

The effectiveness of using asynchronous virtual classrooms on academic achievement in the Advanced Instructional Technology course among fourth-year mathematics students at the College of Education, University of Khartoum

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Abstract

The study aimed to investigate the effectiveness of using asynchronous virtual classrooms on academic achievement in the Advanced Education Techniques course among fourth-year mathematics students at the College of Education, University of Khartoum. The researcher employed a quasi-experimental design, with the research population consisting of fourth-year mathematics students at the College of Education, University of Khartoum. A purposive sample of 40 male and female students was selected and divided into two groups: an experimental group and a control group, each comprising 20 students. Achievement tests were used as the data collection tool, and the data were analyzed using the appropriate statistical methods through the Statistical Package for the Social Sciences (SPSS). The study yielded several results, including statistically significant differences between the means of achievement scores of the experimental group, which studied using asynchronous virtual classrooms, and the means of achievement scores of the control group, which studied through traditional methods in the post-test, in favor of the experimental group. Based on these results, the researcher recommended intensifying the use of virtual classrooms and enhancing their support with necessary modern electronic tools to enhance comprehension abilities and provide alternative educational opportunities for those who have not enrolled in traditional higher education. This would help expand the higher education base in society and apply quality standards to modern information and communication technology, particularly in the teaching field, to enhance the educational process. The researcher also recommended utilizing modern technological means in higher education institutions and electronically disseminating all scientific courses through the international information network to facilitate their exchange. Additionally, conducting training courses and workshops specifically focused on virtual classrooms for both teachers and learners was advised.

Key Words: Virtual classrooms, academic achievement.

فاعلية استخدام الفصول الافتراضية غير المتزامنة على التحصيل الدراسي في مقرر تكنولوجيا التعليم المتقدمة لدى طلاب السنة الرابعة قسم الرياضيات بكلية التربية جامعة الخرطوم.

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المستخلص

هدفت الدراسة إلى التعرف على فاعلية استخدام الفصول الافتراضية غير المتزامنة على التحصيل الدراسي في مقرر تقنيات التعليم المتقدمة لدى طلاب المستوى الرابع رياضيات بكلية التربية جامعة الخرطوم. استخدم الباحث المنهج شبه التجريبي، وتكون مجتمع البحث من طلاب المستوى الرابع رياضيات بكلية التربية جامعة الخرطوم، حيث تم اختيار عينة بطريقة قصدية قوامها 40 طالباً وطالبة تم تقسيمهم إلى مجموعتين مجموعة تجريبية وأخرى ضابطة بواقع 20 طالب وطالبة في كل مجموعة. استخدم الباحث الاختبارات التحصيلية كأداة لجمع البيانات، واتباع الأساليب الإحصائية الملائمة تم تحليل البيانات باستخدام برنامج الحزمة الإحصائية للعلوم الإجتماعية SPSS. خلصت الدراسة إلى مجموعة من النتائج أهمها: توجد فروق ذات دلالة إحصائية بين متوسطات تحصيل درجات المجموعة التجريبية التي درست باستخدام الفصول الافتراضية غير المتزامنة ومتوسطات تحصيل درجات المجموعة الضابطة التي درست بالطريقة التقليدية في الاختبار البعدي ولصالح المجموعة التجريبية. وبناءً على تلك النتائج أوصى الباحث بتكثيف الاهتمام بالفصول الافتراضية وزيادة دعمها بالأدوات الإلكترونية الحديثة اللازمة وذلك لزيادة القدرات الاستيعابية لتوفير فرص دراسية بديلة لمن لم يلتحق بالتعليم العالي التقليدي وتوسيع قاعدة التعليم العالي لدى المجتمع، تطبيق جودة التعليم العالي المعتمدة بصفة أساسية على تكنولوجيا الاتصالات والمعلومات الحديثة وخاصة في مجال التدريس للارتقاء بالعملية التعليمية، الاستفادة من الوسائل التكنولوجية الحديثة في المؤسسات العلمية للتعليم العالي ونشر جميع المقررات العلمية في الصورة الإلكترونية عبر شبكة المعلومات الدولية لتيسير تداولها، عقد دورات تدريبية وورش عمل خاصة بالفصول الافتراضية لكل من المعلمين والمتعلمين.

الكلمات المفتاحية: الفصول الافتراضية، التحصيل الدراسي.

Introduction:

Modern technology and its innovative applications have become an integral part of our contemporary lives, especially in the field of communications and information technology, which has penetrated various domains, breaking down barriers. E-learning has become one of those fields that has benefited greatly from recent technological advancements and diverse means. E-learning complements traditional education with the aim of expanding the scope of education to include a large number of individuals who may not have had a place in traditional higher education. It also equips learners with valuable and diverse skills, aids in developing critical thinking habits, and facilitates the acquisition of scientific content in an easy and simple manner. However, e-learning provides an opportunity for learning without the constraints of time or location. Within its context, e-learning sometimes separates the learner from the teacher, whether in terms of time, place, or both. It utilizes various multimedia as effective channels for delivering education to learners, such as audio, visual, and other electronic and technological tools. E-learning technology, with its modern tools that have made virtual learning environments a fundamental base, is one of the most prominent and rapidly evolving applications of modern technology associated with internet usage. It is an exciting and fast-paced method that allows individuals to interact with both the real and virtual worlds through comprehensive and diverse applications. E-learning provides learners with electronic scientific materials to enable them to learn anytime and anywhere, while also offering an opportunity for effective and distinctive interaction with them. E-learning has become one of the most important requirements for promoting the desired educational process, not only to keep up with technological advancements but also due to its significant importance in the growth and development of educational outcomes. It is an effective and impactful method for providing genuine learning opportunities, especially for workers who have not had the opportunity to obtain formal education and do not have the luxury of dedicating time solely to learning. Virtual classrooms are one of the modern technological techniques that combine e-learning and distance learning. According to Abdul-Mun'im (2003: 20), the goal of virtual classrooms is to create a fertile educational environment with diverse interactive uses and domains between both the teacher and the learner.

Virtual classrooms, as defined by Al-Khalifa (2003), are classrooms where teachers and learners interact through the internet at different times to engage in reading lessons, completing assignments, and accomplishing projects. Salem and Sariya (2003: 382) describe virtual classrooms as electronic rooms that facilitate communication among learners, allowing them to interact with each other and with instructors or supervisors through satellite-connected waves or wires. Rizk defines virtual classrooms as online platforms that provide essential elements for both teachers and learners, employing an interactive learning approach. In this context, Al-Qahtani (2018: 358) views virtual classrooms as the convergence of teachers and learners through the internet at different times to engage in reading lessons, completing assignments, and accomplishing tasks using a range of educational tools that enable direct and interactive learning, similar to traditional education.

Virtual classrooms offer various tools such as audio, video, text chat, interactive whiteboards, application sharing, and instant voting, which facilitate interaction between teachers and learners through web cameras. They also allow the use of emoticons and collaboration in side rooms, enhancing interaction and a sense of belonging to the community (Al-Dismani & Al-Saif, 2018).

With their diverse capabilities, virtual classrooms provide a rich and evolving learning experience, making them prevalent in the field of education. They have different capacities to enhance academic achievement and elevate learners' academic performance. Numerous

studies have shown their high effectiveness when used with learners (Al-Zain, 2019).

Several studies, including Tammam (2018), aimed to design an electronic learning environment based on virtual classrooms to develop teaching skills. Other studies, such as Al-Jader (2019) and Al-Rafai and Al-Ansari (2021), have also emphasized the impact of virtual classrooms on the educational process. Therefore, this study aims to measure the impact of using virtual classrooms on academic achievement in the Advanced Educational Technologies course among fourth-level mathematics students at the College of Education, University of Khartoum.

Study problem

The problem of the study revolves around answering the following main question:

What is the effectiveness of using asynchronous virtual classrooms on academic achievement in the Advanced Educational Technologies course among fourth-level mathematics students at the College of Education, University of Khartoum?

Study Questions:

1. Are there statistically significant differences between the mean scores of the experimental group, which studied using asynchronous virtual classrooms, and the mean scores of the control group, which studied through traditional methods, in the post-test?
2. Are there statistically significant differences between the mean scores of the experimental group, which studied using asynchronous virtual classrooms, in the post-test based on gender?

Study Hypotheses:

1. There are statistically significant differences between the mean scores of the experimental group, which studied using asynchronous virtual classrooms, and the mean scores of the control group, which studied through traditional methods, in the post-test.
2. There are no statistically significant differences, at a significance level of 0.05, between the mean scores of the experimental group, which studied using asynchronous virtual classrooms, in the post-test based on gender.

Study Objectives:

1. To investigate the effectiveness of using virtual classrooms on academic achievement in the Advanced Educational Technology course among fourth-level mathematics students at the Faculty of Education, University of Khartoum.
2. To identify statistically significant differences in the average grades of the experimental group, which studied using asynchronous virtual classrooms, and the control group, which studied using the traditional method, in the post-test.

Importance of the Study:

The importance of this study is determined by:

Theoretical Importance:

1. This study may contribute to the electronic library as an addition.
2. The study may provide educators with the necessary requirements for teaching instructional materials using virtual classrooms.

Practical Importance:

1. This study may benefit students and faculty members who use virtual classrooms in overcoming some of the problems and difficulties they face during the teaching and assessment process.
2. Virtual classrooms may be a solution to the problem of traditional classrooms.
3. Drawing recommendations that may help overcome the difficulties encountered in the experiment, thus facilitating the identification of appropriate solutions.

Study Limitations

First: Objective Limitations

the study focuses on the effectiveness of using asynchronous virtual classrooms on academic achievement in the Advanced Educational Technology course among fourth-level mathematics students at the Faculty of Education, University of Khartoum.

Second: Time Limitations

this study will be conducted during the period 2022/2023.

Third: Spatial Limitations

Faculty of Education, University of Khartoum.

Fourth: Human Limitations

Fourth-level mathematics students at the Faculty of Education, University of Khartoum.

Research Terminologies

Effectiveness: Defined by Al-Saeed (1997: 17) as "the impact that experimental treatment as an independent variable can have on dependent variables."

In light of the above, effectiveness can be procedurally defined as the impact of using asynchronous virtual classrooms on academic achievement in mathematics.

Virtual classrooms:

According to Hind Al-Khalifa (2002), virtual classrooms are defined as classrooms that rely on the online meeting of teachers and learners, providing opportunities for synchronous and asynchronous communication between them. They are not bound by time or location and deliver lectures remotely. They also provide lessons and opportunities for students to complete assignments and required projects.

According to Al-Bahnasawi (2018), virtual classrooms are digital classrooms that simulate traditional classrooms. Both the teacher and students are present on the Internet without being limited by physical boundaries. The virtual classroom allows the teacher to use various tools, techniques, and applications for instruction. It enables the teacher to engage with students, facilitate class discussions, and interact with them while they perform tasks, activities, and assignments to impart knowledge, concepts, attitudes, and teaching skills.

From a procedural perspective, virtual classrooms are defined as an educational environment created in a virtual space that relies on modern technological advancements to deliver a distinguished educational system. They complement traditional classrooms and provide a flexible and collaborative learning environment that surpasses spatial and temporal barriers. They utilize programs and communication tools to connect teachers and students asynchronously, using audio, video, and text.

Academic achievement:

According to Al-Laqani and Al-Jamal (2003), academic achievement refers to the students' comprehension of specific experiences gained during their academic courses. It is measured by the grades students obtain in the achievement tests prepared for them.

From a procedural perspective, academic achievement is the knowledge acquired by students through the use of virtual classrooms. It is measured by the grades students obtain in tests specifically designed for that purpose.

Advanced Educational Technology Course:

The Advanced Educational Technology Course is a course offered by the Department of Educational Technology, with the course code (TEN 4072). It is a fourth-level course required for students in the College of Education at the University of Khartoum.

Theoretical Framework and Previous Studies:

The concept of virtual classrooms:

Virtual classrooms have been defined as classrooms that rely on the internet to bring together teachers and learners at different times to work on reading lessons, completing assignments, and accomplishing tasks using a variety of educational tools that enable direct, interactive learning, similar to what occurs in traditional education (Al-Qahtani, 2018: 358).

Chadha (2018: 8) defines virtual classrooms as simulated online classrooms that provide a suitable communication environment for distance learners, similar to traditional classrooms. The virtual classroom aims to provide an educational experience similar to that of physical classrooms.

Al-Bahnasawi (2018: 97) defines virtual classrooms as digital classrooms that simulate traditional classrooms. Both the teacher and students are present on the internet without being limited by physical boundaries. The virtual classroom allows the teacher to use various tools, techniques, and applications for instruction. The teacher can also manage class discussions through interaction with students during task performance, activities, and assignments, with the aim of imparting knowledge, concepts, attitudes, and teaching skills. From the previous definitions, it is evident that they all share some common characteristics: they are considered a unique means of direct educational communication, and they closely resemble traditional classrooms in terms of practices and activities.

Types of Virtual Classrooms:

Synchronous Virtual Classrooms:

Synchronous virtual classrooms resemble physical classrooms, where both the teacher and learners use software and tools simultaneously over the internet, without being bound by a specific location. Examples of synchronous virtual classrooms include audio conferencing, video conferencing, PalTalk, Talk Room, HP Virtual Classroom, and Centra. These programs provide various services such as live video and audio streaming, whiteboards, chat rooms, and more.

1. Asynchronous Virtual Classrooms:

Asynchronous virtual classrooms are online classrooms where teachers and learners interact at different times over the internet. Learners participate in the same content without being restricted by a specific time or place. Asynchronous virtual classrooms use non-real-time software and tools such as email, discussion forums, and platforms like Blackboard, Moodle,

Caroline, School Gen, and WebCT. They offer learners ample opportunity to review educational material and interact with it through self-paced learning environments.

Characteristics of Virtual Classrooms:

Some important characteristics of virtual classrooms include:

1. **Interactivity:**

Interactivity is a crucial aspect of virtual classrooms. The essential elements of education, including teachers, learners, and educational content, converge in the virtual learning environment. Successful virtual classrooms require interaction between teachers and learners, as well as among learners themselves, using the available online resources. This interaction should be an integral part of instructional design, allowing teachers and learners to provide feedback, guidance, and support during direct interactions.

2. **Synchronicity:**

Communication and information technology play a vital role in virtual classrooms. Users can connect with each other simultaneously through designated programs, where each participant logs in with a password to exchange messages and electronic communication.

3. **Comparison with Traditional Classrooms:**

Virtual classrooms can cover a significantly larger number of learners from diverse geographic areas and different time frames compared to traditional classrooms.

4. **Cost Efficiency:**

Virtual classrooms reduce the costs associated with traditional education, such as school facilities, transportation, and teaching resources. They also alleviate administrative burdens within the education system.

5. **Teacher Benefits:**

Virtual classrooms enable teachers to improve their performance, enhance their skills in using modern technology, and gain knowledge from various sources. They also relieve teachers from heavy tasks such as grading, reviewing, and organizing.

6. **Access to Resources:**

Virtual classrooms provide access to extensive libraries, encyclopedias, research centers, and cultural resources on the internet.

7. **Discussion Opportunities:**

Virtual classrooms offer the opportunity for multiple discussion threads in forums within the virtual study environment.

8. **Flexibility:**

Virtual classrooms offer broad horizons for education, as they are no longer restricted by time and place.

9. **Continuous Monitoring and Feedback:**

Virtual classrooms facilitate continuous monitoring, feedback, and analysis, utilizing modern technological tools effectively.

Advantages of virtual classrooms include:

Virtual classrooms offer a range of advantages for both teachers and learners in the educational process, as identified by Al-Abed, 2019; Al-Desimani & Al-Saif, 2018; Sayed, 2017; Al-Omari, 2017, including:

For teachers:

1. **Content creation and easy management:** Virtual classrooms provide teachers with various tools to create educational content and involve participants in its development through an easy-to-use interface, without the need for programming knowledge. Teachers can provide learners with information about learning content, activities, homework, and different exercises. They can also facilitate discussions and interactions among teachers and learners or among learners themselves. Virtual classrooms can also be relied upon for monthly assessments and immediate result reporting.
2. **Updating and developing educational resources:** Virtual classrooms can assist teachers in regularly updating and developing the educational content provided to learners to align with changes in their professional and subject areas. Teachers can compile and organize content to build a comprehensive and integrated curriculum, present it, and enhance it. This helps teachers use them as electronic learning resources within virtual classrooms. Additionally, it allows for the creation and provision of educational resources and interactive media for learners to use anytime, anywhere.
3. **Assessment and evaluation:** Virtual classrooms offer the possibility of proposing and implementing new assessment and evaluation methods. For example, they can include multiple-choice questions, true/false questions, or interactive communication.
4. **Presentation of reports:** Virtual classrooms enable teachers to present concise and statistical reports on learners, providing feedback and immediate evaluation.
5. **Utilization of learning resources:** Virtual classrooms allow for the seamless utilization of digital learning resources, such as PowerPoint files, shapes and illustrations, videos, and animations.
6. **Digital capabilities and preparedness:** Leveraging the full digital capabilities and preparedness of learners, which traditional classrooms may not be able to provide.

These advantages empower teachers to create and manage content effectively, update resources, assess learners, present reports, utilize various learning materials, and leverage learners' digital capabilities within virtual classrooms.

For learners, the advantages of virtual classrooms, as identified by (Abdulrahim, 2019; Al-Desimani & Al-Saif, 2018; Al-Mubarak, 2018), include the following:

1. **Communication skills:** Virtual classrooms help improve learners' communication skills, making them more socially engaged and breaking their isolation by interacting with peers and expressing their ideas. This enables them to develop deep communication skills and deepen their understanding of using technology in education.
2. **Active communication and participation:** Learners can actively engage in the learning process by understanding their roles and tasks, participating in discussions through discussion boards and polling tools, exchanging files and applications, sharing websites, and engaging in voice chat. The camera also facilitates visual communication and understanding of what is happening inside the virtual classroom.

3. Enhancement of academic and technical abilities: By providing learners with academic and technical skills in a coordinated and convenient manner to access resources and tasks, interact with teachers and peers, learners feel comfortable and become constantly active. This increases their ability to use technology effectively.

4. Flexibility: Learners have the freedom to choose the appropriate time and place according to their personal circumstances and the educational topic they want to study. This flexibility allows them to learn comfortably, absorb more educational material, and have the ability to archive, send, share, or save class sessions.

5. Traditional integration: Virtual classrooms can be relied upon as a supportive medium for traditional education, integrating both approaches.

It is evident from the above that virtual classrooms provide learners with the opportunity to participate in discussions and lectures at their convenience, record lectures in audio or video formats for later retrieval and repeated viewing to maximize understanding, receive immediate feedback and reinforcement during participation, and facilitate the use and utilization of interactive electronic resources by teachers within the classroom. They also enable grouping of learners, creating study sessions, and facilitating collaborative or individual learning.

Comparison of Virtual Classrooms to Traditional Classrooms

There are several differences and contrasts between virtual classrooms and traditional classrooms, or face-to-face teaching, as explained by (Al-Desimani & Al-Saif, 2018; Al-Ghamdi, 2018; Aljadili, 2014). Some of these differences include:

1. Curriculum and Syllabus: Whether traditional or virtual, the nature of the educational curriculum and syllabus used in virtual classrooms differs in that it incorporates various functions such as conducting interactive and cognitive activities, knowledge exploration, and allowing teachers to meet the diverse educational needs of learners, which may differ from those in traditional classrooms and curricula.
2. Learning Environment: In virtual classrooms, teachers hold synchronous online meetings, and learners are encouraged to deal with the challenges they encounter, whereas this may not be the case in traditional school and classroom environments.
3. Assessment: In traditional classrooms, teachers individually assess learners based on their own tests and assignments, while in virtual classrooms, assessment is often conducted through computer-based evaluation or electronic assessment.
4. Technical Skills: In traditional classrooms, teachers are not required to deal with high-level technological knowledge and means, whereas in virtual classrooms, they need to engage in some online courses to acquire skills and knowledge to enable them to handle potential challenges.

Challenges Facing Virtual Learning

Virtual classrooms and their use in the educational process face numerous difficulties and challenges, as outlined by Al-Bahnasawy (2019), Al-Desimani and Al-Saif (2018), and Al-Ghamdi (2015). These challenges include:

1. Technical Skills: Teachers need to possess knowledge and proficiency in dealing with virtual classroom software, interacting with learners through these programs, and providing educational content. Teachers also require technical skills to effectively use and navigate these platforms.

2. **Practical Training:** In some cases, practical training may not be suitable as certain exercises require learners to physically interact with specific educational tools, elements, and situations. These exercises are not conducive to lectures that exceed a two-hour duration. Therefore, training and educational content are divided into smaller parts, which is the optimal solution.
3. **Motivation and Engagement:** Ensuring that everyone is actively listening and engaged during virtual instruction poses a challenge compared to traditional classrooms. There are also difficulties in implementing effective motivation mechanisms to engage learners. It should be noted that there are other motivational strategies and various methods to maintain learner attention and ensure their participation. However, these are significantly more challenging than in traditional classrooms.
4. **Time Constraints:** Attendance in virtual classrooms is limited to specific time slots due to the synchronous nature of activities. This necessitates all learners to gather at the same time.
5. **Content:** Appropriate study materials need to be provided on the website in a language that teachers can understand.
6. **Physical and Human Resources:** The lack of qualified human resources, including programmers, instructional designers, and necessary teachers to manage virtual classrooms, as well as the absence of a system to manage and monitor the system, pose challenges. Additionally, there is a need for advanced and continuously updated devices to keep up with the evolving software updates.
7. **Human Interaction:** In comparison to the interaction in traditional classrooms, there is a lack of human interaction between teachers and learners in virtual classrooms. This has led to an increase in dropout rates, potentially due to a lack of direct interaction with supportive teachers who encourage them, making the process of adaptation more difficult.
8. **Resistance to Change:** Educators may resist the idea of using virtual classrooms as it challenges their acceptance and ingrained belief in traditional lecture-based learning and memorization. It may be difficult for them to embrace the concept of active participation in learning.

With the technological advancements in the current era, along with the continuous expansion of technological infrastructure worldwide, Arabic software solutions have already become widely available. This will help overcome many challenges and issues, especially after the COVID-19 pandemic and the increased prevalence of digital culture.

Previous Studies:

The researcher reviewed several relevant research studies on the subject of the study, including the study by Al-Rifai and Al-Ansari (2021), which aimed to identify the effectiveness of using virtual classrooms in developing the skills of designing and producing electronic achievement files among high school female students. The study used a quasi-experimental approach and its results revealed a statistically significant difference at a significance level of $(0.05 \geq \alpha)$ between the mean scores of the experimental group's pre-test and post-test in favor of the post-test application. The study recommended the importance of emphasizing the use of virtual classroom technologies in the field of training and education, as they provide many benefits and advantages.

On the other hand, the study by Al-Bahiri (2019) aimed to identify the effectiveness of using virtual classrooms in developing an integrated educational system that includes e-learning,

distance learning, in addition to traditional education, at the Egyptian University for e-learning. The study adopted a descriptive approach, and the tools used included a questionnaire administered to a sample of 64 students. The study found that the modern technological capabilities of virtual classrooms in e-learning and distance learning are effective in developing and enhancing the educational process, improving the level and efficiency of teachers and learners, and increasing knowledge. The study also highlighted the role of virtual classrooms in motivating and encouraging students to pursue knowledge and learning, thus contributing to increased focus and creativity. Furthermore, the study concluded that the prescribed e-learning programs in virtual classrooms are effective in developing the integrated educational system. The study recommended the need to focus on virtual classrooms and increase support with the necessary modern electronic tools to enhance students' cognitive abilities.

As for the study by Al-Amri and Ismail (2019), it aimed to identify the impact of the effectiveness of synchronous virtual classrooms on achieving professional performance among middle school mathematics teachers. The study used a quasi-experimental approach, and the results indicated statistically significant differences at a level of (0.05) between the means of the experimental group's pre-test and post-test scores in the cognitive aspect of professional performance skills, in favor of the post-test application. The results also confirmed the superiority of the experimental group's scores in the post-test in each skill of professional performance individually, as well as in the overall professional performance skills. Furthermore, Abdulkhaleq (2018) conducted a study that aimed to uncover the attitudes towards and the effectiveness of using virtual classrooms in teaching mathematics in the preparatory year. The sample consisted of ten faculty members from the Department of Basic Sciences at Najran University. The researcher used an observation card to measure the evaluation skills of teaching mathematics through virtual classrooms, and a scale to measure the attitudes of faculty members towards teaching mathematics through virtual classrooms as research tools, following an interview to measure planning. The study found that faculty members have a high degree of planning skills for using virtual classrooms, while the execution of plans was at a moderate level, and the evaluation skill was weak. The study also found no statistically significant difference between faculty members in terms of their skill in using virtual classrooms and their attitudes towards their use, attributed to the variables of experience and academic qualification. Also, Ghashim and Mohammed (2017) conducted a study aimed at identifying the impact of using a remote training application to equip faculty members at Jazan University with skills in using virtual classrooms in the educational process. The study used a quasi-experimental approach and was conducted on a sample of 30 individuals. One of the key findings of this study was the existence of statistically significant differences between the average scores of the study sample members in the cognitive measurement test of the skills of employing virtual classrooms, both in the "theoretical" and "practical" aspects, in favor of the remote application after using the training program based on celestial learning. Furthermore, the study's results indicated the presence of statistically significant differences between the average grades recorded in the observation card for faculty members in measuring the practical performance of employing virtual classrooms, both in the "theoretical" and "practical" aspects, in favor of the remote application.

In another study by Khalaf Allah (2017), the goal was to determine the effectiveness of different class group sizes in virtual classrooms in developing skills in electronic test production and attitudes towards this technology among faculty members. The study relied on a descriptive approach and prepared a card to determine the required training courses, in addition to preparing an observation card to evaluate performance, as well as preparing an attitudes scale and using a cognitive achievement test. The study also used a quasi-

experimental approach, and the study sample consisted of 48 faculty members divided into two groups: an experimental group of 24 individuals and a control group of 24 individuals. The results of the study proved the effective role of the virtual classrooms training program in cognitive achievement and changing attitudes towards virtual classrooms.

As for the study by Hassan and Ashabi (2017), it aimed to explore the use of virtual classrooms in distance learning programs from the perspective of faculty members at the University of Sudan. The study used a descriptive methodology and a questionnaire that was administered to a sample of 65 faculty members representing the study population. The study concluded the importance of virtual classrooms in distance learning programs and found no statistically significant differences in the respondents' perceptions of the reality of virtual classrooms in distance learning attributed to the descriptive variables of specialization and experience. The study also identified challenges facing the implementation of virtual classrooms in distance learning that need to be addressed and recommended encouraging faculty members to take advantage of technology related to virtual classrooms to enhance their teaching experiences and skills.

Comment on previous studies:

The current study aligns with the study by Al-Rafaai and Al-Ansari (2021), Al-Amri and Ismail (2019), and Ghashim and Mohammed (2017) in terms of methodology, as they all employed a quasi-experimental approach. However, it differs from the study by Al-Bahiri (2019), Abdulhakim (2018), Khalaf Allah (2017), and Hassan and Ashabi (2017) in terms of methodology, as they utilized a descriptive approach, whereas the current study used a quasi-experimental approach. The current study also differs in sample selection, as it focused on students from the Faculty of Education at the University of Khartoum, while the previous studies had different sample selections.

Undoubtedly, the current study benefited from these previous studies, not only in terms of literature review but also in terms of the procedures and tools used. They served as a foundation for this study, enriching the theoretical aspect and providing guidance.

Study Procedures:

Methodology:

The researcher employed the experimental method as it suited the nature of the research. According to Obeidat et al. (2005: 240), the experimental method involves controlled and systematic changes in the specified conditions of the reality or phenomenon under investigation, observing the resulting effects on this reality or phenomenon.

Research Population:

It refers to all elements of the phenomenon studied by the researcher (individuals, objects) that constitute the subject and problem of the research. Al-Asaf (1995: 91) defines it as everything that the research results can be generalized to, whether it is a group, individuals, books, etc., depending on the objective scope of the research problem. Thus, the research population in this study represented the fourth-year students in the Mathematics Department at the Faculty of Education, University of Khartoum.

Research Sample:

The research sample was purposefully selected, meaning that the researcher chose it freely based on its ability to fulfill the study's objectives. The sample consisted of fourth-year students in the Mathematics Department at the Faculty of Education, University of Khartoum, for the academic year (2022-2023), with a total of 40 students. They were randomly divided into two groups. The researcher deemed this sample appropriate for the current research due

to its size, sampling method, and its potential to provide useful information for addressing the research problem.

Description of the Research Sample:

Distribution of the Study Sample by Group and Gender

Table (1) shows the distribution of the study sample by group:

| Group | Number | Mail | Femail | المجموعة |
|--------------|--------|------|--------|-----------|
| Experimental | 20 | 5 | 15 | التجريبية |
| control | 20 | 6 | 14 | الضابطة |
| total | 40 | 11 | 29 | المجموع |

Before the start of the study, the researcher prepared a pre-achievement test for the students in both groups simultaneously with the aim of ensuring the equivalence and similarity of the two groups. The test consisted of five questions, and the total score was (50) points. The test was graded, and the scores were recorded in special lists for each group, with each student's name and score noted. The following

table (2) illustrates the application of the pre-test:

| Test | Comparison group | Number | Mean | Standard deviation | Calculated T value | Degrees of freedom | p-value | interpretation | Result |
|----------|------------------|--------|---------|--------------------|--------------------|--------------------|---------|----------------|-----------------|
| Pre-Test | Experimental | .20 | 17.4974 | 4.5678 | 4.5678 | 1.00 | .235 | No Significant | No Defere nce's |
| | control | 20 | 16.6510 | 4.3569 | | | | | |

We observe from Table No. (2) that the calculated "t" value is less than the "t" value read from the statistical tables at 65 degrees of freedom and under a significance level of 0.05, which equals 1.99. This indicates that there are no statistically significant differences between the experimental and control groups before the start of the study, indicating the similarity and equivalence of the two groups in terms of academic achievement level.

Study Instruments

The researcher used achievement tests as a tool for collecting information according to the following procedures:

Determining the Objective of the Test:

The pre-test in this research aims to determine the equivalence of the students in the two groups in terms of their level of prior knowledge and experiences related to the test topics.

Meanwhile, the post-test aims to determine the academic achievement level of the students in the sample by assessing the extent to which they have achieved the behavioral objectives, and the various educational activities provided by the teacher that help enhance the students' achievement competencies. It measures their comprehension and understanding, identifies their strengths and weaknesses, and assesses their progress in the subject matter, revealing individual differences among them.

Here is the translation to English:

Preparation of Pre-test and Post-test Questions:

A pre-test and post-test were prepared, consisting in their final form of five questions distributed over 12 items of objective-type tests. These tests are characterized by comprehensiveness, objectivity in evaluating the answers, and their ability to cover all parts of the syllabus.

Face Validity of the Pre-test and Post-test:

The initial versions of the tests were presented to several experts in the field of education, totaling six reviewers from the departments of Curriculum and Instruction, Educational Technology, Foundations of Education, and Educational Psychology. Based on their opinions, observations, and suggestions, some questions were rephrased. After the modifications, the test items were presented to some of these experts again for further feedback. Based on their final observations, the tests were approved in their final form, consisting of five questions.

Calculation of Reliability Coefficient for the Pre-test and Post-test

A reliable test is one that gives similar or identical results if administered multiple times under similar conditions (Obeidat et al., 2005:169). To calculate the reliability coefficient of the pre-test and post-test, the researcher selected a random sample to represent a pilot sample from the population, consisting of 15 students. After administering the test to the pilot sample, it was found that the appropriate time for the test was 120 minutes. Then, the reliability coefficient of the pre-test and post-test was calculated using the split-half method and the correlation formula:

$$r = \frac{(\sum X \cdot Y - \sum X \cdot \sum Y / n)}{\sqrt{[(\sum X^2 - (\sum X)^2 / n)] \cdot [(\sum Y^2 - (\sum Y)^2 / n)]}}$$

Where:

- r = correlation coefficient
- n = number of sample members
- X = individual scores
- Y = paired scores

By applying the previous equation, the researcher found that the value of $r = 0.98$.

To find the overall reliability coefficient for the pre-test, the researcher used the Spearman-Brown formula as follows:

$$\text{Reliability Coefficient} = \frac{2r}{1 + r}$$

From this, it was found that the reliability coefficient of the pre-test is 0.99, and the reliability coefficient of the post-test is also 0.99, which is a high coefficient and can be considered reliable.

Calculation of the Intrinsic Validity Coefficient for the Pre-test and Post-test

To determine the intrinsic validity coefficient of the pre-test, the researcher found the square root of the reliability coefficient using the formula:

$$\text{Intrinsic Validity Coefficient} = \sqrt{\text{Reliability Coefficient}} = \sqrt{0.99} = 0.99$$

Similarly, the intrinsic validity coefficient of the post-test was also found to be 0.99. This high coefficient indicates the test's strong intrinsic validity, making it suitable for application.

Statistical Treatments:

To analyze the data, the researcher used the Statistical Package for the Social Sciences (SPSS) by following these statistical methods:

- Pearson Correlation Coefficient To calculate the correlation coefficient and the Spearman-Brown formula to calculate the reliability coefficient of the test.
- T-Test
- Frequencies and Percentages**: For the scores of the study sample members.
- Mean
- Standard Deviation

Presentation and Discussion of Results

To verify the first hypothesis, which states: "There are statistically significant differences at the (0.05) significance level between the means of achievement scores of the experimental group studied using asynchronous virtual classrooms and the means of achievement scores of the control group studied using traditional method in the dimensional test." A two-sample t-test was used, and the following table illustrates the result:

Table 3: Result of the independent samples t-test comparing the means of performance between the experimental and control groups in the dimensional test.

| Test | Group | Comparison | Number | Mean | Standard Deviation | Computed t Value | Degrees of Freedom | Probability Values | Interpretation | Result |
|-------------|--------------|------------|---------|--------|--------------------|------------------|--------------------|--------------------|-------------------|--------|
| Dimensional | Experimental | 20 | 33.6582 | 5.5028 | 1.545 | 60 | .012 | Function | Differences Exist | |
| | Control | 20 | 30.5236 | 5.5421 | | | | | | |

"We observe from the table above that the computed t-value is greater than the critical t-value from statistical tables at 60 degrees of freedom and a significance level of 0.05, which is 1.99. This indicates statistically significant differences between the mean achievement scores of the experimental and control groups after implementing the study in favor of the experimental group. Thus, the first hypothesis stating 'there are statistically significant differences at the (0.05) significance level between the means of achievement scores of the experimental group studied using asynchronous virtual classrooms and the means of achievement scores of the control group studied using traditional method in the dimensional test' is accepted. This suggests that academic achievement among students who studied the Advanced Educational Technologies course using asynchronous virtual classrooms is better than those who studied through traditional methods, confirming the effectiveness of asynchronous virtual classrooms in teaching the Advanced Educational Technologies course. This could possibly be explained by the fact that asynchronous virtual classrooms allowed students to complete tasks and benefit from activities offered in the system with ease and flexibility, aiming to achieve educational objectives. This facilitated cognitive development. Additionally, learning occurred asynchronously, allowing each student to learn at their own suitable time and place, saving time and effort. Moreover, the opportunity to learn through various electronic devices enabled students to use their mobile devices in the learning process. These findings are consistent with the results of a study (Al-Rifai and Al-Ansari, 2021)."

To verify the second hypothesis, which states: "There are no statistically significant differences at the (0.05) significance level between the mean achievement scores of the experimental group studied using asynchronous virtual classrooms in the dimensional test, attributed to the gender variable." A two-sample t-test was used, and the following table illustrates the result:

Table 4: Result of the independent samples t-test comparing the means of performance between boys and girls in the experimental group in the dimensional test.

| Group | Number | Mean | Standard Deviation | Calculated t Value | Degrees of Freedom | Probability Value | Interpretation | Result |
|----------------------|--------|---------|--------------------|--------------------|--------------------|-------------------|-----------------|----------------------|
| Experimental (Males) | 5 | 33.6524 | 9.3625 | .695 | 35 | .444 | Not significant | No differences found |

Based on the table above, we find that the calculated "t" value is less than the critical "t" value, indicating no statistically significant differences between the mean scores of the experimental group (males and females) after the application of the experimental study. This means there is no difference in the academic achievement levels between boys and girls who studied the Advanced Educational Technologies course using asynchronous virtual classrooms. Therefore, the second hypothesis, which states: "There are no statistically significant differences at the 0.05 significance level between the mean achievement scores of the experimental group that studied using asynchronous virtual classrooms in the post-test attributable to the gender variable," is accepted. This confirms the effectiveness of virtual classrooms in teaching the Advanced Educational Technologies course for both genders and shows that their efficacy is not affected by gender differences. This can perhaps be explained by the equal conditions provided to both genders in terms of teacher competency and the type of questions used, which led to no differences in academic achievement levels between the male and female students of the experimental group.

Recommendations

- Intensify focus on virtual classrooms and increase support with modern electronic tools: This is necessary to enhance their capacity to provide alternative educational opportunities for those who have not joined traditional higher education and to broaden the base of higher education within the community.
- Implement accredited higher education quality standards: These should primarily rely on modern communication and information technologies, especially in teaching, to improve the educational process.
- Utilize modern technological means in higher educational institutions: All scientific courses should be made available in electronic form over the international information network to facilitate their distribution.
- Organize training courses and workshops on virtual classrooms**: These should be aimed at both teachers and learners.

Study Proposals

- Proposed Concept for Establishing Virtual Classrooms with Technological Capabilities in Sudanese Universities: This would play an effective role in case of obstacles or incidents such as earthquakes, floods, or crises like wars.
- Conducting a Study on the Attitudes of Faculty Members in Various Specializations Toward Virtual Classrooms: This includes converting their scientific courses from printed to electronic formats.

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