Efficiency of e-Learning in Applied Materials for Visual Communication Students: An Experimental Study

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Abstract This study investigated the utilization of visual communication in e-learning within higher education institutions, commencing with the formal initiation of the e-learning program in March 2020 and extending through September 2022. The researchers utilized Bloom's taxonomy framework to assess the effectiveness of hybrid learning approaches in practical education, focusing on knowledge, skills, and competencies. This study used an experimental methodology to examine the potential advantages of utilizing e-learning platforms for visual communication students in their acquisition of applicable materials. In their empirical study, researchers tracked two groups of twenty students: experimental and control. The results revealed that there was statistically significant improvement for the experimental group after the changes were implemented, which suggests that the methods used were effective. Therefore, scholars must dig further into these questions and design novel approaches to e-learning if it is to become a standard teaching method, especially in higher education.

Keywords: Applied learning, e-Learning, Experimental group, Learning methods, Visual communication

1. Introduction

Due to the lockdowns imposed during the COVID-19 pandemic, many educational institutions worldwide could not conduct pedagogical operations according to the pre-pandemic status quo. Specifically, face-to-face instruction in person and physically in the classroom setting and in-person examinations were simply no longer possible due to the risks of transmitting the potentially fatal virus. This situation no longer exists in many parts of the world thanks to new vaccines, massive public health interventions, and lockdowns, which may be reimposed again should conditions change. This new uncertain reality is expected to continue for the indefinite future and will require individual educators and educational institutions alike to handle the situation with flexible protocols that will most probably include e-learning options. Keeping in mind the negative effects of the long-term prohibition of face-to-face instruction and maintaining proper social distancing

practices (Dubey & Pandey, 2020), educational institutions will likely continue to adopt e-learning instructional modalities to maintain institutional viability as well as to fulfill the mission of public education.

Information and communications technology (ICT) applications such as Google Meetings, Zoom, Microsoft Teams, etc., have played a critical role in delivering pedagogical content for e-learning. These applications help to simulate a regular teaching environment and facilitate the teaching process with video, text conversation, online chat forums, virtual graphics, recording, and various display tools. This technological mediation of e-learning allows for the continued functioning of the university classroom and contributes to the ease of communication between students and teachers, as well as between the students themselves. Due to the abruptness of the lockdowns, many universities were required to adopt an e-learning approach utilizing technological methods despite their lack of readiness and insufficient technological, human, and managerial capabilities. Given these circumstances and the likelihood of future pandemics, it would seem critical to measure the effectiveness of these new distance learning modalities after having endured approximately two years of the pandemic so that universities are better prepared to provide high-quality education.

The literature on the effectiveness of e-learning is still being written, and its nascent conclusions are subject to vigorous debate. Several studies have reported contradictory results (Alsoud & Harasis, 2021). However, an analysis of student satisfaction determines a widely accepted measure of the effectiveness of instruction in general and e-learning. Several e-learning studies conducted during the COVID-19 pandemic strongly confirm the low satisfaction level perceived by students toward e-learning (Adnan & Anwar, 2020). Other literature investigated factors influencing student knowledge of computer systems and technical infrastructure (Alsoud & Harasis, 2021).

This existing literature review examines learning methods in e-learning studies in developing countries such as the insert country named here (Melles et al., 2012), but few studies have followed this approach in developed countries.

The main objective of the study is to explore the effects of distance methods through online teaching of applied design and visual communication materials on students' skills and achievement. In addition, design learning has important stages, namely discovery, interpretation, reflection, experimentation, and development. It mainly aims to answer the following sub-questions:

- Does the e-learning curriculum contain real-life experience?
- Do all students participate in the educational process?
- Is there a relationship between the outputs of the applied subjects and the practice of the real profession?

Answers to these questions can help determine the degree of effectiveness of e-learning design studies in the context of a new experience and offer useful insight for faculty and students alike to maximize the utility of distance education course offerings not only under conditions of imposed lockdown but also for universities seeking to increase enrollment by offering more flexible learning opportunities for potential students.

Despite the pandemic-imposed lockdown, Jordanian universities immediately used a distance learning strategy to carry out their missions as higher education institutions. According to a national poll conducted in April 2020 by the Jordanian Ministry of Higher Education and Scientific Research, only 50%–60% of Jordanian students were satisfied with distance learning. This low rate brought into question the effectiveness of e-learning. Previous research has highlighted many reasons behind such low rates of satisfaction, such as poor internet, lack of proper technology infrastructure, feelings of loneliness, and lack of access to adequate digital devices (e.g., laptop, PC, mobile, etc.). Nevertheless, few studies have been devoted to examining the application of e-learning in a distance learning environment.

2. Theoretical Framework

E-learning relies on quality software and high-speed internet to function effectively. However, in some developing countries, it can be difficult for students and faculty to access the necessary software and

reliable internet services to participate in e-learning. Therefore, the findings of this study offer suggestions related to using blended techniques. For example, distance learning began in the 1700s in the form of the correspondence school model, which eventually turned into electronic formats to deliver education at a distance (Harting & Erthal, 2005). In 1858, the University of London became the first university to offer distance learning degrees. In 1892, the term distance learning was first used in a pamphlet by the University of Wisconsin-Madison in the USA. Infographic tracks that distance learning grew from pre-revolutionary America to 21st-century Britain, where almost 400,000 students were or have been involved in distance learning courses, starting from lectures sent via phonograph and radio broadcast to degrees delivered in the digital age. Many people, such as full-time professionals, housewives and husbands, teenagers, pensioners, and many more, have felt the benefit of a distance learning course (Pappas, 2013).

Arab researcher Tantawi (2020) stresses the importance of e-learning as an urgent necessity imposed by the COVID-19 pandemic. His study is based on the experiences of students and faculty at an Egyptian university. Tantawi argues that online learning can be as effective as traditional education (e.g., face-to-face learning). His findings indicate that students respond differently to online education, and their response is based on their proficiency in using online instruments, their capability to technically access online courses, and the instructors' manner in conducting learning activities and tools.

Overall, few studies have focused on student satisfaction with online instruction, particularly in the transition from traditional to distance learning. Yet, several universities around the world were able to utilize the potential of e-learning by providing scientific and other pedagogical content for students and through a variety of teaching methods. The combination of sound and image enhances student performance and gives them the necessary skills to innovate and think about assigned material. Modern methods of verification (e.g., assessment) are easily adaptable to the new conditions of distance learning. These circumstances imposed by the pandemic have also given rise to new policies and strategies for sustainable education, all of which contribute to an increase in the efficiency of educational content delivery. The ease of applying traditional pedagogical methods to the virtual learning environment provides students with an interactive and immersive learning experience.

Harmelia (2021) confirmed that there is a significant increase in the promotion of students' learning independence. It was noted that 65% of students stated that they were more active in completing class assignments and searching for improvement courses through e-learning. On the other hand, Yang (2021) reports that students evaluated the online learning experience at an Irish university less positively. Most students still preferred in-class learning, and despite some very positive online learning experiences, they felt that the social aspect and benefit of learning in face-to-face interaction with trainers and peers could not be fully emulated in an online learning environment. As all good teachers know, participation is the foundation for an effective learning experience, whether online or face-to-face.

Numerous studies have examined the outcome of distance learning and its effects on student achievement. Melnyk et al. (2020) note that as the COVID-19 pandemic forced students to leave their universities, distance learning helped solve the problem of physical isolation by offering much more than the traditional correspondence format. In addition to tasks and teaching materials, distance learning brings forth an expansion of the classroom framework for students and teachers, the potential for intensive interaction, and an effective form of control or assessment. Further, this form of education allows those who cannot attend face-to-face classes to get not only a flexible program but also the opportunity to work at their own pace and to allocate a few hours a day for processing and training when it is possible and convenient: during breaks, after work, on weekends, etc.

In addition, Kusmaryono et al. (2021) found that e-learning is as effective as face-to-face learning in terms of student learning outcomes. The application of distance learning affords many opportunities to develop rapidly as most academic institutions shift to this model. With the improvement of the quality of distance learning, it can be predicted that the application of distance learning will not only be part of the normal learning process but also may completely replace the current face-to-face conventional teaching and learning.

2.1. E-learning Explores During COVID-19

In the context of the COVID-19 pandemic, the transition from traditional education to online education has affected the educational success of undergraduate students in Jordan. These effects are generated by access to network platforms. Thus, students' acceptance of e-learning is considered one of the main criteria for a successful e-learning system. In addition to altering the nature of knowledge, advancements in the e-education disciplines additionally impacted values, surroundings, demand, and information and communication technologies (ICT; Bates, 2019).

Alsoud and Harasis's study (2021) highlights the impact of distance learning among undergraduate students. Their study was conducted during the COVID-19 pandemic in 12 Jordanian universities and utilized an online questionnaire and descriptive analysis. Their study was conducted during the COVID-19 pandemic in 12 Jordanian universities and utilized an online questionnaire and descriptive analysis. Their study indicates that online education requires that instructors have prior training in technical skills. Thus, students were more likely to learn by studying the shared study materials rather than by attending online lectures. Another study, conducted at six universities in Jordan and Saudi Arabia, focuses on the main criteria related to technological issues (Almaiah et al., 2020). The factors were related to qualitative data obtained from interviews and analyzed using the thematic analysis technique using the NVivo software. The qualitative data were classified into the following four categories: (1) technological challenges, (2) individual challenges, (3) cultural challenges, and (4) course challenges. Based on these findings, the researchers suggest that technical support, necessary hardware and software, and a stable internet connection are all crucial to the success of e-learning. Thus, the research indicates that providing efficient, effective, and transparent means of e-learning activities through the e-learning system could increase trust, which is the key element that can play a significant role in increasing the use of e-learning systems among students.

Alameri et al. (2020) explore e-learning from the students' perspective and examine the effect of self-learning on academic achievement. Their results indicate that software like Microsoft Teams and Zoom platforms help students develop efficient self-study habits and assist them in concentrating on their work. In addition, it helps students develop time management skills and motivates them to learn. An important study was also conducted at Al-Zaytoonah University in Jordan during the pandemic on 470 engineering and technology students, of which 76.1% were males and 23.9% were females (Alkhalil et al., 2021). The results of the study provide general insight into the effectiveness and perception of e-learning and other e-learning methods offered by the university, such as technological devices, software, content comprehension, and adequate support. The study found that online learning offers greater flexibility and convenience. This is due in part to the fact that online learning provides students with opportunities to develop more consistent study habits, which improves their efficiency. However, the results are unequal among different demographic groups from underrepresented and lower socio-economic backgrounds.

Another study conducted by Abdullah et al. (2021) compared students' performance in their grades and activities before and after the coronavirus pandemic to understand how it impacted their grades. They relied on data collected by the Center for E-Learning and Open Educational Resources. In addition, they utilized data on students' grades collected by the Admission and Registration Unit. The dataset contains 9,246 students distributed over three semesters (Spring/2020, Summer/2020, and Fall/2021). The researchers applied two machine learning models: random forest (RF), extreme gradient boosting (XGBoost), and one deep learning model, feed-forward neural network (FFNN). The study shows how e-learning during the pandemic has impacted students' performances and how the students benefited from online learning. A high success rate has been observed during the pandemic compared to what it was before. There was one fail level grade of less than 50 percent, and this is expected because the exams were open and the monitoring was weak. The authors recommended that there should be different methods of evaluating students' performance, such as attendance at exam venues, monitoring devices used during exams, and requiring students to keep their cameras on during exams.

In the East, many studies focused on the impact of COVID-19 on socioeconomic effects. Some cases focused on the concept of gender and the extent of its impact on mental health, and others on participation in universities (Salah & Al-Doghmi, 2023) and other examples of language on a wider

global scale. Lailiyah et al. (2023) make a distinction between the speech patterns of men and women when they realize the complaints made by COVID-19 survivors in Indonesia. Lailiyah et al. (2023) concluded that women tend to be more diplomatic in their complaints than their male-speaking counterparts, who tend to utilize more aggressive complaining techniques after analyzing the speech of 36 COVID-19 survivors from a gender and educational perspective. Surprisingly, they discovered that female undergraduates express their problems more harshly than their non-undergraduate counterparts. Another outcome differs from that of Nurbayani and Dede (2022), who investigated COVID-19's impact on 22 white-collar employees, both male and female, from a semantic standpoint in Indonesia. Their research shows that men made more in-depth statements about COVID-19, as evidenced by using adverbs and adjectives to indicate the need for "a proper [linguistic adaptation]" (p. 73). Such semantic analysis reveals the meaning of diverse signs or linguistic symbols, demonstrating an indefinite generalization in the process.

2.2. Design Learning Approach in E-Learning Studies

One of the approaches in e-learning is design projects, which focus on developing students' research skills and creative confidence and linking design outcomes between real-world problem-solving and classroom environments. Moreover, Goldschmidt (2017) states that designing includes more than one point of view that focuses on aspects of innovation and the human being and his or her needs. Two basic practices focused on two distinct aspects, namely descriptive models based on observation through reality and an applied model through which institutions and companies seek to provide innovations in the field of products and commodities.

During this iterative process, students are encouraged to not only understand and challenge assumptions but also to redefine problems and do research; academic research emerges when it is linked to professional practice or an academic project (Cross, 2007). The essence of designing is the desire to improve products by analyzing and understanding how users interact with them and investigating the conditions in which they operate. This involves asking questions and challenging assumptions. As pointed out by Skaggs (2018), design, tool observation, experience, and query allow designers to understand human needs and shape information through an awareness of experience. It means that once students have questioned and investigated the circumstances of the problem, the process of generating solutions will help produce ideas that reflect the real limitations and aspects of that problem. Design projects provide a way to go deeper. It helps focus research, prototyping, and testing products and services to find new ways to improve a product, service, or design. Lindbergh et al. argue that design thinking is not like any other method, as it allows freedom in choosing possibilities through a participatory process and the experience of team-based learning from different disciplines (Moore & Kearsley, 2012).

Further, the Melles et al. (2012) study found that it is difficult to train design specialists, such as interior and industrial designers because the problem was seen as a design idea or a product rather than an integrated system that has several aspects. Their study was conducted on 90 students at Swinburne University studying simultaneously in Melbourne and Hong Kong in the first semester of 2011, where a course in design thinking was implemented as a curriculum through discussions and special workshops. Students were asked to implement projects on campus by attending lectures and blog discussions, reviewing the literature, and collecting notes.

On the other hand, Miiller and Smith (2009), in their study comparing e-learning and face-to-face learning outcomes of drawing and design, found no difference in the quality of the learning process or the drawing drawings made. Students from both types of learning modalities developed artistic potential and explored processes, materials, and approaches to the creative experience. The instruments used for the two different types of learning were the only difference; for example, distance learning utilized digital online handouts, while face-to-face instruction used paper handouts. In addition, Magistretti et al. (2021) state that design learning has been proven to be an approach based on dynamic capabilities. His study stated that design learning had been proven to be an approach based on dynamic capabilities. His research scrutinizes four different cases of consulting projects where the adoption of dynamic capabilities strengthens the value of digital technologies toward a more human-centric digital

transformation. Based on a business-to-business market, the consulting environment tells how to design e-learning dynamic capabilities that are evident for digital transformation.

3. Methodology

This study is based on real experiments in project-based education. The researchers used the experimental method on a deliberate and controlled variable for the specific conditions of reality and the phenomenon to control behavior and the ability to predict (Al-Rahman, 2014). The researchers also relied on building the experiment by restructuring the study groups to reveal each variable's impact and role. An independent variable is entered to measure the impact of the experiment, positively or negatively (Al-Mandalawi, 2016).

The study consisted of independent and dependent variables, as follows:

1. The independent variable is the proposed project based on the design of e-learning processes (distance and direct instructor).
2. The dependent variable is students' interaction and offering flexible and creative solutions in a hypothetical environment.

The study tests the following hypotheses:

H1: There is a statistically significant difference between the two research groups in the average level of knowledge of students in the experimental groups who used e-learning design blended techniques and the control group who were online direct instructors.

H2: There is a statistically significant difference between the average skills (number of realistic solutions) for the members of the two groups, the experimental groups in whom blended techniques were used, and the control group that was taught directly.

H3: There is a statistically significant difference between the two research groups in the average level of students' competencies in terms of responsibility and autonomy in the experimental groups in whom design blended techniques were used and the control group that studied online directly.

3.1. Participants and Setting

The researchers used intentional sampling to select 40 male and female students between the ages of 18 and 22 from the first, second, and third-year subjects. They then divided the sample into two equal groups: an experimental group and a control group. The homogeneity factor was taken into account when selecting the sample between the two groups in terms of stage of the study, age, and gender to ensure the possibility of dimensional comparisons between the two groups.

Table 1
Sample of Experimental Participants

Sample Groups	Age	Gender	Study stage
Experiment Group	18 – 22	Male / Female	First / Second / Third Year
Controlled Group	18 – 22	Male / Female	First / Second / Third Year

The average age of the experimental group was 14.33 years with a standard deviation of 0.651, while the arithmetic average of the control group was 14.25 years with a standard deviation of 0.621. Using the Mann-Whitney test, the researchers examined whether the age difference between the two groups was significant ($u = 66.50$). The result showed no statistical significance, suggesting that the two groups had similar ages. The researchers then applied the same test to see how the experimental and control groups differed in their mean scores on the pre-test for behavioral problems.

3.2. Instruments

Data was gathered using Office 365 Microsoft Teams platform records, which include asynchronous and synchronous learning. All hypotheses were tested using independent t-tests. Further, only the practical specialization subjects, which are described as applied, were highlighted. The researchers

assumed equal opportunities among students in the major in terms of the presence of high-bandwidth Internet and the existence of educational platforms and teaching tools for materials, given that the design and visual communication specialization already requires the presence of tools and techniques suitable for the implementation of various projects. The study was conducted on teaching applied subjects by linking them to the real world and its possibilities from a distance.

3.3. Procedure

3.3.1. Data Collection

The experiment was applied to students in the second and third years in the subject of advertisement design in the second semester of the year 2021 for six months. According to the description provided by the Visual Communication Department of Jadara University, Jordan, the course aims to identify the foundations and considerations on which the design of the advertising medium is based while employing those foundations and triggers in designing the various reproductions that are displayed in roads, means of transportation, shops, institutions, and companies, as well as studying the methods of providing periodic information to various institutions and bodies and the public dealing with a commodity, product or service through the design of daily correspondence paper, envelopes, covers, and annual calendar.

Materials were evaluated according to quality requirements and based on the theory of Bloom's taxonomy (1956), which has three levels, namely: knowledge, skills, and competencies.

Table 2
Approved Evaluation Methodology for the Subject at Jadara University (Department of Design and Visual Communication)

Knowledge	Skills	Competencies
A1-Theoretical Understanding K1- Be aware of customer needs. A2- practical application K2- To apply the principles of design.	B1 - General problem-solving and analytical skills S1- To analyze the problem into its primary elements. B2 - Telecommunications, Information Technology, Communications, and Computers S2- The work must be done using technology (Adobe programs, e.g., Photoshop, Illustrator, InDesign).	C1 - Autonomy, responsibility, and context C1 - To be creative by coming up with new and unrepetitive ideas. C2 - to anticipate the most appropriate solutions to the problem.

Based on the prior evaluation, the students were subjected to a two-week experiment where a realistic project was put forward by designing the identity of the university's cultural café. The researchers assigned 20 male and 20 female students (matched by gender, age, and school stage) to two groups. When the idea of the identity for the cultural café that would be established at the university was presented as a realistic prototype, the students were asked to form two groups consisting of 10 people and brainstorm ideas for designing a logo that was not specified with a specific number.

The students formed two groups, then an insightful introduction was given about the café, its objectives, and its components, and the request was made to proceed with the design as usual. The two groups of students in the first stage were asked to build their perceptions about the cafe as the control group, then two students from each group were asked to discuss the topic and put their perceptions about the café in the form of drawings, questions, and notes. Then, the students were asked to discuss remotely from different disciplines about the café, determine the students' ideas through the café, and write proposals. Then, they were asked to add modifications, make observations, make a prototype, and test it to find out whether it was desirable from the users' point of view.

In the study, the learning methods varied according to the design phase objectives and through under-standing its functionalities and efficiency. For example, during the solution design phase, a digital

whiteboard was used for fast ideation, collecting, and prototyping ideas named "brainstorming freehand".

3.3.2. Data Analysis

The data analysis for this study was conducted using SPSS software, following the institute's evaluation system based on Bloom's taxonomy. Descriptive statistics were used to describe the characteristics of the participants and their scores on the pre-test and post-test, which were based on three levels of knowledge, skills, and competencies. Each level category was evaluated with five marks based on two outcomes, denoted by the symbols k1 and k2 for knowledge outcomes, s1 and s2 for skills, and c1 and c2 for competency levels (Tables 3 & 4). Independent t-tests were used to compare the mean scores of the experimental group and the control group on the post-test. The significance level was set at 0.05 for all statistical tests.

Table 3
Results of the Control Group

Certified results	Tools and techniques used	Achieved results					
		A		B		C	
		K1	K2	S1	S2	C1	C2
		5	5	5	5	5	5
The first experiment	Classroom discussions, Manual whiteboard, face-to-face meetings.	3	3	2	4	3	2
The second experiment	Classroom discussions, Manual whiteboard, face-to-face meetings.	2	4	1	3	1	1
The third experience	Classroom discussions, Manual whiteboard, face-to-face meetings.	1	3	1	4	1	1
The fourth experiment	Classroom discussions, Manual whiteboard, face-to-face meetings.	2	2	1	4	1	1
The fifth experiment	Classroom discussions, Manual whiteboard, face-to-face meetings.	2	4	1	4	2	1
The sixth experiment	Classroom discussions, Manual whiteboard, face-to-face meetings.	1	3	1	4	1	2
The seventh Experiment	Classroom discussions, Manual whiteboard, face-to-face meetings.	2	2	1	4	1	2

Table 4
Results of the Experimental Group

Logo for a cultural café at the university	Tools and techniques used	Achieved results					
		A		B		C	
		K1	K2	S1	S2	C1	C2
The first experiment	Digital Whiteboard, Chat rooms, planner, Padlet.	3	4	4	4	4	3
The second experiment	Digital Whiteboard, Chat rooms, planner, Padlet.	4	4	3	3	4	3
The third experience	Digital Whiteboard, Chat rooms, planner, Padlet.	3	3	3	3	3	2
The fourth experiment	Digital Whiteboard, Chat rooms, planner, Padlet.	4	3	4	4	4	3
The fifth experiment	Digital Whiteboard, Chat rooms, planner, Padlet.	2	2	3	4	2	3

4. Results

The first hypothesis: There is a statistically significant difference between the two research groups in the average level of knowledge of students in the experimental groups who used design blended

techniques of e-learning and the control group who studied traditionally. The hypothesis was tested using an independent t-test.

Table 5
T-test Results for the First Hypothesis

Group	Mean	Std. Deviation	T	Sig
control group	2.43	0.53452	4.12	0.04
experimental group	3.20	0.75829		

The researchers employed an independent t-test to address the first hypothesis. The results, as shown in Table 5, indicate that the mean knowledge level of students in the experimental group who utilized design blended e-learning techniques was 3.2, while for the control group, who received traditional instruction, the mean was 2.43. Furthermore, the calculated T-value was 4.12, with a significance value of 0.04, suggesting statistically significant differences in knowledge levels in favor of the experimental group.

The second hypothesis: There is a statistically significant difference between the average skills (number of realistic solutions) for the members of the two groups, the experimental groups in which design blended techniques were used, and the control group that was taught traditionally. The hypothesis was tested using an independent t-test.

Table 6
T-test Results for the Second Hypothesis

Group	Mean	Std. Deviation	T	Sig
Control group	2.50	.28868	7.56	0.01
Experimental group	3.50	.50000		

The researchers utilized an independent t-test to evaluate the second hypothesis. The results, presented in Table 6, reveal that the mean skill level of students in the experimental group, who employed design blended e-learning techniques, was 3.5, while for the control group, who received traditional instruction, the mean was 2.5. Furthermore, the computed T-value was 7.56, with a significance value of 0.01, indicating statistically significant differences in skill levels in favor of the experimental group.

The third hypothesis: There is a statistically significant difference between the two research groups in the average level of students' competencies in terms of responsibility and autonomy in the experimental groups in which design blended techniques were used, and the control group was studied traditionally. The hypothesis was tested using an independent t-test.

Table 7
T-test Results for the Third Hypothesis

Group	Mean	Std. Deviation	T	Sig
Control group	1.44	.53452	13.24	0.00
Experimental group	3.10	.54772		

The researchers applied an independent t-test to analyze the third hypothesis. The results, depicted in Table 7, indicate that the mean competencies related to responsibility and autonomy for students in the experimental group, utilizing design blended e-learning techniques, was 3.1, while for the control group, receiving traditional instruction, the mean was 1.44. Additionally, the computed T-value was 13.24, with a significance value of 0.00, signifying statistically significant differences in competencies in favor of the experimental group.

5. Discussion

The primary focus of this study was to investigate the potential of e-learning, specifically the application of design-blending techniques, to enhance the learning experience. The results obtained from the

experiments reveal significant differences between the experimental group, which utilized e-learning tools, and the control group, which underwent traditional teaching methods in terms of knowledge levels, skills, and competencies. These findings underscore the advantages of e-learning, particularly in fostering more flexible learning outcomes across these dimensions.

The experimental group, which actively engaged with e-learning tools such as Microsoft Teams, demonstrated a notably higher level of knowledge. This advantage can be attributed to the group's enhanced communication and collaboration opportunities, resulting in a deeper understanding of the subject matter. For instance, the experimental group displayed superior client knowledge compared to the control group, likely stemming from their improved communication and interaction.

In terms of skills, the experimental group outperformed the control group by offering a greater number of solutions during the study. This higher skill level can be attributed to the collaborative nature of e-learning tools, which facilitate open discussions and idea generation. The experimental group's ability to generate more solutions is indicative of the efficacy of their collaborative learning environment. Comparable results were obtained by Miiller and Smith (2009), who found that there is no difference in the quality of art outcomes between e-learning and face-to-face learning.

In addition, the experimental group scored as having a higher level of skill due to the greater number of solutions they offered in the study; the tool allows participants to discuss openly, thus generating more solutions. Similar to past research (Abdullah et al., 2021), the researchers found students' scores are improved after using e-learning.

In the category of competencies, the experimental group scored higher because of the efficacy of the solutions they generated. These results indicate that the group of students to whom classic learning methods were applied took more time to determine decisions and built their results according to customer knowledge than the other group, which only had the traditional methods applied to them. The past study by Miiller and Smith (2009) comparing e-learning and face-to-face learning outcomes of Drawing and Design found no difference in terms of the quality of the learning process and the drawings that students made. Furthermore, the experimental group exhibited higher competencies, largely due to the effectiveness of the solutions they generated. Their decision-making processes were more effective, most likely because of the collaborative problem-solving that e-learning tools facilitated. In contrast, the control group, subjected to traditional methods, appeared to require more time to arrive at decisions and formulate results based on client knowledge.

The study also revealed challenges associated with remote e-learning, particularly in terms of communication with the work environment and beneficiaries. While students struggled to effectively communicate through applications and official websites, they resorted to personal means. This prompted the consideration of repeating the experiment with improved stability in communication channels.

Beyond its immediate findings, this study provides valuable insights into various aspects of e-learning, including curriculum development, student engagement, solution generation, the effectiveness of solutions tested, and the bridge between academic subjects and real-world professional practice. Additionally, it is anticipated that this research will offer recommendations for effective applied methods in the field of design and visual communication, contributing to future research endeavors. Furthermore, educational institutions must carefully strategize and plan their services to enhance student satisfaction and promote development and positive change. The study results suggest several considerations for the future:

1. Emphasizing the development of experiential learning within curricula due to its significant positive impact on learning outcomes.
2. Enhancing communication through applications and university websites to provide clear guidance to students.

Modern education systems, including e-education and blended hybrid education, have gained prominence globally. However, successful implementation requires comprehensive training for both students and teachers. Failure to do so may hinder the learning process, leading to suboptimal outcomes.

The researchers also found that the remote e-learning process encountered difficulties in terms of communicating with the work environment and the beneficiaries as the prototypes were discussed with people. However, students could not communicate optimally with the university and beneficiaries through the applications and the official website. Students reached out to them in personal ways, which prompted the researchers to repeat the experiment but with greater stability. Groups are required for the effectiveness of design thinking, and design thinking methodologies are oriented toward highlighting the importance of managing communication and emotion among team members (Camacho, 2018). This enables groups to work productively and cross boundaries: "One of the project's defining characteristics was its active pursuit of breaking down barriers between design, academia, and the real world.

It's important to acknowledge the limitations of this study, including the relatively small sample size, limited distribution scope, and potential lack of external validity or generalizability of the results. Additionally, the study identified different obstacles in face-to-face learning and e-learning contexts, emphasizing the need for tailored solutions. Future research in this rapidly evolving educational landscape must adapt to address challenges and cater to evolving educational needs and requirements.

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