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INTRODUCTION

Today, digitalization is used in many fields. It offers opportunities such as facilitating access to information, copying, distributing, and changing information. Its use in education has also increased in recent years as it enables educational components to come together by eliminating space and time limits. The global pandemic is one of the biggest reasons for this change in education (1).

The effect of Google Classroom distance education method on student success and satisfaction in anatomy course

Abstract

Aim: Google Classroom (GC), an e-learning platform, has received a lot of attention in the educational community. The aim of the study was to investigate the effectiveness of GC on students in learning a difficult-to-understand topic like nervous system.

Materials and Methods: A total of 144 students studying in the Department of Nursing participated in the study. Students were divided into 3 groups: The group receiving classical education (Group 1), the group receiving education with GC (Group 2), and the group receiving supplementary education with GC and classical education (Group 3). Research data were collected through "Structured Student Introduction Form", "Google Classroom Satisfaction Questionnaire" and "Nervous System Anatomy Knowledge Exam".

Results: In the results, students stated that they found the system and the use of GC easy and that they were satisfied with it. When the achievement tests between the groups were analyzed, the post-test achievement level of Group 2 and Group 3 was significantly higher than Group 1 ($p<0.005$), and the post-test achievement level of Group 3 was significantly higher than Group 2 ($p<0.005$). At the same time, although students were generally satisfied with GC, they reported that they experienced problems such as difficulty accessing the internet and uploading homework, and distraction.

Conclusion: Since health sciences education is an applied education, its suitability for distance education is controversial. However, the study found that providing distance education as a support to traditional education increased interest in the course, motivation and success.

Keywords: Anatomy, anatomy of the nervous system, Google Classroom, medical education

Anatomy knowledge is a fundamental requirement for medicine and health sciences. It is emphasized that this knowledge is important for understanding the structure and functioning of the human body for clinical practice. Digital anatomical applications provide opportunities to improve both medical and health education as well as operative skill training. Augmented reality (AR), virtual reality (VR), 3D printers, and other digital technologies play an effective role in transforming operative skill training in healthcare. These technologies are used across a wide

range of areas, from nursing education to surgical practices (2).

In parallel with digitalization and internet development, new technologies and methods are being developed in every field, and Google Classroom (GC) is one of these new technologies and methods. Developed by Google in 2014, GC offers an internet-based collaborative working environment in the field of education. It is a web-based learning management system that facilitates content creation, assignment, assessment and evaluation, and strengthens communication by providing students with a collaborative working environment (3). The use of this method of education, which enables distance education, increased intensively in 2020 when schools around the world switched to distance education due to COVID-19 (4).

This digital classroom platform allows teachers to create and share free online learning resources, collect and evaluate students' assignments. Users need a free Gmail account to use the application. The application is accessible via smartphones and other computer devices. Teachers can create classes and enable student participation by sharing the class code (5). Additionally, it provides teachers with the opportunity to quickly create, edit, and provide feedback on assignments. Teachers can use various Google tools such as Gmail for communication, Google Drive for file sharing, Google Calendar for scheduling, and Google Slides for content presentation. Google documents can be edited and commented on, allowing students to develop teamwork skills. Furthermore, some applications can be accessed offline with the necessary settings, thus increasing the flexibility of the learning environment and providing a solution to the access problem in distance education (6). According to a study by Diny et al. (2020), it was determined that the use of GC was effective in improving students' writing skills, and this practice encouraged students' more active participation in the learning process inside and outside the classroom, as well as increasing their interaction with their classmates and teachers (7).

Nurses are often the medical professionals closest to patients and are typically the first to identify neurological changes. Therefore, it is crucial for nursing students to gain practical skills in patient assessment and to be able to effectively evaluate the neurological condition of patients before entering the clinical setting. In this regard, having sufficient knowledge of the anatomy of the nervous system is essential for them to be able to make accurate assessments (8). Anatomy of the nervous system is one of the most challenging subjects for students to understand (9). There is a need for a holistic and detailed examination of the GC environment within the framework of a learning environment, its purpose, the opportunities it offers, its strengths and weaknesses, its implementation experiences, and its future (10).

Although many studies have been conducted on GC, more research is needed, especially on anatomy education, in order to obtain healthy results. Therefore, the purpose of our research is to analyze the impact of GC on student satisfaction and success in learning this difficult-to-understand subject.

MATERIALS AND METHODS

Type of Research

Population and sample of the study

The study population consisted of Siirt University, Faculty of Health Sciences, and Department of Nursing students in the 2022-2023 academic year. Power analysis (NCSS-PASS Statistical package) was performed to determine the number of students in the research sample. This analysis concluded that the sample size should be 135 to conduct a study with $p \leq 0.1$ levels. The students included in the sample group were determined by randomization by a researcher outside the study for the sake of transparency. A selection process was performed in the Excel program for randomization. The study did not include students who had previously taken the Anatomy of the Nervous System course. Participants were divided into three groups.

Group 1: Classically instructed group (n=48),

Group 2: Group instructed with GC (n=48),

Group 3: The group receiving supportive instruction with GC and classical education (n=48).

As a result, the study sample consisted of a total of 144 students who were informed about the purpose of the study, received permission to participate after being informed, and met the sampling criteria of the study.

Data Collection Tools

GC, an e-learning platform, was used in the study. The research data were collected through the "Structured Student Introduction Form," "Google Classroom Satisfaction Questionnaire," and "Knowledge Exam on Anatomy of the Nervous System".

Structured Student Introduction Form

In the Student Introduction form, sociodemographic characteristics of the students, such as age, gender, and educational status, were included. It consists of 3 questions in total.

Google Classroom Satisfaction Questionnaire

The "Google Classroom Satisfaction Questionnaire" prepared for the GC system were used in the research. The survey was developed by Yılmaz et al. (2020) (11). The survey included 10 satisfaction questions about the GC system. The questions are graded on a five-point Likert scale; "1" is completely disagree, "2" is disagree, "3" is partially agree, "4" is agree and "5" is completely agree.

Knowledge Exam on Nervous System Anatomy

The prepared knowledge exam was selected from topics including the nervous system anatomy, and the lecturers of the related course prepared the questions. The exam consists of 20 questions. Four were visual questions based on the atlas image; the others were multiple-choice. Each question was scored 5 points, and the exam was evaluated out of 100 points. The pre-test and post-test contained the same questions.

Design of the Study

The sample for the study was first determined (n=144), and the students participating in the study were asked to fill out the Informed Consent Form. The participants were divided into three groups (n=48) by randomization. After the necessary explanations about the study were made in all three groups, the Structured Student Introduction Form and the Knowledge Test on Anatomy of the Nervous System (pre-test) were applied. Explanations were made about what the students in which group would do. A live lesson was planned for the following week by giving a link to Group 3 and Group 2 via GC. With GC, the topic

was summarized to Group 3 the day before the theoretical lesson, and face-to-face lecturing took place on the day of the class. For Group 2, the subject was explained live on the day of the lecture (as it was explained face-to-face) via GC. Group 2 and Group 3 were told that they could ask questions and communicate with the instructor via GC. Group 1 was taught face-to-face with the classical method. At the end of the training, all three groups were tested with the Anatomy of the Nervous System Knowledge Exam (post-test). Group 2 and Group 3 were administered the Google Classroom Satisfaction Questionnaire, and the data were analyzed (Figure 1).

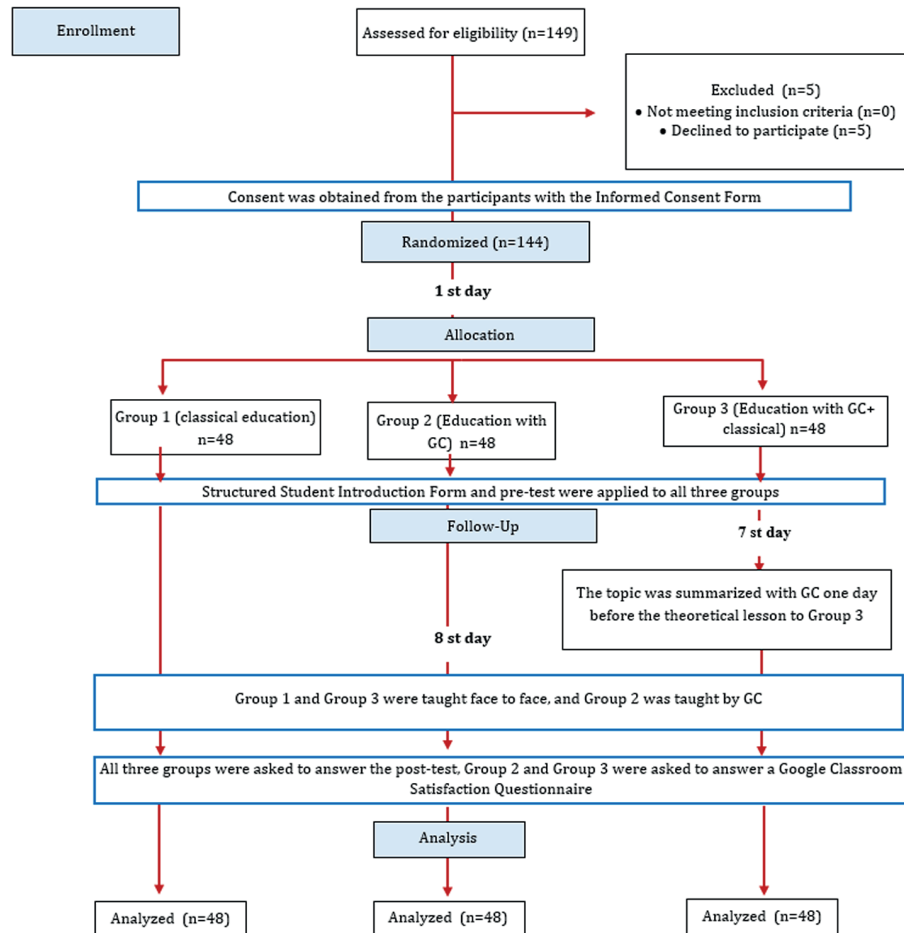


Figure 1. Sample of the study flow chart based on CONSORT 2010 flow diagram

Statistical Analysis

After the data were transferred to the IBM SPSS Statistics 23 package program, frequencies (number, percentage) for categorical variables and descriptive statistics (standard deviation, mean) for numerical variables were used in the analysis. For the numerical variables (scale and subscale scores) to be statistically tested, normality was checked separately in the control and experimental groups by normality testing and skewness kurtosis coefficients. Parametric statistical methods

were used for normally distributed variables, and nonparametric statistical methods were used for non-normally distributed variables.

- Comparison of (categorical) descriptive characteristics of students in the intervention and control groups=Chi-Square Test,
- Comparison of numerical descriptive characteristics (numerically) of students in the intervention and control groups=Mann Whitney U (t-test in independent groups),

- Comparison of students in the intervention and control groups before and after the instruction (categorical)=Mc Nemar,
- Before and after (numerical) comparison of students in the intervention and control groups=Wilcoxon Test (t-test in dependent groups),
- Pearson correlation analysis determined the relationship between total scale scores.

Ethical Approval

The study was started with the decision taken by Siirt University Ethics Committee with the date 30.12.2022 and number 4038. Informed Consent Form was obtained from the participants.

RESULTS

80 of the 144 participants were female (55.6%) and 64 were male (44.4%) (Table 1). The mean age of the students was 19.1 years.

Table 1. Gender distribution of the students in the study

Gender	n	%
Female	80	55.60
Male	64	44.40
Total	144	100

Content analysis of the data collected from the students through the Google Classroom Satisfaction Questionnaire was conducted in detail. According to the results, students stated that they found GC easy to use (47.8% agree, 13% completely agree), they were satisfied with the GC system (45.7% agree, 13% completely agree), they could easily access course content (47.8% agree, 28.3% completely agree), they could easily upload their homework to the system (28.3% agree, 13% completely agree, 43.5% partially agree) (Figure 2).

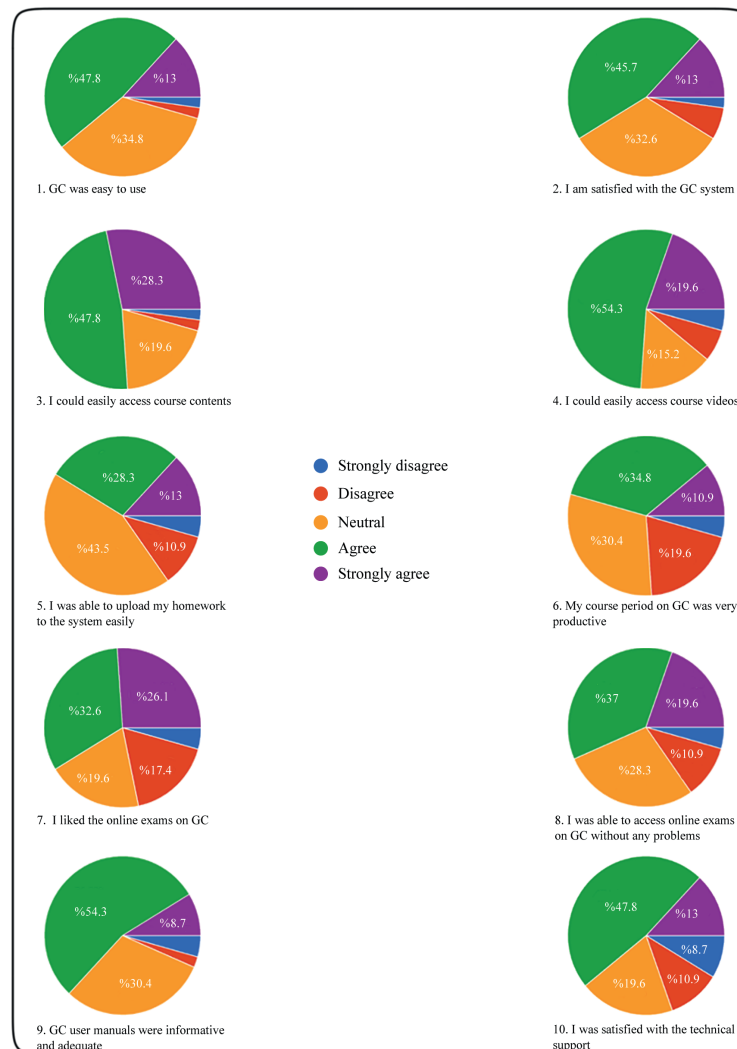


Figure 2. Google Classroom Satisfaction Survey results

When the intra-group and inter-group differentiation of the achievement test was examined, it was seen that there was a significant difference between the pre-test and post-test in all three groups ($p<0.05$). The post-test achievement level was significantly higher than the pre-test achievement level. When the differentiation of the achievement tests between the groups was examined, it was seen that there was no significant difference between the groups in the pre-test. At the same time, there was a significant difference between the groups in the post-test ($p<0.05$). According to the pairwise comparisons made

to determine from which group the difference originated, the increase in the post-test achievement level of Group 2 and Group 3 was significantly higher than Group 1, and the increase in the post-test achievement level of Group 3 was significantly higher than Group 2 (Table 2).

The results of the descriptive analysis of the data related to the question "What are your positive or negative comments about this education system you use?" asked the students through the questionnaire form are given in Table 3.

Table 2. Pre-test and post-test scoring differences between groups

	Pre-test	Post-test	p-value
	Average ($\pm$ SD)	Average ($\pm$ SD)	
Group 1	11.35 $\pm$ 4.21	50.41 $\pm$ 11.10	*0.00
Group 2	11.56 $\pm$ 4.96	50.83 $\pm$ 11.21	*0.00
Group 3	11.25 $\pm$ 5.30	61.14 $\pm$ 9.06	*0.00
p value	0.950	*0.00	

SD: standard deviation, *: $p<0.05$

Table 3. Themes and sub-themes for the question "what are your positive or negative comments about this education system you use?"

	Themes	Sub-themes
Group 2	1. Positive comments	a. No time and place constraints b. Having many opportunities to repeat the lesson c. The training technique used is easy to use
	2. Negative comments	a. Problems with internet access b. Internet should be free of charge c. It should be used as a support rather than an alternative to face-to-face education
Group 3	1. Positive comments	a. It increases comprehension and retention of the lesson b. It increases motivation c. It is possible to repeat regardless of time and space
	2. Negative comments	a. Distraction in distance education b. There are problems with the internet

Student views on the sub-themes of the main themes for Group 2 are as follows.

- 1.a. "It was beneficial to follow the lesson wherever and whenever we wanted and to listen to it again."
- 1.b. "Access to the course content allowed us to repeat the course as much as we wanted."
- 1.c. "GC was an easy-to-use, understandable system."
- 2.a. "It is difficult to connect to the course at times and places where internet access is difficult."
- 2.b. "Since our internet quota is limited, I had difficulty attending classes. It would be useful if the internet were

provided only for classes."

- 2.c. "Supporting the courses with distance education would be more beneficial than only distance education."

For Group 3, student views on the sub-themes related to the main themes are as follows.

- 1.a. "GC made it easier for me to understand and memorize the lesson."
- 1.b. "Listening to the lesson summarized beforehand increased our motivation for the lesson."
- 1.c. "Being able to repeat the lesson whenever we want made it easier for me to study."

2.a. "When I evaluate it compared to face-to-face training, it can be distracting."

2.b. "We had problems with the internet (internet signal and internet limit)."

DISCUSSION

Nursing education continues to evolve worldwide to support clinical and professional roles, and it is vital for nursing students to have a strong understanding of anatomy to become successful practitioners post-graduation (12).

A thorough understanding of human anatomy is vital for a comprehensive grasp of the human body. Educators tasked with teaching anatomy play a significant role in this regard (13). The ongoing discussion surrounding the most effective methods for teaching anatomy reflects the evolution of educational practices. While cadaver dissection has historically been the primary method for gaining anatomical knowledge, its outdated, costly, and time-consuming nature, as well as potential hazards, have rendered it less favorable. The shift from standalone anatomy courses to integrated, system-based curricula, along with the challenges of limited resources and teaching personnel, has prompted many Western institutions to embrace more efficient and modern teaching approaches such as plastination. Online learning platforms offer a pathway for the advancement of anatomy education (14). These platforms make theoretical courses more engaging, enhancing learning and problem-solving skills. They extend the benefits of virtual classrooms to medical and health sciences students worldwide (15).

Many nursing students may struggle to recall and apply anatomy knowledge, leading to some students experiencing difficulties and performing poorly in both classes and clinical practice. Traditional educational methods encompass theoretical lectures and laboratory work, but this method may be insufficient for some students; therefore, the learning process can be made more efficient by utilizing new and interactive methods (16).

Like in higher education at all levels, distance learning has gained popularity in education, and as with any new learning environment, GC has been well-received within the educational community (17,18). Many studies have been conducted on the role and effectiveness of GC in education, yielding positive results on students (19-21). In this study, aimed at evaluating the impact of virtual classrooms on anatomy education, we found that virtual classrooms, alongside traditional education, increased students' academic achievement and interest in classes. While students generally expressed satisfaction with its usability, they reported minor issues such as internet access and uploading assignments. Another study using the GC application also found, based on survey data from 163 students, that it was easy to use, increased motivation, but encountered problems with uploading and downloading assignments when there were internet access issues (22).

With the convenience of technology, learning is no longer limited by space, distance, or time. GC enables distance learning and provides flexibility, time-saving, and ease of use (23). At the same time, students can gather and continue their studies with their peers outside of school (24). In the study, it was observed that students generally responded positively to the questions in the satisfaction survey. They mentioned that the absence of time and space constraints had a positive effect on increasing interest in classes, and the opportunity for continuous revision had a positive impact on understanding the lessons and their memorability. In a study conducted after the pandemic, it was found that the use of GC was easy for both students and teachers, and materials and assignments were easily accessible as they were provided by Google. Additionally, in this study, it was observed that GC provided a platform for students and teachers to submit assignments from anywhere at any time. However, weak connections prolonged the download and upload processes for students to submit assignments (25). Similar results were observed in our study, and besides positive feedback, we identified issues with activities such as uploading assignments and downloading lecture notes, which we believe may be due to a lack of information. This finding is also supported by other studies in the literature (14,23,26). Therefore, it would be beneficial to provide appropriate training to students on how to use GC before implementing virtual classrooms. The GC application is easy to use and free (27-29). However, another problem we identified in the study is related to internet access. Students have stated that unlimited and free internet access is necessary to effectively use this system.

It is an undisputed fact that technology has yielded positive results in education. However, distance learning can disadvantage student groups with attention deficits and lack of internal motivation (30). Some studies have shown that a significant majority of students struggle with time management in distance education, and they find it challenging to concentrate at home, leading to a lack of self-motivation (31,32). When we look at the results of our study, we see that students were generally satisfied with distance education through GC and found it easy to use. However, a small number of students mentioned that face-to-face education was better and that they felt distracted during GC education. Additionally, we observed that both students receiving education through GC and face-to-face education were more successful compared to other groups.

In a randomized controlled study, 74 nursing students were randomly assigned to experimental (n=39) and control (n=35) groups. While the experimental group received one hour of traditional instruction and GC education per week, the control group received two hours of traditional instruction per week. The results showed that the experimental group scored higher than the control group in terms of acceptance of GC, learning satisfaction, and academic achievement. Additionally, it was found that the experimental group found GC enjoyable and

beneficial, and the blended learning method provided similar learning satisfaction and academic achievement as the traditional learning method (33).

In a comprehensive study conducted before, during, and after the COVID-19 pandemic, the learning achievements of nursing students in anatomy and physiology courses were compared. The study found that during the COVID-19 period, exam scores were significantly higher than those before the COVID-19 period, but there was no difference between the pre-COVID-19 and post-COVID-19 periods. Additionally, it was concluded that nursing students would prefer synchronous, online, and hybrid learning modes to learn anatomy and physiology in the event of a new coronavirus situation in the future (34). Therefore, virtual classrooms such as GC should be used not independently but integrated into traditional education for teaching and learning activities. GC enables effective communication and a smoother workflow.

It seems that in the century we live in, students' learning habits have changed, and they have started using tools such as e-books through technological devices instead of traditional textbooks (9). This way, they can use their information without using paper and thus contribute to minimizing paper consumption (27). Following their lessons at home with GC increases students' interest in the class. With this application, student assignments are created in a digital environment, allowing educators to spend more time with their students and less time on documentation (6). Although this virtual classroom has been tried and proven successful in many fields several times, it is not yet actively used, especially in anatomy education in health sciences. When we look at the usage process, it has generally been used for distance education during the COVID-19 pandemic (28,35,36). Integrating these innovative teaching methods into health sciences education is a challenging field. The integration of a new technique does not necessarily mean an increase in the quality of education. It is important for users to adopt the new technique and be able to apply it effectively (27,37-39). In this sense, relevant studies have suggested that the GC platform can assist teachers and students in their learning experience (40).

The opinions of nursing students about the application have been detailed in the satisfaction survey applied in the study. Evaluating the results in general, it has been concluded that GC is suitable for the new generation learning style, easily accepted by students, and feasible.

Limitations of the Research

Although GC is a system that is generally easy to use and satisfied with by students, there are technical constraints such as lack of devices that can access the internet, internet access problems, and limited and paid internet access. In addition, the fact that it was applied to a single department course at a single university and the students did not have sufficient knowledge and infrastructure brought limitations to the study.

CONCLUSION

Students' perception and satisfaction have been measured for GC in health sciences education. In this challenging and long undergraduate education, we have not seen a study measuring success in the literature that we could reach. Since health sciences education is applied, its suitability for distance education can be discussed. However, this study found that distance education as a support to traditional education increases interest in the course, motivation, and, most importantly, success. Our most important conclusion about this study is; Innovative education systems that match the learning styles of today's students should be widely used in health sciences education.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

The study was started with the decision taken by Siirt University Ethics Committee with the date 30.12.2022 and number 4038. Informed Consent Form was obtained from the participants.

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