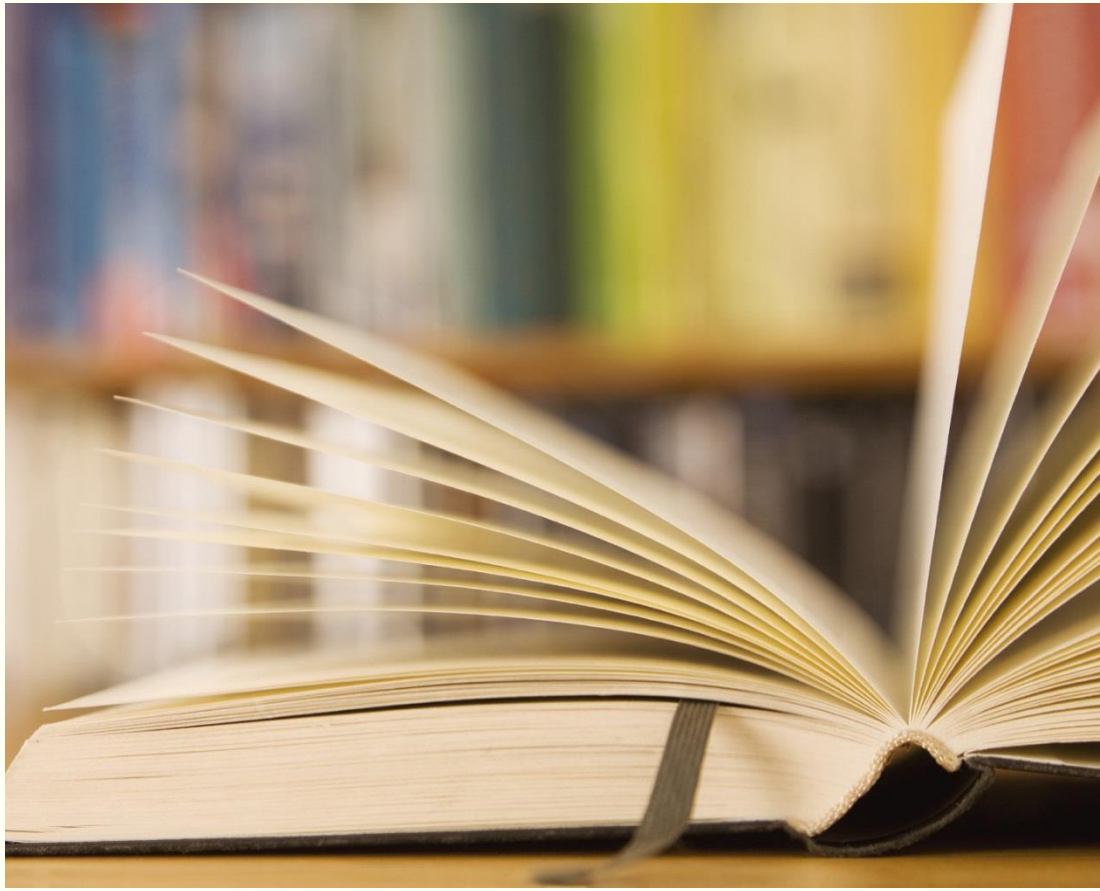
Martín-Gutiérrez, J., Fabiani, P., Benesova, W., Meneses, M. D., & Mora, C. E. (2015). Augmented reality to promote collaborative and autonomous learning in higher education. *Computers in Human Behavior*, *51*, 752-761.

Augmented Reality to Promote Collaborative and Autonomous Learning in Higher Education



발표자: 엠레

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Table of Content

Introduction

- This research is about the application of augmented reality in higher education contexts
- The study has been conducted on Basic Electrical Engineering course (in one of the universities in Spain).
- Three AR applications (mobile/desktop) has been developed for the research.
- Sample were two groups. Each of them consists of 25 students.
- One sampling group used those app for one school semester; the other group was demonstrated how the applications are performed.

Why is this Study Needed?

- That course is the first year course of engineering. That means students have no any experience in the subject.
- The laboratories which provide students to make practice are overcrowded, in Spain, worsening the teaching quality and reducing the teacher's dedication to every student.
- This is a very big problem especially for the subjects needing practical teaching, because in those lessons, students mentoring and supervision is much more necessary, and learning must be completely personal and manipulative.
- Therefore, there was a need of new learning method which can provide autonomies learning.

What is Augmented Reality (AR) ?

- AR is shortly interaction with virtual objects in real world.
- An augmented reality environment allows the user to see the real world with virtual computer-generated objects superimposed or merged with real surroundings.
- Augmented reality is applied to several areas such as medicine, architecture, marketing, advertising, military, archeology and leisure (Craig, 2013).

Virtual Reality:

- VR technology completely immerses the user in a synthetic environment, which can interact with obtaining answers, while not seeing the outer real world

The Applications which are developed for the research

Applications were created for mobile phones and tablets(Android/IOS). Besides, one of them can be used in computers, too.

Application Name	The aim of the application	Knowledge type
ElectAR_notes	Theoretical electricity notes enriched with AR contents	Theoretical knowledge
ELECT3D	App for electrical plans reading	Practical + theoretical knowledge
ElectARmanual	AR training for installations and electrical machines practice in the laboratory	Practical knowledge

Pictures from the study

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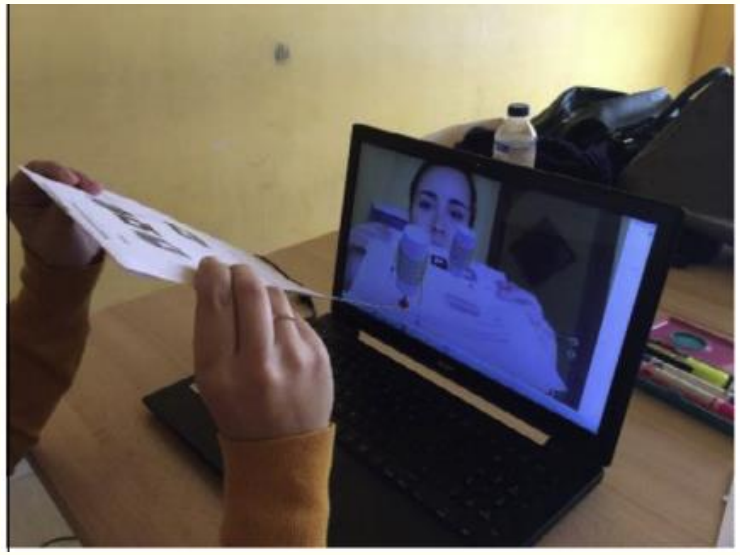
Fig. 3: Producción de un campo magnético

En la figura se muestra un núcleo rectangular con un devanado de N vueltas de alambre enrollado sobre una de las ramas del núcleo. Si el núcleo es de hierro o algún otro material ferromagnético, casi todo el campo magnético producido por la corriente permanecerá dentro del núcleo, de modo que el camino de integración de la ley de Ampère es la longitud media del núcleo, l_c. La corriente que pasa por el camino de integración I_{net} es entonces Ni, puesto que la bobina de alambre corta dicho camino N veces mientras porta la corriente i. La ley de Ampère se expresa entonces:

$$H\ell_c = Ni$$



Data Collection Tools and Methods

- The System Usability Scale (SUS) questionnaire was used for measuring usability (completed by all students)
  - The usability test was hold by all students.
- Feedback survey
  - Feedback survey was hold by the group of students who use applications for one semester

Result of the Study

- All three applications are founded as useful by scoring 80%.
- According to Feedback survey test, students think that
  - Multimedia content has a high quality.
  - The application does not show any unexpected difficulty about its use.
  - Applications are a great help for learning.
  - These kinds of applications could be used in other similar subject.
  - Those tools help to understand the abstract concepts.

Conclusion

- In certain teaching/learning contexts, AR applications can be performed by the student on his own, thus saving teacher's time spent on repeating explanation (autonomous learning).
- AR provides proper methods for not only developing **professional competences**, but also
  - **Instrumental competences** (*analysis and synthesis skills, planning and organization skills, solving problems, managing information as well as taking decisions*),
  - **Personal competences** (*teamwork, workplace interpersonal relations skills, critical reasoning*) and
  - **Systemic skills** (*autonomous learning, leadership, initiative, entrepreneur, motivation for quality*)
- According to usability test, those applications are free of errors in terms of effectiveness and efficacy.
- According to feedback survey, students are satisfactory of the lesson in terms of practical and theoretical knowledge.

Conclusion

- Student motivation is high, so it is **believed** that the academic performance is high, too.
- Different AR learning scenarios presented in this work are adequate for promoting collaborative and autonomous learning.
- AR is cost-effective and provides much safer lab.
- Those kinds of applications can be created for other majors, which include practice knowledge, such as mechanical engineering.