

# Revisión de la realidad aumentada y realidad virtual como impulso a la educación de los estudiantes más jóvenes

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## **Abstract**

Este artículo presenta una revisión exhaustiva de la literatura existente sobre la integración de la realidad aumentada y la realidad virtual en el ámbito educativo. Se analizan casos de estudio, investigaciones y enfoques pedagógicos que han empleado estas tecnologías con el objetivo de mejorar el proceso de enseñanza-aprendizaje. Además, se exploran tendencias emergentes y perspectivas futuras en este campo. La revisión destaca el impacto positivo de la realidad aumentada y virtual en la motivación de los estudiantes, el compromiso y la comprensión de los conceptos. Se discuten los desafíos y las oportunidades que estas tecnologías presentan en el contexto educativo y se subraya la importancia de su implementación adecuada.

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## 1 Introducción

La educación es un pilar fundamental en el desarrollo de la sociedad, y en la era digital en la que vivimos, la integración de tecnologías innovadoras se ha convertido en una oportunidad clave para enriquecer la experiencia de aprendizaje de los estudiantes más jóvenes. En este contexto, la realidad aumentada y la realidad virtual han surgido como herramientas prometedoras que pueden transformar la forma en que los estudiantes interactúan con el conocimiento.

El presente estudio busca abordar las implicaciones y posibilidades que ofrecen la realidad aumentada y la realidad virtual en el contexto educativo. A través de una revisión exhaustiva de la literatura existente, se analizarán casos de estudio, investigaciones y enfoques pedagógicos que han empleado estas tecnologías con el objetivo de mejorar el proceso de enseñanza-aprendizaje. Además, se examinarán las tendencias emergentes y las perspectivas futuras en este campo, con el propósito de proporcionar una visión completa y actualizada de cómo la realidad aumentada y virtual están influyendo en la educación de los jóvenes estudiantes.

## 2 Método

Se realizó una búsqueda de artículos con las palabras clave:

- Realidad aumentada en la educación
- Realidad aumentada
- ¿Qué es la realidad aumentada?

Y se clasificaron los resultados de acuerdo a lo siguiente...

## 3 Revisión de la literatura

### 3.1 Realidad Aumentada

#### 3.1.1 Beneficios de la Realidad Aumentada en la educación

#### 3.1.2 Desafíos y Limitaciones de la Realidad Aumentada en la Educación

#### 3.1.3 Impacto en la Enseñanza y el Aprendizaje

#### 3.1.4 Motivación y Participación de los Estudiantes

#### 3.1.5 Opiniones y Experiencias de los Profesores

#### 3.1.6 Comparación entre Realidad Aumentada y Realidad Virtual en Educación

1. “Los elementos motivacionales del uso de la tecnología están ya suficientemente probados como para quedar fuera de discusión (Reinoso, 2012) y muchos autores defienden que la tecnología de RA sirve realmente para mejorar la práctica educativa y la comprensión de ciertos aspectos de la realidad por parte de los alumnos. Igualmente se ha utilizado también para proporcionar prácticas a los discentes (aplicaciones médicas) que de otra forma serían imposibles de proporcionar con sujetos reales”. [1]
2. “Otras mejoras vendrán de la mano de aplicaciones que permitan la interacción entre los propios marcadores, esta clase de interacción ya está conseguida y funciona perfectamente (por ejemplo, ARChemistry de Paradox). No se ha encontrado ninguna aplicación gratuita que las implemente, ésta es una de las características que la empresa Aumentaty ha señalado para desarrollar en su próxima versión de su software gratuito Aumentaty Author”. [1]

3. “The incorporation of AR into teaching situations makes it necessary to envisage several principles, such as: designing environments which are flexible enough to ensure that AR incorporation does not become a technological problem but an educational and didactic issue; assuming the limitations posed by the context; working with curricular contents for the purpose of achieving a penetration level that goes beyond merely marginal aspects, and enabling teachers as well as students to have sufficiently developed digital competences; doing research into the methodologies which can be mobilized within AR; producing multi-platform materials which can be used in various formats; and training the teaching staff in didactic competence so that they can incorporate AR into educational practices and use it to create scenographies that prove enriching in educational terms, and not merely beautiful from an esthetic and technological perspective. These are the aspects around which our research project will revolve. The present paper is going to conclude with the remarks made”. [2]
4. “The considerations above allow us to establish a clear difference between AR and VR, since virtual data replace physical ones in the latter, as a result of which a new reality arises. Instead, AR shows two realities overlapping on different information layers in various formats (computer-generated images, video sequences, animations, etc.) in order to shape a new reality which is the one that a person truly interacts with.”. [2]
5. “Overall, results of the students’ surveys and teacher feedback suggest that there are multiple benefits to using this suite of technology for teaching and for learning. For teaching, AR can be harnessed to create a learning experience that is student-centered, and provides opportunities for peer-teaching, collaboration, and one-on-one teacher guidance.”. [3]
6. “Teachers reported high levels of student engagement with the smartphones, but written survey results from the teachers indicated mixed opinions about the specific impact of the smartphones on student learning. Teachers’ surveys indicated a strong feeling about the effectiveness of the probeware for supporting student learning, while the AR was rated more neutrally on this same question. Through analysis of observations, survey responses, and interviews we concluded that, in this use case, AR was most effective as a mode of engagement and as a way of structuring and enhancing the probeware-based activities of the field trip.”. [3]
7. “Such feedback suggests that AR can provide a powerful pedagogical tool that supports student-centered learning. Given the positive effects of student-centered approaches on higher-order skills such as critical thinking and problem solving (McCombs & Whisler, 1997), these technologies may support the use of sophisticated pedagogical approaches of great benefit to student learning. They can encourage active processing thus helping students to develop deeper understanding, discover gaps in their understanding, and realize the potential for transfer in similar contexts.”. [3]
8. “Students had no problems at all in learning how to interact with the different masterpieces presented and easily switched among the pictures. They quickly learned how to navigate through the information presented. From the very beginning of the experience, a collaboration nexus among students was established.”. [4]
9. “The motivation mean scores obtained were  $M = 3.62$  for the augmented reality based learning scenario and  $M = 3.29$  for the course based on slides. A clear improvement on the attention and the satisfaction motivation factors for the learning environment based on augmented reality technology compared with a more traditional learning environment was noticed. These results were supported by a qualitative study where students claimed that an AR learning environment was more appealing and easy to understand than the slidebased course”. [4]

10. “We believe that the immersive capabilities of AR helped students maintain higher levels of attention and interest on the learning content. The higher concentration and memorization levels that students claimed to achieve with AR technology, seems to cause this positive effect on learning outcomes.” [4]
11. “In relation with the usability study, authors were greatly surprised to observe how students were able to quickly learn and use the augmented reality system and the ease with which students overcame the technical problems that arose. Students manifested their interest in continuing using this technology in other courses and at home. Thus, although AR is not mature enough to be used massively in education, enthusiasm of middle-school students diminished most of the barriers found.” [4]
12. “Teachers appreciated the visualization/ virtualization, augmentation, and interactivity affordances offered by AR for integrating ARinE. Some teachers thought that it is easy to find AR resources, while others thought that it is difficult.” [5]
13. “Teachers believed that AR mainly increases students’ interest and engagement as well as it facilitates students’ interaction, understanding, exploration, explanation and experiences that previously were not possible. In addition, they considered that AR supports and facilitates interactive learning and experiential learning as well as visualization and teaching topics that previously were not possible” [5]
14. “On the other hand, these teachers believed that the cost of buying and maintaining AR equipment and resources as well as the lack of AR educational content and resources prevent the integration of ARinE” [5]
15. “One type of AR technologies includes a head-mounted display and/or an additional backpack with computer equipment. The cumbersome and expensive design could cause problems such as discomfort and poor depth perception (Kerawalla et al., 2006). To avoid these problems, current development of AR systems adopts portable technologies that are less obtrusive and enhance a sense of immersion and presence.” [6]
16. “Our analyses and discussions of empirical studies in AR indicated that while augmented reality can be created by integrating multiple technologies and has a great potential to support learning and teaching, there are various issues to consider when AR is implemented in educational settings.” [6]
17. “The t-test result of their post-test scores indicates that the learners’ knowledge related to elastic collision was significantly improved by using the developed AR Physics system.” [7]
18. “The results indicate that the implementation of new technologies in education of virtual and augmented reality improve interactivity and student interest in mathematics education, contributing to more efficient learning and understanding of mathematical concepts when compared to traditional teaching methods.” [8]
19. “Prior to using the AR technology in the learning environment, researchers are encouraged to plan well-structured teaching and learning components encompassing (1) students’ needs, (2) learning objectives, (3 ) the forms of support such as equipment, and (4) the types of learning strategies that suit students’ needs” [9]
20. “The technologies used in particular Augmented Reality must be integrated with appropriate learning strategies for the purpose of making an impact on improving the quality of the learning process. The selection of appropriate learning strategies can influence the success and effectiveness of the technology support used, such as Augmented Reality in education.” [9]

21. “Una aplicación de contenidos multimedia basada en Realidad Aumentada requiere realizar los siguientes pasos: a) diseño de la aplicación y de los contenidos, b) generación de los contenidos y c) desarrollo de la aplicación en la plataforma de Realidad Aumentada (AMIRE)”. [10]
22. “La Realidad Aumentada establecerá un puente entre los conceptos teóricos y la realización física de los experimentos con los dispositivos reales. El sistema mediante una cámara captura la imagen del dispositivo real (por ejemplo un circuito electrónico) y mostrará al alumno en la pantalla del ordenador el dispositivo real con información adicional. La información virtual añadida a la imagen real estará relacionada con los conceptos teóricos del dispositivo real y se presentará en un formato 2D, 3D, video, audio o texto entre otros”. [10]
23. “a longer AR intervention is likely to result in higher positive responses, such as higher learning motivation or better learning attitude, and higher learning achievements, such as learned knowledge and skill.” [11]
24. “Use of AR in language or social studies learning is more likely to result in higher positive responses than use of AR in science learning. The reason conjectured for this finding may relate to the nature of different subject areas and how AR may provide different degrees of senses of innovative experiences for a subject area, but this conjecture requires future investigation” [11]
25. “It was found that using refined or innovative AR interventions can further promote students’ positive responses by another small effect size, and enhance students’ knowledge and skill by another medium effect size, when compared to original or regular AR interventions.” [11]
26. “From the data analyzed, we also highlight that once the availability of resources, class planning and initial teacher training are overcome, augmented reality provides benefits and advantages centered on pedagogies that allow for greater enthusiasm on the part of the students, with significant advantages in creativity, innovation, participation, and especially in the motivation of participants.” [12]
27. “Visual education has many advantages, such as learning faster, memorability and in terms of paper expenses. The visual animations and presentations have become a very important material in higher education in recent years along with the development of computer technologies.” [13]
28. “It can be easily preferred and applied in the departments such as Chemistry, Biology and Geography in the field of Science. The unclarity of images used in courses leads to ambiguity. In this study, image processing based approaches have been developed to ensure more effective learning of the courses in higher education.” [13]
29. “The capacity to overlay rich media onto the real world for viewing through web-enabled devices such as phones and tablet devices means that information can be made available to students at the exact time and place of need. This has the potential to reduce cognitive overload by providing students with “perfectly situated scaffolding”, as well as enable learning in a range of other ways.” [14]
30. “It was found that augmented reality technologies stimulate the educational process and provide the opportunity to implement knowledge in both humanities and natural sciences. This technology expands the educational process towards clarity and motivates the student to further study the material.” [15]
31. “The introduction of augmented reality technology makes it possible to improve the quality of education by motivating students to self-study, increasing audience

- interest in educational material, developing a desire to use modern interactive technical capabilities and technologies, replacing textbooks and laboratory equipment with multimedia computer models.”[15]
32. “These applications show that augmented reality can be means of enhancing, motivating and stimulating learners’ understanding of certain events, especially those for which the traditional notion of instructional learning have proven inappropriate or difficult. Furthermore, the students can learn in a quick mode by interacting on the augmented environments.” [16]
  33. “Se aporta una solución tecnológica móvil de bajo costo, con el fin de innovar el proceso de enseñanza donde los estudiantes podrán acceder a contenidos virtuales en tercera dimensión sobre los temas que están aprendiendo, generando un ambiente de trabajo diferente que motive a los alumnos a aprender.” [17]
  34. “La aplicación de la tecnología de la realidad aumentada al proceso de enseñanza-aprendizaje presenta ventajas respecto a los métodos tradicionales de enseñanza. El realismo, interactividad, motivación e interés en aprender son los factores más importantes a destacar, evidenciado en los alumnos a partir del uso de esta herramienta.” [17]
  35. “Se considera que la unión de una o varias herramientas a la realidad aumentada podrían generar mejor obtención de resultados independientemente del área de aplicación a la que sea sometida esta tecnología.” [17]
  36. “En el caso de las Ciencias de la Educación llevar a cabo estudios como este presenta como principal limitación, el desconocimiento que tanto docentes en ejercicio como en formación puedan presentar ante las herramientas digitales que van apareciendo en la sociedad y que los estudiantes incorporan a su vida cotidiana de manera natural.” [18]
  37. “La RA puede provocar en los estudiantes la curiosidad y sorpresa por aprender, elementos claves en la etapa de infantil, momento en el que las actitudes, aptitudes, estereotipos, valores, creencias, etc. van cobrando forma. En consecuencia, es relevante la visión que tienen los maestros en formación en torno a esta herramienta catalogada como emergente ya en 2012” [18]
  38. “Results from the survey imply that students show significantly improved results in increasing the interest, understanding and interiorizing the learning material. University teachers found that using augmented reality is significantly improving the learning process of students and their teaching process in a pedagogical and technical sense.” [19]
  39. “Gracias a la realidad aumentada se puede realizar un seguimiento de las partes del cuerpo, con imágenes, referencias, añadir contenidos multimedia interactivos para hacer la transferencia de conocimientos de una manera más potente.” [20]
  40. “Las soluciones educativas AR-VR representan una nueva frontera, no sólo en la enseñanza, sino incluso en el trabajo y la investigación. Hay un campo amplio por descubrir con el fin de averiguar cómo influyen estas aplicaciones de educativas interactiva en tiempo real en procesos cognitivos y emocionales durante nuestras actividades de aprendizaje.” [20]

### 3.2 Realidad Virtual

## 4 Resultados

Se encontraron 40 artículos referentes al tema, entre los cuales, destaca la postura o iniciativa de tecnología en la que se describe un método como lo plantean los autores x, y, y z. A partir de lo cual, se reconoce que. . .

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