Communicative Learning Aided by AR for Activity with Students within a Group HCI

Fernando Suarez-Warden
Tecnologico de Monterrey, Mexico

Salvador Barrera
Carnegie Mellon University, United States of America

ABSTRACT
Communicative learning progress in industry and education must gain focus and commitment otherwise innovation efforts by new technologies and recent researches will produce scarce results. Frequently, it appears gaps in quality and efficiency due to lack of ideas assimilation, matter that can be noticed. Investigators may discourse about platforms which serve as communication medium for instructor and participants. The objective is to propound Human-Computer Interaction group activity where it is crucial to display program key contents through Twitter. The inputs are goals and instructions related to a scheduled task for a session. Messages and comments are managed by the students in classroom to accomplish learning actions, announcements deployed with basic schoolroom equipment (projector, speakers, laptops, Wi-Fi). A case with new .EXE code is developed containing main commands and targets of the activity aided by Augmented Reality. This paper alludes to some data structure architectures, communication layers and configuration of system.

Keywords: Augmented Reality (AR); communicative learning; Human-Computer Interaction (HCI); visualization

INTRODUCTION

Since few years, the large amount of information that a student receives and needs to manage has rapidly augmented. So better focus and stronger commitment must be delivered with the innovation efforts made by new technologies and recent researches to produce extensive and satisfactory results in communicative learning or the time will create gaps in quality and efficiency due to lack of ideas assimilation, matter that can be noticed.

State of the literature

- INTERFACES: an outstanding expert argue HCI effect is greater than that of (bad) interfaces while others foster new systems to interface with objects, course information and opinions.
- PROBLEMS AND ABILITIES: various authors detect misconceptions and troubles of students for avoiding under-predict, e.g., problem-solving ability whereas others want students to develop investigative, technical and communicative skills to augment abilities and connect them to others.
- SYSTEM STRUCTURE: some researchers speak about data structure architectures, communication layers and configuration of systems.

Contribution of this paper to the literature

- This work is trying to cross the barrier of the difficulty of ideas assimilation in education and industry
- Depending on contents, productivity and quality at the same time can be earned as a benefit by undertaking a complex activity (difficult for many students) aided by AR which is a demonstrated technology
- One advantage is to increase the effective transmission of learning elements associated with a proposed activity by using a robust combination of AR and HCI

Various industrial and educational efforts through comprehensive designs involving Augmented Reality (AR), like (for example) the Oceanus application, outline several technologies used for implementing a project. Notwithstanding some of the ITs and new hardware can support platforms to operate interesting systems to face this challenge, several authors investigating in similar and parallel areas related to communicative learning with endeavors that must be presented forward have not yet combined the thrust of the HCI team with the advantage of AR technology. Furthermore, it is convenient to mention additional concepts as LED (light emitting diode) and Unity (animation multiplatform motor available for MS Windows), which are important tools to contribute to a communicative learning from a technological point of view.

It can also be considered significant, in this case, to see about a medium which serves as communication framework between professor and students. And that be possible to describe its operation including a communicative process having core modules as database connection, opening theme, display of learning elements and messages from an archive, filtering and closure. This work intends a platform for sending key messages to a participative group in order to generate an effective learning, so it may be possible to share constructive ideas, for teamwork, to accomplish activities of a topic (planned in advance). Albeit there are efforts to develop proposals, for example, one which is mentioned by Henderson and Feiner (2011) of training and maintenance aided by AR, it has been a problematic task to know works that convey to explore about communicative learning involving HCI issue at the same time.

This paper proposes a teaching methodology as a communication system using the social network Twitter for establishing a group HCI. Moreover, the complex activity schemes made by a professor are assisted by AR depending on a deeper preparation of corresponding scenes with their contents, under diverse productivity criteria to pursue profitable ventures. The plan of this article is to include a Literature review in Section 2, a Methodological Description of the Operation that fulfills Section 3, Results and discussion in Section 4, and the Conclusion in Section 5.

LITERATURE REVIEW

A number of outstanding accomplishments are commented as follows.

A review about how to teach in higher education (covering literature and author opinions) is undertaken by Thimbleby (2008) which research considers despite that interfaces are bad if the processes, good examples and reference to HCI are kept thus students are motivated because even elementary HCI knowledge empowers them to make a meaningful difference.

Barrera et al. (2004) argue technological limitations on current interfaces have forced investigators to develop new devices for interacting with objects. So speaking about the subject of this work, one important research task is the deployment of systems for allowing the user to interface with an environment of course information and participant opinions.

And commonly there is a typical supposition that science learning often builds upon students' previously acquired ideas and therefore science and technology teachers need to anticipate the knowledge of learners. About this concern, Zhou et al. (2016) investigated the pre-service science teachers' knowledge of student misconceptions and troubles as an essential element of the Pedagogical Content Knowledge (PCK) on Newton's Third Law. Their outcome indicated a tendency for pre-service science teachers to under-predict the problem solving ability considering a sample of senior high school students.

Teachers can learn about basic human characteristics and may improve some necessary skills to explore people activities with and around technologies. Conversely, according to Churchill et al. (2016) students need to develop investigative, technical, communication and advocacy skills to help them shape interactive technologies that augment abilities, enhance their creativity, connect them to others and protect their interests. A motivating effort (aforementioned) is the Oceanus application that functions as an announcement tool about which, e.g., Neira et al. (2014) in their unpublished work, describe data structures, communication layers and configuration.

This research alludes to some of the architectures of the data arrangements, communication stratums and configuration of system. It is useful to describe interactions among end users of an application, external and internal connections, application and the system, and administration users managing the system.

METHODOLOGICAL DESCRIPTION OF THE OPERATION

The Twitter archive web application is utilized for the purpose of searching, filtering and archiving tweets for later retrieval by a consumer device for displaying. An administrative user will be able to log into the system, set up "feeds" consisting of twitter searches, and then monitor results for these feeds. The user selects what tweets are filtered and therefore approved, and these tweets are archived in a SQL Server database for later retrieval by a consumer application. **Figure 1** exhibits a proposed diagram to illustrate the operation.

In this case, there are (a) the main objective consisting in generating consciousness about problems, necessities and opportunities (Main Objective of Activity 1 is in **Table 3** at row 4 column 3) of the society, and (b) the key instruction (Instruction #2 in **Fig. 1**) which is to elaborate a diagram of relations (named conceptual map in **Table 3** at row 3 column 3), containing contacts that can help the team. These (a) and (b) items change respect to activities 2, 3, 4, 5 and 6 of the course program but follow the same pattern.
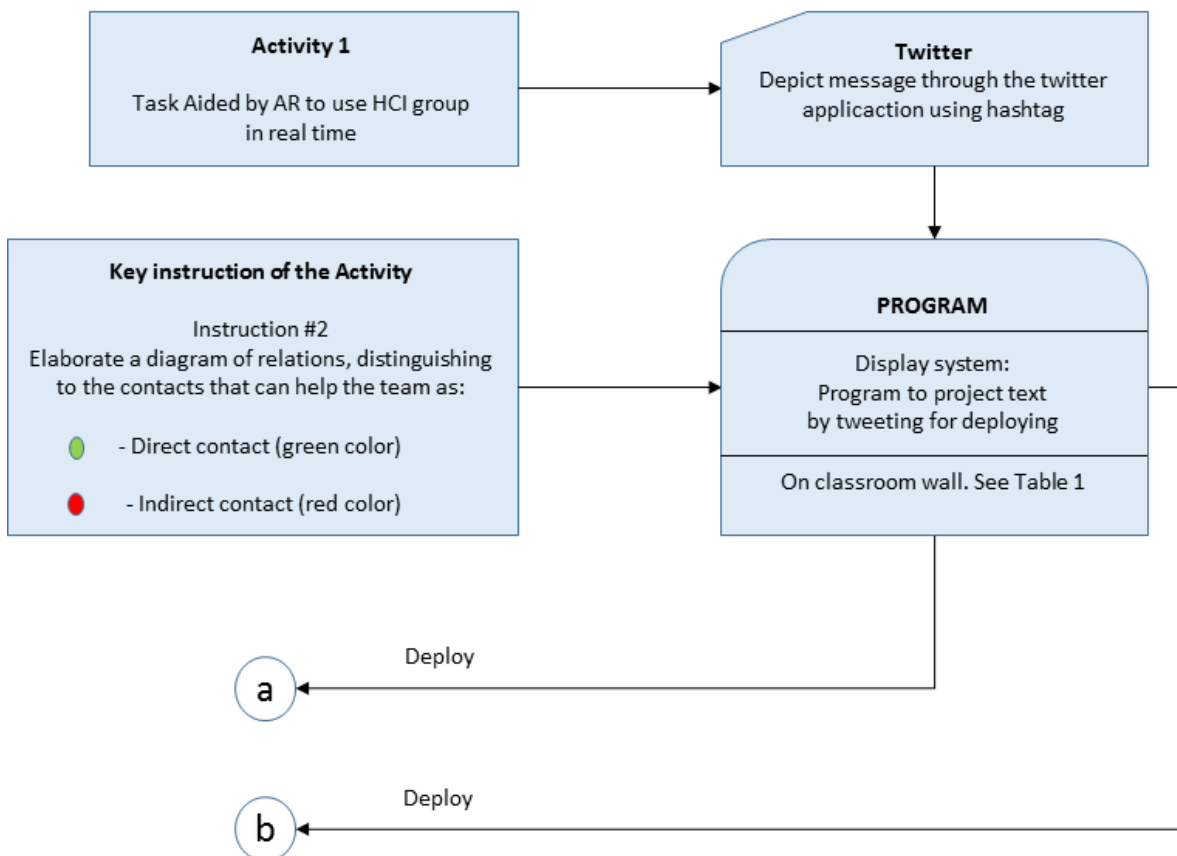

Figure 1. Diagram of the operation for a communicative learning for the Activity 1 of a course where a = main objective of the session; b = key instruction of the activity

A practice of sending tweets to the led screen is outlined and exhibited. In **Table 1**, a process is exposed and proposed designating steps, servers and subhead.

Table 1. Process of sending tweets to the led screen

Steps	Servers (*t*)	Subhead (*t*)
Hashtags and Keywords: The selection on the current topics is sent to the server and located through a code number that refers to the images in AR. As soon as it locates the number a corresponding image will be displayed.	Audience is registered through the internet, and smart phones and sent tweets through the tags and keywords associated with the search. Students in the classroom send tweets to relate to the topic through hashtags and then the most common student selections are filtered.	Images are shown on screen in the appearance of AR texturing style. The various categories (according to the selected topic) become whirlpools of hashtags from Twitter followers.
Filter profanity (Filters):	Search for inappropriate expressions by using a program and/or through volunteers for filtering.	
Select tweets:	Once tweets pass the filter those approved will be chosen at random to be displayed.	
Express tweets:	Tweets are expressed in a selected LED area.	Many images and written tweets appear with the ink painting style in screen area.

Otherwise a communicative learning process may be shown at the beginning of the session 1, using the **Figure 2** for representing an introductory preview to the students to try to establish the group HCI.


Figure 2. Diagram of a Proposed Communicative Learning

A communicative process can have five major parts: Database connection, Opening Topic, Display of Subjects and Messages from the Database/Archive, Filtering the received message, Deployment of Images and Closure Scene.

Making an action to order ideas, a data arrangement that includes the cognitive (learning) elements of a typical session is presented in **Table 2.**

Table 2. Learning elements of an activity with students in a HCI group

Elements	Image	Teacher note
Previous knowledge (before taking a class)		Student read before
Required material (to carry to class)		See next required material
Instruction (mandatory)		See corresponding activity
Main Objective (s)		Target of the activity
Homework		According how the activity describes it

This understanding serves for obtaining guidelines to lead students to targets such as use of materials, key instructions and comprehension of task requirements to go ahead for getting an associated knowledge.

RESULTS AND DISCUSSION

Herein, a disclaimer note is included because it is also possible to realize a pilot course or a sample planning to introduce the concept of this work to a group, we do not make this action yet in this first paper but in a related article of this work in progress.

Figure 2 showed that professor may select a large number of topics that students can see and with which participate in a class session. This number of topics depends on the interest of each user (agreeing with the learning element in **Table 2**). It is important to identify the common interest of students by these subjects. Through the use of the software the professor tweets messages from the classroom to a main server where there is a repository. Here the system can filter the most common numbers and may show, according to these ciphers, the figures and images on the LED and AR display. An intelligent system filters undesirable messages when a grammatical error or offense appears, so the corresponding tweet is jumped and the next communication is examined.

It is not necessary to develop a smart phone application since any phone with access to twitter works. Since the Twitter feeds anytime, the content is continually updated and may not grow stale.

The Activity 1 (and so on respect to Activities 2, 3, 4, 5 and 6 of the course with students) can be more assisted by AR depending on a deeper preparation of correspondent scenes with their contents, under different efficiency criteria. Final results are fully functioning Unity scenes, for each experience and design documentation, surrounded by adequate musical sounds. The outcome interactions that are displayed generate a unique end user experience engaging the audience toward the depth core of the topic.

This work is a one year, four quarter project evolving interactive experiences for a classroom group. See the **Figure 3**
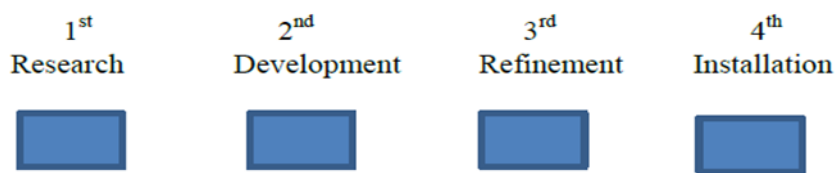

Figure 3. Project work flow

One of the main advantages of this project is to increase the effective transmission of the learning associated with a proposed activity by using a combination of AR technology and HCI. It is expected to get a better group interaction among the participants because they achieve an enjoyable environment by fostering that the instructor can appreciate the reaction of the student in a more agile way to respond to corresponding requirements of learning or training.

An interesting outcome is produced when the contents of Activity 1 are exemplified. Consequently it is appropriate to derive **Table 3** by putting in the 3rd. column of a new Table, with the same first two columns of **Table 2**, the particular cognitive (learning) elements of Activity 1.

Besides five images in **Table 3**, among particular elements in guidelines (in case of Activity 1) such as social problems, cardboards, conceptual map and Graph of Gant are items that can be modeled and texturized to construct AR contents for arranging the animation scenes to illustrate a better way of reaching know-how for making actions and homework, according to Castro (2012) and Rios et al. (2011).

Also, it is recommendable to measure the new learning times occurred using a communicative learning process for comparing them with those elapsed by traditional method using small sample size for complex cases as Suarez-Warden et al. (2015) suggest.

Table 3. Learning elements for the Activity 1 in a pilot course with students within the HCI group

Elements in general	Image	Element in Activity 1
Previous knowledge (before taking a class)		None
Required material (to carry to class)		<u>Cardboards</u> (next session)
Instruction (mandatory)		Select one of five actual generated problems or necessities justifying by saying why this situation is a trouble including related information and draw a <u>conceptual map</u> of the contacts of the team which can give help to the group
Main Objective (s)		Make consciousness about necessities as opportunity areas of social problems
Homework		Elaborate an investigation about planning of a project including: 1. Introduction, 2. Description and development, 3. One example of <u>Graph of Gant</u>, 4. Conclusions, 5. References

CONCLUSION

Learning elements as previous concepts (acquired before an academic class or an industrial course) and tasks, images with certain significance and the components of an activity can be adequately arranged to be transmitted and deployed using a proposed platform for taking advantage of the rapid development of various emergent technologies. It was not necessary to develop a smart phone application since any phone with access to twitter worked. Since the Twitter was fed anytime, the content was continually updated and was not grown stale. The final output was fully functioning Unity scenes for each practice and design documentation, as well as music for receiving both experiences and for engaging the audience toward the preconceived depth core. Among jobs of Human-Computer Interaction (HCI), it has been seen that productivity and quality is expected to achieve at the same time as a benefit by performing a complex cognitive activity for students, like the communicative learning assisted by Augmented Reality technology via proposed communication system using Twitter, within an established group HCI. It is feasible to realize a pilot course or a sample planning to introduce the concept of this work to a group. And it is possible to measure the new learning times for comparing them with those elapsed by traditional method. Correspondingly, it is convenient to estimate the new error number

(which reflects quality) to compare it with the errors generated by mean of the habitual common method.

ACKNOWLEDGEMENTS

REFERENCES

Barrera, S., Takahashi, H., & Nakajima, M. (2004, June). Hands-free navigation methods for moving through a virtual landscape walking interface virtual reality input devices. Proceedings of the Computer Graphics International CGI conference 388-394. *IEEE Xplore.* DOI: 10.1109/CGI.2004.1309239. Crete, Greece.

Castro G., C. A. (2012). A methodological framework for augmented reality technological applications in industrial fields. Thesis M.Sc. in *Manufacturing,* Tecnologico de Monterrey. Mexico.

Churchill E. F., Bowser A. & Preece J. (2016). The Future of HCI Education: A Flexible, Global, Living Curriculum. Forum HCI education. *Interactions* March-April, 70-73. © 2016 ACM 1072-5520/16/03. DOI: 10.1145/2888574

Henderson S. & Feiner S. (2011). Exploring the Benefits of Augmented Reality Documentation for Maintenance and Repair. *IEEE Transactions on Visualization and Computer Graphics 2011; 17*(10): 1355-1368. DOI: 10.1109/TVCG.2010.245

Neira L., Barrera S., Méndez J.M. & Juárez O. (2014). Massive Human-Computer Interaction in Real Time. *Unpublished* (work in progress). Mexico.

Rios H., Hincapié M., Caponio A., Mercado E. & González-Mendivil E. (2011). Augmented Reality: An Advantageous Option for Complex Training and Maintenance Operations in Aeronautic Related Processes. R. Shumaker (Ed.), Virtual and Mixed Reality part I - New Trends. Orlando FL, USA. *Lecture Notes in Computer Science 2011*; 6773, 87-96. DOI: 10.1007/978-3-642-22021-0_11

Suárez-Warden F., Rodriguez M., Hendrichs N., Garcia-Lumbreras S. & González-Mendívil E. (2015). Small Sample Size for Test of Training Time by Augmented Reality: an Aeronautical Case. International Conference on Virtual and Augmented Reality in Education. Monterrey, Mexico. *Procedia Computer Science 75*(2015) 17-27. 2015 Elsevier B.V. DOI: 10.1016/j.procs.2015.12.190

Thimbleby H. (2008). Teaching HCI to Make It Come Alive. HCIed Conference April, 9–16. Rome, Italy. Keynote, *Magazine of Interaction Design and Architecture,* (3 & 4), 9-16 special issue, Giovannella, C., Kotze, P. & Wong, W. (Eds.) © 2008 ACM 1581130000/00/0008.

Zhou S., Wang, Y., & Zhang, C. (2016). Pre-Service Science Teachers' PCK: Inconsistency of Pre-Service Teachers' Predictions and Student Learning Difficulties in Newton's Third Law. *Eurasia Journal of Mathematics, Science & Technology Education, 12*(3), 373-385. DOI: 10.12973/eurasia.2016.120

http://iserjournals.com/journals/eurasia