Educational Revolution: Study on The Impact of Interactive Video in the Teaching of Scientific Subjects

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Abstract. The rapid expansion of interactive video in the educational sector is creating a growing demand to extract meaningful information from this dynamic visual content. Advances in the field of interactive video make it possible to fully exploit these visual resources to enhance the educational experience.
This study focuses on the integration of interactive video to enrich the learning of science subjects for students at the higher normal school of Tetouan. The aim is to provide quality education using interactive videos to stimulate student engagement and improve academic performance. The use of interactive videos offers an innovative approach to engaging learners, taking into account various aspects such as learning preferences, academic interactions and student behaviors.
The necessary data were collected through questionnaires and the institution's academic section (HNS). A process of data pre-processing and analysis was undertaken to eliminate inconsistencies, reduce data complexity and identify the most relevant features in the context of interactive video. This approach aims to optimize the use of interactive video in education, opening up new perspectives for improving the quality of learning processes words.

Keywords: Interactive Video, Scientific Material, Performance, Higher Education.

1 Introduction:

In the midst of the technological revolution, interactive videos are emerging as a disruptive force. As technology continues to transform the way we learn, interactive videos represent an innovative convergence between traditional "conventional" videos and interactive technologies[1]. Interactive video refers to a multimedia format that enables two-way communication between viewer and content, promoting engagement and participation[2]. By involving traditional video elements with interactive features such as clickable zones, questionnaires, quizzes or decision points, improved user engagement and learning experiences are observed [3]. This creative fusion of text, images, sound,

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video and animation offers a new dimension to learning and engagement, transforming viewers from passive observers into active participants[4].. This form of video technology is attracting growing interest and can be used in a variety of fields, including education[5].

In the educational field, interactive videos have shown great potential for enhancing learning experiences, enabling students to actively engage with the material and fostering deeper understanding and retention of information. [6] What's more, interactive videos can cater to different learning styles and preferences, offering a more personalized learning experience. Students can navigate content at their own pace, revisiting sections as needed and choosing paths that match their interests or learning goals. This adaptability can lead to increased student satisfaction and better learning outcomes[7].

From general education to higher education, interactive videos have proven their effectiveness as a dynamic pedagogical tool. Their positive impact on learning in the university setting can be seen in the improvement of the learning process and the promotion of academic inclusion [8]. In addition, the integration of interactive elements in educational videos can enhance student motivation, facilitating a differentiated approach to teaching academic subjects [9]. This trend towards the use of interactive videos is also reflected in higher-level science subjects [10]. Their adaptation in these fields opens up new prospects for immersive, hands-on learning [11], enabling students to explore complex scientific concepts interactively [12]. By integrating interactive elements into fields such as physics or chemistry, these videos offer students the chance to virtually manipulate complex concepts, visualize abstract phenomena, simulate laboratory experiments, explore scientific phenomena in depth and acquire understandings of theories and practical applications [13]. Thus, interactive videos are becoming an essential pillar for enhancing the understanding and application of scientific knowledge at university level[14].

Despite the potential benefits, the integration of interactive video into the teaching of science subjects has limitations that require careful attention and consideration. Indeed, studies generally focus on a particular university level or a specific institution, potentially limiting the applicability of results to other student populations or other subjects [15]. In addition, the limited number of samples may compromise the statistical power of the study and hamper the generalization of results [16]. In addition, technological constraints such as access to the Internet and compatible devices can limit the scope for using interactive videos in certain educational contexts [17]. In response to these challenges, this article proposes to explore strategies for optimizing the use of interactive video in education, opening up new perspectives for improving the quality of learning processes. This research question will guide the entire study:

What are the best practices for designing and integrating interactive videos into online educational environments to enhance learner engagement and optimize learning outcomes?

2 Research Methodology :

The methodology implemented for this study on the impact of interactive video in science education was structured to ensure the validity and reliability of the results. This methodology was based on a multidisciplinary approach to comprehensively address the cognitive, pedagogical and technological dimensions of this issue. Initially, the study sample was made up of 344 students enrolled in the Bachelor of Education program at HNS in Tetouan. These students were selected at random in order to represent a diversity of skill levels in scientific subjects. The sample was representative of different fields of scientific study, to ensure adequate representativeness of the university student population. The participants were drawn from a variety of educational science degree courses. This diversity within the sample was intended to enable in-depth analyses of the potential impacts of using interactive video in the teaching of science subjects.

First, a questionnaire was developed to gather quantitative data on students' perceptions of the use of interactive video in learning science subjects. The questionnaire was designed taking into account the main theoretical concepts, the issues involved in integrating interactive video into teaching, and the variables relevant to assessing the effectiveness of this teaching method. The questionnaire yielded quantitative data rich in insights and perspectives. Next, an experimental methodology was developed to evaluate the effectiveness of interactive video compared with traditional teaching methods. This methodology included the design and production of interactive videos adapted to each scientific subject studied, as well as the selection of a representative sample of students to take part in the experiment.

Participants were randomly assigned to two groups: an experimental group exposed to interactive video instruction and a control group receiving traditional textbook and lecture-based instruction. This approach enabled direct comparison of the relative effectiveness of the two teaching methods, controlling for potentially disruptive variables. Quantitative and qualitative measures were used to assess the academic performance, knowledge retention and engagement of participants in both groups. At the same time, data were collected on students' perceptions and attitudes towards the use of interactive video in their learning. Questionnaires and observations were used to collect this data, which was analyzed qualitatively to identify trends and emerging themes.

Finally, the results of the study were statistically analyzed to determine whether the use of interactive video had a significant impact on participants' academic performance and engagement in learning science subjects. The findings of this analysis have been used to draw out pedagogical implications and suggest recommendations for the effective integration of interactive video into the teaching of science subjects, thus contributing to the ongoing educational revolution.

3 Results of the Data Analysis :

In the table below (see table 1), a comparative study was carried out between the experimental group, exposed to teaching using interactive videos, and the control group who followed traditional teaching methods. The results were analyzed using the t-test, based on the answers obtained in the questionnaire.

Table 1. Comparative analysis of questionnaire scores between experimental and control groups

	Group	N	Mean	SD	t	p
Questionnaire results	Experimental group	173	16,805	,1801	11,380	,000
	Control group	171	14,523	,1612	11,392	,000

The results presented were examined by assessing participants' perceptions and performance with regard to the use of interactive video in the teaching of science subjects, comparing two distinct groups who had followed two different teaching methods.

The experimental group, exposed to the use of the experimental method, had a higher mean score than the control group. These differences in means are confirmed as significant with p-values below 0.001, indicating that the results are not the result of chance, but of the intervention of the experimental method. Furthermore, the standard deviations for each group show some dispersion of the data around the mean, but this dispersion is relatively similar between the two groups. As the t-values are also similar, this suggests that the differences observed between the two groups are consistent. In summary, these results highlight the effectiveness of the experimental method in improving participants' performance compared with traditional methods, offering support for its adoption in science subject teaching.

In the following table (see table 2), a new criterion has been studied, namely the effect of the experimental method involving the use of interactive videos in the teaching of science subjects, compared with traditional teaching methods, on participants' perceptions and performance.

Table 2. Comparison of results obtained between the experimental and control groups in the experimental method study

	Group	N	Mean	SD	t	p
Results of the experimental method	Experimental group	173	16,524	,1514	12,543	,000
	Control group	171	14,201	,1202	12,461	,000

The results presented in the table show the performance of participants in the study, where the efficacy of the experimental method is assessed against a control group. The experimental group, exposed to the experimental method, outperformed the control group. These differences in means are statistically significant, with p-values below 0.001, indicating that the results are not attributable to chance, but are the result of the intervention of the experimental method. Furthermore, the standard deviations for each group show some dispersion of the data around the mean, but this dispersion is relatively similar between the two groups. The t-values, which measure the difference between the means of the two groups, are also similar. In summary, these results highlight the effectiveness of the experimental method in improving participants' performance compared with traditional methods, thus providing support for its adoption in science subject teaching.

4 Discussion and Conclusion :

The results shed light on participants' perceptions and attitudes towards the use of interactive video in the teaching of science subjects, comparing two groups with different teaching methods.

Firstly, average questionnaire scores in the experimental group were significantly higher than in the control group, highlighting the positive impact of using interactive video on students' perceptions and performance towards their science subject learning experience. Secondly, a significant difference was observed in the standard deviations between the two groups, underlining the importance of considering this difference when interpreting the data. In addition, t-values were similar in both groups, reinforcing the consistency of the impact of the teaching intervention. Finally, p-values below 0.001 confirm the statistical significance of the differences observed, underlining that the differences in participants' perceptions and attitudes are not random, but the result of the pedagogical intervention.

The study results reveal significant differences between the experimental and control groups. In terms of mean, the experimental group showed a higher mean, highlighting higher mean scores among participants exposed to the experimental method, reflecting more favorable perceptions and attitudes towards this approach. In terms of standard deviation, there was a notable difference between the two groups, with a larger standard deviation in the experimental group, highlighting a different dispersion of data between the two groups, and greater variability in the responses of participants in the experimental group. Furthermore, the closeness of the t values suggests comparable differences between the means of the two groups, reinforcing the reliability of our conclusions. Finally, p-values of less than 0.001 in both groups confirm the significance of the differences observed, supporting the idea that these divergences in perceptions and attitudes are not random but due to the intervention of the experimental method.

The results obtained from this study are consistent with many previous studies, such as those conducted by Kulkani. [18], Sulistya et al. [19],Fitria et Susanto. [20] and Ramasany et al. [21], who have converged on the common conclusion that interactive videos represent an effective pedagogical tool for teaching science subjects. Not only do they promote student interest and engagement, but their understanding of scientific concepts, resulting in a significant improvement in their learning outcomes.

In conclusion, the results underline the effectiveness of using interactive video in teaching science subjects, promoting more positive perceptions and performance among students. These results offer valuable insights for the integration of new technologies into the educational process, and underline the importance of taking differences in data dispersion into account when analyzing the results.

Despite attempts to mitigate the above limitations, it should be noted that certain constraints persist and require particular attention when interpreting the results. Firstly, the study took place at a single specific institution (HNS), which hinders the generalizability of the findings to other academic institutions. In addition, the research was limited to assessing the effectiveness of interactive videos in science learning, without considering other factors that may also influence learning outcomes. In addition, important aspects such as undergraduate students' skills and attitudes were not explored, highlighting the need for further studies in these areas. Finally, it is possible that the study was affected by response bias or distortions in participants' answers to questionnaires, which could have altered the results obtained. Furthermore, future studies would explore differences in the effectiveness of the experimental method according to individual student characteristics, as well as investigating its long-term impact on the learning of science subjects and overall academic performance.

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