
A	0.91	2.61	0.11
B	0.70		

Table 8: Summary from SUS instrument for both groups, means and T-Test results.

Group	M	Σ	*T*	*df*
A	65.50	19.51	-2.5	43
B	77.60	13.45		

The results for the usability perception for all the participants are summarized in Figure 4.

The SUS mean combined score for both groups is 72.22. The minimum score is 27 (achieved only 1 time) the maximum score is 100. This is a considerable result that denotes how easily the students have interacted with the cloud-based tools used for learning purpose. The objective of the use of this instrument was to explore about the usability of the proposed cloud-based tools with an acceptable reliability and mean values with great opportunities to be improved.

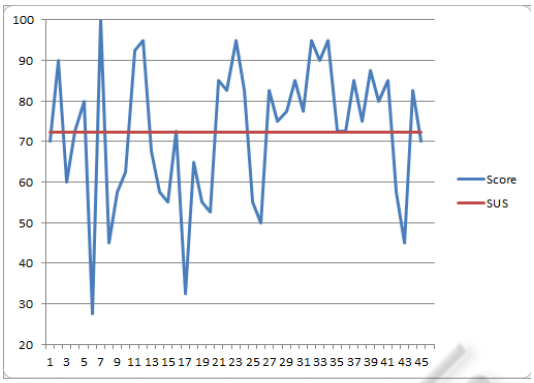

Figure. 4. SUS – Usability of cloud-based learning tools. (Horizontal: participants that fill the instrument, Vertical: Usability score for each participant, the Horizontal line is the SUS mean combined score 72.22).

4 CONCLUSIONS

The results present a low emotional barrier on using a Cloud-Education Environment, which corresponds with the 95% of participants indicating that they like the idea of using this environment. There are high motivation results from the instruments used, and the SUS scale indicates that from the student's perception the cloud-based tools are highly usable.

The results obtained from the motivational perspective appear to demonstrate a high value of intrinsic motivation for students while being part of cloud-based learning activities: this result is an important requirement to engage the student in the learning process without the necessity of reward or constraints.

Analysis from professor's perspective suggest that while doing and planning learning activities, the professor have a growing interest on using new tools and resources that are easy to use, mix and reuse.

The Cloud Education Environment has a promising future and further experimentation is necessary. Still there are many open areas, such as providing integrated systems with high usability, accessibility and interoperability with the aim to create a Cloud Education Environment that can be orchestrated by professors.

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