

# Strengthening Engineering Education in Higher Education. Teacher Training Update in Data Mining, Internet of Things, and Metaverses

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**Abstract.** Teacher training and updating are revealed as fundamental pillars in engineering education in Higher Education, especially in the current technological context. The integration of technologies such as artificial intelligence, virtual reality, Big Data, and IoT plays a crucial role in providing valuable tools and data for student training. These tools not only enrich the educational experience but also equip future engineers with skills and knowledge in line with the demands of the modern world. The interconnection between the metaverse, augmented reality, and IoT adds an additional dimension, expanding the possibilities of innovative applications in biomedical and industrial education. To achieve effective education, it is essential for educators to stay updated on these constantly evolving technologies. By investing in their training and preparation, educational institutions can ensure that teachers are equipped to guide students in the optimal use of these advanced tools. Thus, it ensures that graduates are ready to face the challenges and opportunities of a constantly changing technological world and are prepared to contribute significantly to the fields of biomedical and industrial engineering.

**Keywords:** teacher training, information technology, Engineering, Higher Education, and updating.

## 1 Introduction

Higher education and engineering face a constant challenge: staying up-to-date in an increasingly technological environment. In Latin America, teacher training and updating are essential to meet the demands of an increasingly competitive job market. As noted by education expert John Dewey, "education is not preparation for life; education is life itself" (Dewey, 1916). In other words, education must not only provide theoretical knowledge but also practical skills that can be applied in the real world.

Particularly in the fields of medicine and engineering, the continuous increase in the availability of information and data has transformed the way research and new discoveries are made. The use of computational techniques and tools is essential to make sense of the vast amount of information generated in industrial and administrative areas.

The implementation of augmented reality in university education is changing the way students learn. As reported by Forbes, "augmented reality enhances motivation and increases attention by almost a third within the teaching-learning process" (Forbes, 2019). Furthermore, it opens up endless teaching opportunities for universities, such as distance learning and interactive classes.

On the other hand, data mining and the Internet of Things are emerging and crucial areas in the mass production of biomedical products in Latin America and the world. According to technology expert Gartner, "the Internet of Things will be the main driver

of digital transformation in industry and the economy in the coming years" (Gartner, 2019). It is essential for universities to be prepared to face the challenges and opportunities that the future presents. As philosopher and educator Paulo Freire said, "education does not change the world; it changes people who are going to change the world" (Freire, 1970).

Therefore, teacher training and updating are fundamental for higher education and engineering. Universities must be up-to-date regarding the availability of information and data, and they must use technological tools such as augmented reality and data mining to improve teaching and research. In this sense, the training of new professionals in these emerging and crucial areas is crucial for the future of Latin America and the world.

## **2. Theoretical framework**

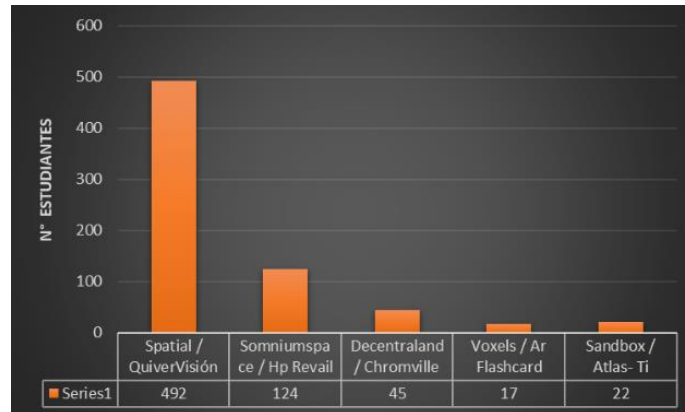
Teacher training in data mining, IoT, and metaverses is crucial for engineering education in Higher Education. According to Han and Kamber (2006), data mining is "an analytical process designed to explore large amounts of data in search of consistent and systematic patterns." Atzori, Iera, and Morabito (2010) describe IoT as "the interconnection of physical and electronic devices through the Internet." Metaverses, defined by Linden Research (2009), are "a shared virtual space created by the convergence of virtual reality and Web 2.0 technologies." These technologies can enhance learning effectiveness and decision-making. It is important to address potential limitations, such as the lack of resources and teaching skills, to enhance their effectiveness and viability in higher education.

## **3. Method**

A mixed methodology of data analysis (quantitative and qualitative) was used, and a self-designed ad hoc questionnaire was created to analyze the perceptions of 700 students regarding the advantages and disadvantages of the strategies implemented in the classroom and the augmented reality apps used in classrooms, educational seminars, and conferences held at various universities in Latin America.

## **4. Result**

The perceptions of 700 students from different universities were analyzed regarding the most motivating AR apps and metaverse and didactic applications used in augmented reality seminar sessions in educational contexts. The Spatial/QuiverVision app was selected by over 70% of students as the most interesting mobile application due to its dynamism, interactivity, usability, and didactic relevance for use in educational contexts. Figure 1 shows the frequency of student responses regarding the most significant AR applications from a training perspective and used in their classes.



[Figure 1: Frequencies of student responses (created from Acuña, 2023)]

## 5. Discussion

Discussions about teacher training in data mining, IoT, and metaverses for engineering education in Higher Education include the need for updating, the balance between theory and practice, effective implementation considering limitations, and the importance of ethics and privacy. This highlights the importance of teacher updating to improve the quality of education, but also the need to address limitations and find an appropriate balance between theory and practice, as well as pay attention to ethics and privacy in the use of these technologies in the future.

## 6. Limitations and future research

The limitations of the teacher training method in data mining, IoT, and metaverses for engineering education in Higher Education include resource limitations, teaching skills, technology, and curriculum adaptation. It is necessary to address these limitations to improve the effectiveness and viability of teacher training in this field.

## 7. Conclusions

In conclusion, teacher training in data mining, the Internet of Things, and metaverses for engineering education in Higher Education is essential to ensure that students are well-prepared to face the challenges of the modern world. This teacher updating process must be carefully designed and tailored to the specific needs of each institution and its students.

While the method presented can be effective in achieving learning objectives, it is also important to consider the potential limitations of the method and find ways to address them. It is necessary to invest in adequate teacher resources and training, as well as

technology and curriculum adaptation, to ensure that teacher training in data mining, IoT, and metaverses is effective.

Ultimately, teacher training in data mining, IoT, and metaverses for engineering education in Higher Education can improve the quality of education that students receive, equipping them with the skills needed to succeed in the modern world and face future challenges in their careers.

## 8. Reference

- Acuña Acuña, EG (2023). Aplicación de minería de datos e Internet de las cosas (IoT) para productos biomédicos. *REVISIÓN TECNO. International Technology, Science and Society Review /Revista Internacional De Tecnología, Ciencia Y Sociedad* , 12 (1). <https://doi.org/10.37467/revtechno.v12.3444>
- Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: A survey. *Computer Networks*, 54(15), 2787-2805.
- Dewey, J. (1916). *Democracy and Education: An Introduction to the Philosophy of Education*. New York: Macmillan.
- Freire, P. (1970). *Pedagogy of the Oppressed*. New York: Continuum.
- Forbes. (2019, 17 de octubre). How Augmented Reality Is Transforming Higher Education. Recuperado el 19 de marzo de 2023, de <https://www.forbes.com/sites/forbestechcouncil/2019/10/17/how-augmented-reality-is-transforming-higher-education/?sh=79cd4e18738d>
- Gartner. (2019, 26 de noviembre). Gartner Identifies the Top 10 Strategic Technology Trends for 2020. Recuperado el 19 de marzo de 2023, de <https://www.gartner.com/en/newsroom/press-releases/2019-10-21-gartner-identifies-the-top-10-strategic-technology-trends-for-2020>
- Han, J., & Kamber, M. (2006). *Data Mining: Concepts and Techniques*. Morgan Kaufmann Publishers.
- Linden Research. (2009). What is a metaverse? Retrieved from <https://www.lindenlab.com/pressroom/releases/2009-what-is-a-metaverse>