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ORIGINAL STUDY

The Enhanced Booklet Technique and Its Impact on Learning Outcomes in the Motor Education Course

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Abstract

This study aims to examine the effect of enhanced Booklet Technique on the learning outcomes of the motor education course. The researchers adopted a quasi-experimental methodology employing a two-group post-test design, with one experimental and one control group. The sample, randomly selected, consisted of 120 first-year students from the Faculty of Physical Education at the University of Sadat City during the academic year 2023/2024, representing 16.74% of the total population. The participants were divided equally into an experimental group (n = 60) and a control group (n = 60). An additional exploratory sample of 60 students (8.37% of the total population) was drawn from outside the primary study sample to pilot the research tools and assess the feasibility of implementing the enhanced booklet. Data collection and analysis relied on instruments such as the Mental Ability Test (intelligence test, not "scale") and a perception and attitude questionnaire regarding the use of enhanced Booklet Technique. Findings indicated statistically significant differences in the post-test results of both groups in favour of the experimental group in cognitive achievement—both oral (improvement rate = 52.38%) and written tests (improvement rate = 41.15%)—as well as in the practical performance dimension of the motor education course (improvement rate = 49.74%). Furthermore, student perceptions within the experimental group reflected strong positive attitudes toward the enhanced booklet, with approval rates ranging from 97.00% to 100.00%. These findings affirm the efficacy of the enhanced booklet in promoting affective engagement and improving students' attitudes toward the motor education course.

Keywords: Enhanced booklet technique, Learning outcomes, Motor education

1. Introduction

Augmented reality plays a significant role in the educational process and is considered one of the recent technological innovations that have rapidly gained prominence across various educational domains. Numerous educational institutions and universities have adopted augmented reality as a tool to enhance teaching and learning. This technology contributes to the advancement of the educational process, as it is among the most effective means of supporting learners. It aids in the visual perception of information, improves academic achievement, and provides content through diverse, accessible, and rapid methods. As a result, learners are better able to interact with and comprehend information in a more dynamic and visually intuitive manner (Billinghurst and Duenser, 2012; Chen and Tsai, 2012).

Augmented reality is a three-dimensional technology that merges real and virtual environments—that is, it integrates both physical and virtual elements—and enables real-time interaction while the individual performs an actual task. The result is a composite display that blends the real-world scene perceived by the learner with a computer- or mobile-generated virtual scene, which enhances the real view with additional information. This creates an immersive experience in which the user feels as though they are interacting with the real world rather than a simulated one (Khamis, 2015). With the rapid advancement of augmented reality technologies, a new concept has emerged: augmented reality books and their integration into the educational process.

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The study by McKenzie and Darnell (2003) highlighted the importance of using enhanced books in developing various skills among learners. It emphasized that such books contribute to promoting collaboration among students, increasing their motivation, enhancing academic achievement, and fostering interaction between the learner and their surrounding environment. Moreover, enhanced books play a vital role in revitalizing both traditional and electronic books.

The textbook remains the most widely used tool in the educational process and is considered one of the most critical inputs in learning. It serves as a fundamental resource in educational subjects. However, with the current wave of technological advancement, learners have increasingly gravitated toward digital books. As a result, the traditional textbook requires substantial technological support through the integration of digital media with its printed pages.

With the growing adoption of augmented reality technology across various fields—particularly in education—what is now known as augmented reality books has emerged. These books integrate traditional print materials with virtual content. Augmented books are among the most widespread and successful applications of augmented reality in education. They provide students with two-dimensional and three-dimensional digital presentations, as well as interactive learning experiences, through augmented reality technologies. These printed books are enhanced using technological devices such as smartphones and specialized AR glasses. They contain augmented reality elements that, when viewed through a camera, interact with the real-world environment. In doing so, the books are brought to life by the digital addition of interactive, animated models presented in the form of texts or illustrations originally embedded in the traditional printed material (Zhang and Cristol, 2019).

Kesim and Ozarslan (2012) stated that "augmented books are printed on paper, but when a smartphone camera is directed at them, virtual elements appear. These elements may include three-dimensional graphics, videos, and various multimedia types involving different forms of interaction, thereby creating a connection between the real and virtual worlds. This integration renders information more dynamic" (p. 300).

The use of augmented reality books has been found to help overcome various educational challenges faced by learners. According to a study by Cheolil and Taejung (2011), augmented books contribute to enriching the educational process by encouraging learners to read, comprehend, focus, and engage in problem-solving. Similarly, Bacca et al. (2014) argued that augmented books have the potential to make learners more engaged and motivated to explore learning resources and experiences, applying them meaningfully to real-world contexts. The technology of augmented books can be employed to engage all human senses, thereby making learning more enjoyable and immersive.

Kazanidis et al. (2018) indicated that the use of augmented books in the educational process offers a range of advantages, most notably the enhancement of printed books with three-dimensional objects, images, illustrations, audio clips, video segments, and various multimedia elements. They noted that among the most frequently used digital components in augmented books are educational videos. The authors emphasized the importance of considering design variables related to the integration of video within the augmented reality framework.

Augmented books have been defined as "books that bridge the gap between the real world and the virtual world by incorporating multimedia elements, including 3D animations, video clips, and audio. By directing a smartphone camera at specific codes printed on the pages, learners can view images, illustrations, and video content" (Yuen, Yaoyuneyong, and Johnson, 2011, p. 122).

An augmented book is also defined as "a fusion between the printed book and mobile phone technology, aimed at utilizing multimedia as enhanced digital content. Learners can access the augmented book by pointing their smartphone camera at a barcode to explore the digital content, which may include two-dimensional or three-dimensional animations or video" (Saraubon & Kobkiat, 2011, p. 34).

The findings of numerous studies have confirmed the importance of using augmented books and their effective impact on developing various learning outcomes. Among these are the studies conducted by Yilmaz, Kucuk, and Goktas (2017); Dong and Si (2018); Lou (2019); and Attia (2019). The preceding discussion suggests that, in the coming decades, augmented books may replace both printed and electronic books.

Motor education is considered one of the most effective programs within physical education for achieving the goals of general education in its comprehensive sense. It represents one of the most effective instructional approaches during early childhood and primary education. This necessitates greater efforts to establish a scientifically organized framework for designing motor education programs with precision, as well as for preparing motor education teachers with proper training, high instructional quality, and advanced teaching competence (Fahim and Taha, 2015).

The motor education course, both theoretical and practical, is inherently engaging as it introduces students to the methods and strategies for teaching and interacting with children in kindergarten and the first

three grades of primary education. Despite the implementation of various approaches aimed at improving students' performance in both cognitive and practical domains, their outcomes have not met expectations. This shortfall is attributed to several factors, including limited class time, increasing student numbers, and the nature of the course content, which encompasses a wide range of practical and theoretical experiences and knowledge. These are primarily delivered through printed textbooks that lack interactivity and fail to provide practical models for the course's applied components. Consequently, these limitations have hindered students from achieving the desired level of performance.

Therefore, this study emerged with the aim of examining the impact of enhanced Booklet Technique on learning outcomes in the motor education course.

1.1. Research objective:

This study aims to examine the enhanced booklet technique and its impact on learning outcomes in the motor education course among first-year students at the Faculty of Physical Education, Sadat City University.

2. Research hypotheses

The study is based on the following hypotheses:

1. There are statistically significant differences between the post-test results of the experimental and control groups in cognitive achievement in the motor education course, in favor of the experimental group.
2. There are statistically significant differences between the post-test results of the experimental and control groups in the implementation of the practical aspect of the motor education course, in favor of the experimental group.
3. There is variability in the emotional impressions and attitudes of the experimental group students regarding the use of enhanced Booklet Technique.

3. Research terminology

3.1. Enhanced booklet technique:

It is a fusion of printed booklets and mobile technology, aimed at integrating multimedia as augmented digital content. Learners can interact with the enhanced booklet by pointing their mobile phone cameras at a barcode to access the embedded digital materials, which may include 2D or 3D animations or instructional videos.(Kazanidis et al., 2018)

3.2. Methodology and procedures:

3.2.1. Research methodology

The researchers employed a quasi-experimental approach deemed suitable for the nature of the study and its sample. The design comprised two groups: an experimental group and a control group, with post-measurements applied to all research variables.

Table 1. Classification of the Research Sample into the Study Groups Under Investigation.

Sample Type	Study Groups	Number	Percentage (%)
Main	Experimental Group	60	66.67
	Control Group	60	
Pilot Group		60	33.33
Total		180	100%

3.2.2. Research population and sample

3.2.3. Research population

The research population consisted of 717 first-year male students enrolled at the Faculty of Physical Education, University of Sadat City, during the academic year 2023/2024.

3.2.4. Research sample

The research sample was purposively selected from first-year students enrolled in the Faculty of Physical Education at Sadat City University during the 2023/2024 academic year. The total number of participants was 120 students, representing 16.74% of the overall population. These students were randomly divided into two equal groups: a control group consisting of 60 students, and an experimental group also comprising 60 students as shown in Table 1. In addition, a separate sample of 60 students—equivalent to 8.37% of the total research population—was drawn from outside the primary research sample to serve as a pilot group. This group was used to conduct the scientific procedures related to the research tools, test the applicability of the enhanced booklet, and identify any potential issues.

Accordingly, the total number of students involved in the research amounted to 180, representing 25.10% of the overall study population. The following table presents a detailed breakdown of this distribution.

4. Statistical normalization of the research sample

To confirm that the sample followed a normal distribution, skewness coefficients were calculated for

Table 2. Mean, Standard Deviation, Median, and Skewness Coefficient of Growth Indicators (Age, Height, Weight, Intelligence) for the Research Population (N = 180).

No.	Variables	Unit of Measurement	Mean	SD	Median	Kurtosis	Skewness Coefficient
1	Age	years	19.72	0.59	20.00	–0.553	0.171
2	Height	cm	176.45	7.14	175.00	0.261	0.882
3	Weight	kg	71.65	6.87	70.50	–0.445	0.028
4	Intelligence	score	66.29	4.22	67.00	–0.800	–0.012

Table 3. Significance of Differences Between the Means of the Two Research Groups ($n_1 = n_2 = 60$).

		Experimental Group		Control Group			
No.	Variables	–M	±SD	–M	±SD	MD	Calculated t-value
1	Age	19.68	0.60	19.65	0.58	0.03	1.43
2	Height	175.73	6.49	176.00	7.23	0.27	0.20
3	Weight	72.10	6.81	70.02	7.34	2.08	1.62
4	Intelligence	67.32	4.59	66.13	4.15	1.18	1.59

The tabulated *t*-value at degrees of freedom (df) = $(n_1 + n_2) - 2 = 118$ and at a significance level of 0.05 is 1.98.

the growth indicators (age, height, weight, and intelligence).

Table 2 shows that the skewness coefficients for the selected growth indicators—age, height, weight, and intelligence—ranged between ±3, with values falling between –0.012 and 0.882. Additionally, kurtosis values ranged between ±7, with values between –0.800 and 0.261. These results indicate that the distribution of the selected sample across the research groups in terms of the growth indicators—age, height, weight, and intelligence—was normal, suggesting that the data follow a normal distribution and fall within the standard curve.

4.1. Equivalence of the research groups

To ensure the similarity of levels between the experimental and control research groups in the selected growth indicators—age, height, weight, and intelligence—and to control for differences between the two groups, the researchers calculated the equivalence between them. This is presented in the following table.

Table 3 shows that the calculated t-values are lower than the tabulated t-value for all the examined variables. This indicates that there are no statistically significant differences between the experimental and control groups in the selected growth indicators—age, height, weight, and intelligence. Accordingly, the two research groups can be considered equivalent.

4.2. Data collection tools

The researchers employed the following tools to collect and analyze the data:

- Analysis of relevant literature and scientific studies related to physical education teaching methods.
- Mental Ability (Intelligence) Test.
- Questionnaire on students' attitudes and impressions toward the use of enhanced Booklet Technique.

The following is a detailed explanation of each of the aforementioned steps:

1. **Data analysis:** This involved reviewing reference studies, scientific research, scholarly publications, and conference proceedings, as well as consulting relevant academic sources—both Arabic and foreign—pertaining to the subject of the study. Additionally, references specific to methods and strategies of teaching physical education were examined.
2. **Assessment of cognitive abilities (Intelligence)**
   The researchers administered the Verbal Intelligence Test for secondary and university levels, developed by Jaber Abdel Hamid and Mahmoud Ahmed Omar (2007). This test has been widely utilized in various studies across diverse samples, and its validity and reliability in measuring the intended construct have been well established.

4.2.1. Scientific properties of the intelligence test:
4.2.2. Discriminant validity via the extreme groups method:

The researchers employed the method of discriminant validity using the extreme groups comparison technique between the upper and lower quartiles of a single group. A t-test was used to determine statistical differences, as illustrated in the following table.

Table 4. Significance of Differences Between the Upper and Lower Quartiles on the Intelligence Test $n_1 = n_2 = 15$.

	Upper Quartile $n_1 = 15$		Lower Quartile $n_2 = 15$		Mean Difference	Calculated
Variables	M	± SD	M	± SD	MD	t-value
Intelligence Test	70.00	2.75	60.87	1.13	9.13	18.06

Table 5. Reliability Correlation Coefficient Between the First and Second Administrations of the Intelligence Test n = 60.

	First Administration		Second Administration		Calculated Correlation
Variables	M	± SD	M	± SD	Coefficient ("r")
Intelligence Test	65.42	3.74	65.45	3.98	0.917

*Tabulated "r" at df = n – 2 = (58), significance level (0.05) = 0.250

The tabulated *t*-value at a degree of freedom (df) of $(n_1 + n_2) - 2 = 28$ and a significance level of 0.05 is 2.048.

Table 4 shows that the calculated *t*-value is less than the tabulated *t*-value for the intelligence test under investigation, indicating that the *t*-value is statistically significant. This result points to the existence of differences between the upper and lower quartiles, in favor of the upper quartile. Accordingly, the intelligence test demonstrates the ability to discriminate among individuals, thereby confirming the validity of the test in measuring the construct for which it was designed.

4.2.3. Reliability coefficient of the intelligence test:

The reliability of the intelligence test was calculated using the test-retest method. The test was administered twice to a pilot sample consisting of 60 first-year students who were not part of the primary research sample. The time interval between the two administrations was seven days. The first administration took place on Thursday, February 29, 2024, and the resulting scores were used in the validity calculations. The second administration occurred on Thursday, March 8, 2024. The Pearson correlation coefficient was used to determine the reliability between the two sets of scores. The following table presents the reliability coefficient of the intelligence test under investigation.

The tabulated "r" value at df = 58 and a significance level of 0.05 is 0.250.

As shown in Table 5, the calculated "r" value exceeds the critical "r" value for the intelligence test, indicating that the correlation is statistically significant. This suggests a positive relationship between the first and second administrations of the test, thereby confirming the reliability of the instrument.

4.2.4. The opinion and impression questionnaire on the use of enhanced booklet technique

The finalized version of this questionnaire consisted of ten statements designed to assess the perspectives and attitudes of students in the experimental group regarding the integration of enhanced Booklet Technique into the Motor Education course.

Procedures for Developing the Opinion and Impression Questionnaire on the Use of Enhanced Booklet Technique and Its Impact on Selected Learning Outcomes in the Motor Education Course (Prepared by the researchers)

To construct a scientifically valid and pedagogically relevant tool for evaluating students' perceptions of the enhanced Booklet Technique and its effect on specific learning outcomes within the Motor Education course, the researchers employed a rigorous, multi-step methodology. These steps included an extensive review of prior literature, consultation with subject matter experts, alignment with contemporary pedagogical standards, and iterative refinement through pilot testing to ensure both content validity and reliability.

4.2.5. Formulation and definition of the statements:

Guided by the research title and its primary objective, and grounded in relevant academic literature and prior reference studies, a set of statements was carefully formulated to reflect students' perceptions regarding the use of enhanced Booklet Technique and its impact on selected learning outcomes in the Motor Education course.

To ensure methodological appropriateness, the researchers employed the five-point Likert scale, which was deemed suitable for the nature and goals of the study.

4.2.6. Scientific validation of the opinion and perception questionnaire:

- Expert Validity (Content Validity): The questionnaire was submitted to a panel of three experts from the Department of Curriculum and Instruction in the Faculties of Physical Education (see Appendix 1). Their input was solicited to assess the suitability of the questionnaire for student respondents, particularly regarding the clarity,

accuracy, and appropriateness of each statement. The experts were also invited to recommend modifications, deletions, or additions to improve the instrument. Based on their feedback, minor revisions were made to the wording of several statements. The experts' approval ratings for the final set of items ranged from 90% to 100%.

- Reliability of the Questionnaire: To determine the reliability of the instrument, the researchers employed the test-retest method. The questionnaire was administered to students in the experimental group following two weeks of exposure to the enhanced Booklet Technique. The first administration took place on Thursday, February 29, 2024, and the second on Thursday, March 8, 2024—allowing for a six-day interval between the two applications. The reliability coefficient was then calculated based on the responses from the same experimental group to ensure consistency and dependability of the instrument.

Table 6. Correlation Coefficient Between the First and Second Administrations of the Scale Measuring Opinions and Perceptions Toward the Use of Enhanced Booklet Technique and Its Impact on Selected Learning Outcomes in the Motor Education Course (N = 60).

Variables	r-value
Opinions and Impressions Scale Regarding the Use of Augmented Booklet Technique and Its Impact on Learning Outcomes in the Motor Education Course	0.726

The tabulated r-value at df: N–2 = (58), significance level (0.05) = 0.254

It is evident from Table 6 that the calculated Pearson correlation coefficient "r" is less than the critical value, indicating a statistically significant correlation between the first and second application of the opinion and perception questionnaire regarding the use of the augmented booklet technique and its impact on certain learning outcomes in the motor education course. This signifies the existence of a strong correlation between the two applications.

4.3. Steps for developing the augmented booklet technique for the motor education course

The researchers reviewed several instructional design models to inform the construction of their own model for designing augmented reality-based educational content. The process included the following phases:

4.3.1. First: Analysis phase

This stage includes the following steps:

1. **Defining the general objective:** The overarching goal is to utilize the augmented booklet technique and examine its influence on selected learning outcomes in the motor education course.
2. **Analysis of learner characteristics:** This is one of the most crucial steps in instructional design. The learners in question are first-year students in the Faculty of Physical Education with no prior experience related to the subject (motor education course). The researchers considered the students' needs and characteristics to ensure compatibility with the augmented booklet and its components, aligning with the intended educational objectives.
3. **Determining environmental requirements:**

- The traditional textbook.
- The booklet using augmented reality technology.
- Defining the technological infrastructure: This involves ensuring that students possess mobile phones, as these serve as the primary devices for downloading the augmented reality applications. It was confirmed that all students owned mobile phones and had active internet subscriptions on their devices.

4. **Content specification:** The content was determined based on the official course description of the motor education subject taught to first-year male students at the Faculty of Physical Education, University of Sadat City, encompassing both theoretical and practical components.

4.3.2. Second: Design Phase

1. **Designing multimedia elements for delivery via the augmented booklet**

The researchers developed a list of multimedia components to be included in the augmented booklet, tailored to support the content of the Motor Education course. These components comprised images, videos, concept maps, infographics, quizzes, and various types of questions. The material was divided into two parts: theoretical content and practical application.

2. **Designing interactive interfaces**

The interactive interface consisted of the augmented booklet pages that allowed students to engage directly with the content. In designing these interfaces, the researchers integrated textual content and QR codes (barcodes) that, when scanned using a mobile phone camera, would display instructional videos, provide detailed audio explanations of educational elements, or present static infographics and concept maps. Students could also access knowledge tests and answer questions through these interfaces.

A prototype of the augmented textbook content was designed, including the placement of QR codes linked to the chosen augmented reality application, as well as preliminary outlines of activities and assessment tools.

4.3.3. Third: Production and development

1. **Initial scenario planning**

At this stage, the researchers drafted a scenario for the augmented booklet, outlining its content and specifying what the learner would see on their smartphone screen upon scanning the barcode.

2. **Production of multimedia content for the augmented booklet**

Once the necessary multimedia elements were identified and categorized to align with the learning objectives—whether sourced from the internet or custom-designed by the researchers—all selected media were produced and prepared. Each item was then linked to a specific barcode, which, when scanned with a mobile phone, displayed the media in a detailed and interactive format.

3. **Production of educational content and activities**

The instructional content and activities were developed in alignment with the learning objectives defined in the official course description for the Motor Education curriculum at the Faculty of Physical Education, Sadat City University.

4. **Development of interactive interfaces and user interactions**

The augmented booklet was created to include text, images, illustrations, and QR codes. When learners pointed their mobile phone cameras at these codes, virtual information would appear in the form of interactive multimedia, such as video explanations, concept maps, quizzes, or detailed textual explanations.

4.3.4. Fourth: Implementation and evaluation

4.3.5. Testing the augmented booklet technique:

At this stage, the researchers conducted a pilot study using a sample of 60 participants drawn from the same population but outside the primary research sample. The purpose of this step was to assess the feasibility of applying the augmented booklet, identify any issues that might arise during its implementation, and ensure the accuracy and reliability of the instruments. This preliminary testing served to validate the tools and confirm their suitability for use in the main experimental study.

4.3.6. Steps for conducting the research experiment:

- **Meeting with the students:** A meeting was held with the first-year students selected for the study sample, during which the researchers explained the significance and potential benefits of the research. They emphasized that the study aimed to enhance the students' performance in both cognitive achievement and the practical application of the Motor Education course, ultimately contributing to a more effective and rewarding learning experience.
- **Pre-measurements:** The researchers conducted pre-measurements for the variables under investigation—growth indicators (height, weight, and age) and the intelligence test—across the control, experimental, and pilot groups. These assessments were carried out on Thursday, February 15, 2024.
- **Main study:** Instruction was delivered to the students on campus according to the predetermined academic schedule, with sessions held once a week—specifically on Thursdays—from February 15, 2024, to May 3, 2024. During this period, the experimental group received instruction using the augmented booklet, while the control group, along with the rest of the cohort, was taught using the conventional instructional method.
- **Post-testing:** The post-test assessment was administered to evaluate students' performance in the practical component of the Motor Education course on Sunday and Wednesday, May 12 and 15, 2024, by an examination committee comprising faculty from the Department of Curriculum and Instruction, Training, and Motor Behaviour at the Faculty of Physical Education–Sadat City University. The opinion and impression survey were conducted with the experimental group on Thursday, May 16, 2024. Additionally, data were collected from oral examination scores administered alongside the practical exam, as well as from the final written examination held at the end of the second semester of the 2023/2024 academic year, which took place on Tuesday, June 5, 2024.

4.3.7. Sixth: Statistical treatments

The researchers employed statistical methods appropriate to the nature of the study using the Statistical Package for the Social Sciences (SPSS). The following statistical treatments were applied:

- Arithmetic mean
- Standard deviation
- Median
- Skewness coefficient

Table 7. Statistical Significance of Differences Between the Post-Test Mean Scores in the Cognitive Achievement Level of the Motor Education Course for the Experimental and Control Groups ($n_1 = n_2 = 60$).

Cognitive Achievement in Motor Education Course	Experimental Group		Control Group		Mean Difference (MD)	Calculated "t" Value	Improvement %
	M	± SD	M	± SD			
Oral Test	8.82	0.91	4.20	0.48	4.62	46.98	52.38%
Written Test	25.88	1.35	15.23	1.53	10.65	80.70	41.15%

*Tabulated "t" at df = $(n_1 + n_2) - 2 = (58)$, significance level (0.05) = 2.000

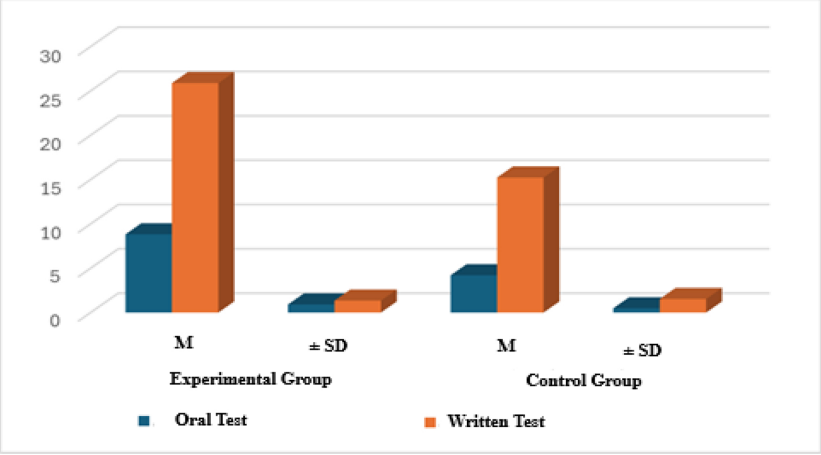

Fig. 1. Illustrates the differences in post-test mean scores between the experimental and control groups in the cognitive achievement level of the Motor Education course.

Presentation and Discussion of Post-Test Results for the Experimental and Control Groups in the Practical Implementation Level of the Selected Motor Education Course (Under Investigation).

- Kurtosis
- Pearson correlation coefficient
- t-test formula (F-test)
- Percentage rates of improvement

5. Results

Presentation and discussion of the post-test results for the experimental and control research groups concerning the level of cognitive achievement in the selected motor education course under investigation.

Table 7 Significance of Differences Between the Post-Test Mean Scores in the Level of Cognitive Achievement in the Motor Education Course for the Experimental and Control Groups. It is evident from Table 7 that the calculated "t" value exceeds the tabulated "t" value in the cognitive achievement level of the Motor Education course. This indicates that the "t" value is statistically significant, reflecting the presence of differences between the post-test measurements in favor of the experimental group. The calculated "t" values ranged between (46.98, 80.70), with an improvement percentage ranging from (41.15% to 52.38%). This is further illustrated in Fig. 1.

It is evident from Table 8 that the calculated "t" value exceeds the tabulated "t" value in the implementation level of the practical component of the Motor Education course. This indicates that the "t" value is statistically significant, reflecting the presence of differences between the post-test measurements in favor of the experimental group. The calculated "t" value reached (149.70), with an improvement percentage of 49.74%. This is further illustrated in Fig. 2.

As shown in Table 7 and Fig. 1, there are significant differences in the post-measurement scores of cognitive achievements in the motor education course in favour of the experimental group. The researchers attribute this improvement to the use of the enhanced Booklet Technique, which contributed to better acquisition of knowledge and skills related to the cognitive content of the motor education curriculum.

This technology created an active learning environment by engaging students in activities that promoted participation rather than passive reception. The enhanced booklet transformed the student from a passive observer into an active learner by incorporating a variety of interactive elements that encouraged students to engage with and respond to the presented content. This interactive experience captured students' attention and heightened their awareness of the key elements of the material, thereby facilitating better information retention and higher levels of cognitive achievement.

Table 8. Statistical Significance of the Differences Between the Post-Test Mean Scores in the Practical Implementation Level of the Motor Education Course for the Experimental and Control Groups ($n_1 = n_2 = 60$).

Variables	Experimental Group M	Experimental Group ± SD	Control Group M	Control Group ± SD	Mean Difference (MD)	Calculated t-value	Improvement %
Practical Component of the Motor Education Course	27.22	1.03	13.68	1.52	13.54	149.70	49.74%

*Tabulated "t" at df = $(n_1 + n_2) - 1 = (59)$, significance level (0.05) = 2.000

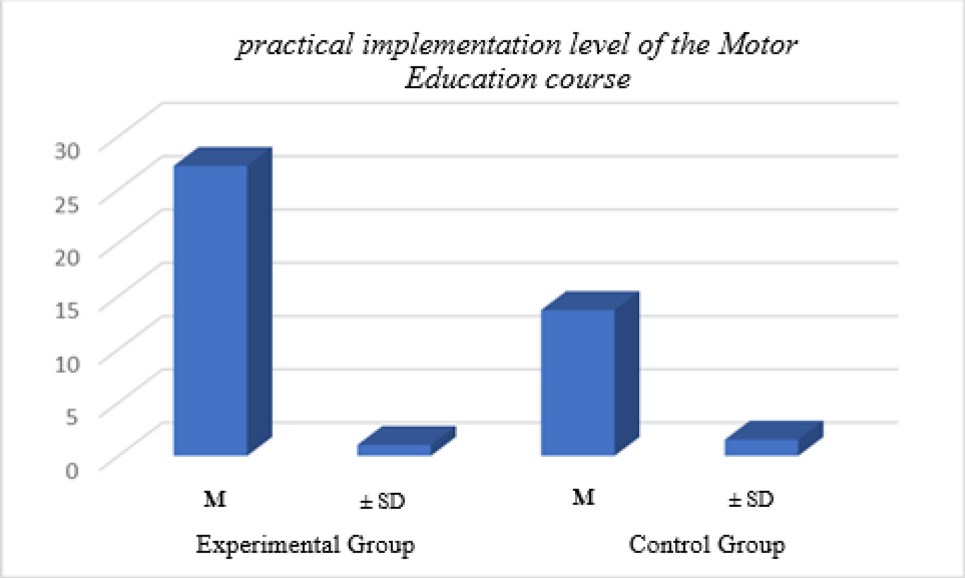

Fig. 2. Illustrates the differences in mean scores between the post-test measurements of the experimental and control groups in the implementation level of the practical component of the motor education course.

Presentation and Discussion of the Results of Variance Percentages in Students' Opinions and Impressions within the Experimental Group on the Opinion and Impression Questionnaire Regarding the Use of the Augmented Booklet Technique and Its Impact on Selected Learning Outcomes in the Motor Education Course.

The augmented Booklet Technique enabled students to merge the real and virtual worlds by allowing them to visualize and interact with virtual objects in real time within their actual learning environment. This capability significantly enhanced students' ability to retain knowledge, improved their perceptual understanding, and deepened their conceptual grasp of the material.

Furthermore, the augmented booklet offered students an engaging and enjoyable learning experience by enabling interactive engagement with the academic content. The digital elements—such as instructional videos, detailed explanations, concept maps, and static infographics—along with the inclusion of formative questions at the end of each topic, allowed students to assess their level of comprehension and understanding. These features collectively facilitated more rapid comprehension and enriched the overall learning experience.

These findings are consistent with those of previous studies (Attia, 2019; Larsen et al., 2011; Chen, Lee, and Lin, 2016; Cheolil and Taejung, 2011; Suleiman, 2017), all of which affirmed the effectiveness of augmented book technology in enhancing students' cognitive achievement.

Accordingly, the first hypothesis is confirmed, which states: "There are statistically significant differences between the post-test results of the control and experimental groups in the level of cognitive achievement in the motor education course, in favour of the experimental group."

Table 8 and Fig. 1 reveal significant differences in the post-measurements of practical performance in the motor education course, favouring the experimental group. The researchers attribute this improvement to the use of the augmented Booklet Technique in implementing the practical component of the course. This technology supported and encouraged students in effectively acquiring the knowledge and skills required for the practical aspect of the curriculum. The augmented booklet created a fully interactive learning environment that enhanced

Table 9. Responses of the Experimental Group Students to the Items of the Opinion and Impression Questionnaire Regarding the Use of the Enhanced Booklet Technique (N = 60).

No.	Statement	To a Very Great Extent	To a Great Extent	To a Moderate Extent	To a Small Extent	To a Very Small Extent	Total Score	Percentage	Rank
1	My use of the augmented Booklet Technique provided me with immediate and continuous feedback during the study of the motor education course.	59	-	1	-	-	298	99.33%	3
2	Utilizing the augmented Booklet Technique supported me in effectively executing the practical component of the course.	56	4	-	-	-	296	98.67%	6
3	The use of the augmented booklet enabled me to enhance my abilities in memory retention, analysis, and application.	53	5	2	-	-	291	97.00%	10
4	This technology helped me gain a better understanding of the cognitive aspect of the motor education course content.	57	3	-	-	-	297	99.00%	5
5	Employing the augmented booklet fostered my awareness of the teacher's positive role in developing motor skills.	54	4	2	-	-	292	97.33%	9
6	The augmented booklet improved my perception of the finer details associated with learning the motor education course.	55	5	-	-	-	295	98.33%	7
7	Using the augmented booklet increased my motivation, as well as the sense of excitement and engagement throughout the course.	60	-	-	-	-	300	100%	1
8	The augmented booklet made me more efficient and enabled me to acquire a greater amount of knowledge in a shorter period of time.	59	1	-	-	-	299	99.67%	2
9	This technology enhanced my cognitive development and understanding within the context of the motor education course.	58	2	-	-	-	298	99.33%	3rd (tied)
10	The augmented booklet helped me recognize and correct the mistakes I made while implementing the motor education lesson.	55	3	2	-	-	293	97.67%	8

student engagement and promoted the acquisition of relevant competencies necessary for successful practical application.

The augmented Booklet Technique delivered the content in a dynamic and sensory-rich format by connecting real-world experiences with virtual environments. This was achieved through the use of instructional videos and applied models that illustrated the execution of various components of a physical education lesson. These tools provided students with a vivid, hands-on learning environment, offering concrete examples of what should be carried out during motor education classes. This approach brought reality closer to the learners, fostering deeper engagement with the presented material and enhancing their attention and awareness of critical content elements. As a result, students were better able to apply the acquired knowledge in instructional contexts, which stimulated their motivation and reinforced their desire to learn and implement what they had studied.

These findings align with previous research highlighting the effectiveness of augmented books and augmented reality technologies in enhancing students' skill acquisition and learning outcomes (Abdel-Halim, 2018; Al-Siyabi, 2024; Chen, Lee, and Lin, 2016; El-Sayed, 2019; Mansour, 2021; Mousa, 2019; Suleiman, 2017).

Accordingly, the second hypothesis is confirmed, which states: "*There are statistically significant differences between the post-test results of the experimental and control groups in the level of practical performance in the motor education course, in favour of the experimental group.*"

Table 9 clearly illustrates the relative significance of the experimental group's opinions and impressions regarding the use of the augmented Booklet Technique, with response percentages ranging between 97.00% and 100.00%.

The researchers attribute these reactions to the augmented booklet's incorporation of various technological media—such as instructional videos, concept

maps, images, and other diverse visual stimuli—which facilitated student engagement, eliminated feelings of boredom and passivity often associated with traditional teaching methods, and increased their enthusiasm and motivation to learn. This, in turn, enabled students to acquire essential knowledge required during the learning process and heightened their drive for learning.

Accordingly, the third and final hypothesis is confirmed, which states: **"There is variation in the emotional opinions and impressions of the experimental group students regarding the use of the augmented Booklet Technique."**

6. Conclusions

In light of the study's objectives and hypotheses, and based on the research sample, the following conclusions were reached:

1. There were statistically significant differences between the post-test results of the control and experimental groups in the level of cognitive achievement (oral and written tests) in the motor education course, in favour of the experimental group that used the augmented Booklet Technique. The improvement rate in the oral test reached 52.38%, while the improvement rate in the written test was 41.15%.
2. There were statistically significant differences between the post-test results of the control and experimental groups in the level of practical application of the motor education course, also in favour of the experimental group, with an improvement rate of 49.74%.
3. The relative importance of the opinions and impressions of students in the experimental group regarding the use of the augmented Booklet Technique ranged between 97.00% and 100.00%, indicating the effectiveness of the augmented booklet in enhancing students' emotional engagement and improving their attitudes toward the motor education course.

7. Recommendations

Based on the findings obtained and in view of the study sample, the researchers propose the following recommendations:

- Organize workshops for faculty members and teaching assistants to train them in the use of augmented Booklet Technique and encourage its integration into the educational process.
- Conduct future studies to examine the effectiveness of augmented reality in teaching various subjects and educational stages, with particular emphasis on higher education learning environments.

Conflict of interest

The authors declare no conflict of interest.

Author contribution

1. Prof. Dr. Magdy Mahmoud Fahim Mohamed: Contributed to the selection and formulation of the research idea, objectives, problem statement, and hypotheses; participated in application and preparation of the final test; performed statistical data analysis; designed tables and graphs; interpreted and commented on the results; contributed to writing the main body of the study.

2. Prof. Dr. Amira Mahmoud Taha Abdel-Rahim: Contributed to the selection and formulation of the research idea, objectives, problem statement, and hypotheses; participated in application and preparation of the final test; developed the booklet; discussed and substantiated the results; formulated conclusions and recommendations; contributed to writing the main body of the study.

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Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Appendix 1: Names of expert reviewers

Experts in the Field of Curricula and Teaching Methods

No.	Name	Job Title
1	Prof. Dr. Iman Hassan Al-Harouni	Emeritus Professor of Teaching Methods, Department of Curricula and Teaching Methods, and Former Dean, Faculty of Physical Education for Girls, Zagazig University.
2	Prof. Dr. Sahar Yousry Sharaf Al-Din	Professor of Motor Education, Department of Curricula and Teaching Methods, Faculty of Physical Education for Girls, Al Jazeera–Helwan University.
3	Prof. Dr. Hala Ahmed Mostafa Al-Kady	Emeritus Professor of Teaching Methods, Department of Curricula and Teaching Methods, Faculty of Physical Education for Girls, Al Jazeera–Helwan University.

Note: Names listed in order of seniority.