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Effect of cloud computing on digital content skills and technology acceptance among secondary school students

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ABSTRACT

This paper aims to determine the impact of cloud computing digital content skills and technology acceptance among secondary school students. Using the quasi-experimental research design, the researchers succinctly measured the cloud computing effects on three variables: Cognitive achievement, digital content skills, and technology acceptance. A sample of 86 secondary school students in Jeddah was sampled using the cluster random sampling technique. The sample was divided into an experimental group and a control group; each group consisted of 43 students. Data were collected via a cognitive and performance test and a technology acceptance scale. Findings showed statistically significant differences between the mean scores of the experimental and control groups in the achievement test, the observation sheet, and the post-technology acceptance scale in favor of the experimental group (α=0.05). This indicates a positive impact of cloud computing on digital content skills and technology acceptance among secondary school students. Based on the findings, it is recommended to (a) effectively use cloud computing Apps and (b) replace the traditional paper-based method with technology to effectively store and work on available Apps embedded in cloud computing.

1. Introduction

Rapid digitization in the ongoing era requires individuals and institutions to remain updated, especially educational institutions. The educational sector has become in need of new and appropriate tools to access modern content faster and more effectively (Nalyvaiko et al., 2021). Admittedly, an appropriate learning environment must be linked to the objectives and compatibility between the characteristics of such an environment with the learning objectives to achieve the desired goal (Wilson et al., 2015). Organizations and educational institutions should opt for the good services that cloud computing provides (Yang et al., 2020). For instance, it contributes to and facilitates permanent access to the network at the users' request. Let alone a set of essential services such as software as a Service, SaaS, Platforms as a Service, PaaS, and Infrastructure as an IaaS service (Takabi et al., 2010). That said, cloud computing services empower all those who are interested in the educational field. It is of high flexibility with different options to implement what suits them through the appropriate service. It offers five models, viz. self-service on demand, access to a wide network, multiple rents, pooling of resources, and scalability (Ometov et al., 2022).

It also has several types, including the public cloud, which is concerned with large-sized enterprises, and the private cloud for specific groups. Also, the hybrid cloud allows users to choose by combining general and personal characteristics. Finally, community computing shares its services with a community (Kushida et al., 2011). Information technology has recently witnessed a heavy reliance on cloud computing for its suitability at the level of individuals and organizations. This has increased the challenge for cloud service providers in providing the customers' needs in several aspects, including information security and privacy protection (Tabrizchi and Kuchaki Rafsanjani, 2020). For cloud computing to be used well, a set of elements must be available: Software, applications, platform, service providers, and infrastructure (Pardeshi, 2014).

Cloud computing has characteristics and benefits. It is basically self-service and on-demand as it can be requested anytime and anywhere. It has quick

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flexibility as it provides requests when accepting certain conditions. It also contributes to reducing infrastructure and operation expenses. It enables access to the required services quickly and flexibly (Zhang et al., 2010). The Communications and Information Technology Commission also adds other characteristics–broad network access, resource aggregation, and service measurement (Kushida et al., 2011). Additionally, it costs less, despite faster services and flexibility. It is also environmentally friendly and does not require a certain quality of specific devices (Ruandzy, 2020). At the level of the educational process, it facilitates communication, provides feedback, works as groups via the Internet, and the flexibility of accessing information anytime (Takabi et al., 2010), easy access to tests, programs, training, and sending and receiving all required knowledge. Cloud computing spawns opportunities for improving the quality of education through flexibility and accessibility via the Internet. This facilitates the interaction of students and teachers from multiple locations and exchanging knowledge using cloud-based sites such as Facebook, Twitter, Gmail, and Flickr (Yang et al., 2020).

Cloud computing Apps in education include Google Drive. It is characterized by the storage, exchange, and synchronization of services. It is also a free platform that enables users to access it at any time and provides writing and editing texts, maintaining the confidentiality of information (Slavkov, 2015). What is more, Google Slides, used for presentations, provides a display service through Google. It is an alternative to traditional programs that require download on the device, providing a good space for use, which makes access to this application easy and flexible for all types of users (Takabi et al., 2010). Other cloud computing Apps include blogs, Wikis, cloud storage, image processing, storage, and sharing, creating and sharing electronic exams, storing and sharing videos and sounds, and e-mail service (Aduba and Mayowa-Adebara, 2022).

Despite advantages and features, cloud computing has some pitfalls, primarily privacy and security problems, Internet access, and server maintenance cost (Zhang et al., 2010). Other drawbacks include dependence on service providers and the possibility of data deletion (Takabi et al., 2010). Despite these drawbacks, cloud computing and its Apps have proven effective in the educational process. Lin et al. (2014) identified the potential of Google Docs in supporting collaborative learning. The study sample comprised 28 male and female students at Formosa University in Taiwan. The results revealed increased written contributions through these applications and a high degree of interactivity among the participants. Likewise, Zheng et al. (2015), adopting the semi-experimental research design, examined the role of cloud Google Docs in developing writing skills in the state of Colorado. The sample consisted of 257 students from the sixth grade, divided into an experimental group and a control group. The results showed the effectiveness of integrating this technique among students, increasing their interaction and improving their writing. In a similar vein, Ambrose and Palpanathan (2017), using a semi-experimental research design, studied the role of Google Docs in improving writing skills. The sample of this study consisted of 114 male and female students in a Chinese high school in West Malaysia. The results showed an improvement in favor of the experimental group. It also revealed an improvement in the receptivity of technology.

Other quasi-experimental studies include Wang (2017) and Liou et al. (2016). Wang (2017) identified the impact of cloud computing on students' learning and learner satisfaction. The sample consisted of 18 male and female students who studied for 18 weeks at Central Taiwan University. The results indicated effective teaching in favor of the cloud computing group. Also, they showed positive results in the satisfaction of the learners who use computing. Liou et al. (2016) confirmed learning through a cloud computing system with the traditional approach to teaching science. The study consisted of 92 students from the undergraduate program. The results showed that students with cloud computing had outperformed those with the traditional method.

On the other hand, digital content has a role in digitizing information, making the contents smooth and easy to access and process through which learners take a set of procedures to transform the traditional educational content of the digital image over the Internet into content that includes interactive multimedia, including texts, pictures, graphics, shapes, sounds, videos, and animations (Chang, 2008; Al-Sawy, 2021). Digital content allows learners to learn and access information quickly and through a considerable number of them and with high flexibility of time and geographical location. It also provides the advantage of compatibility with the student's learning speed and the extent of their control over their learning. It requires only an access tool, Internet access, and appropriate digital content (Özcan and Yavuz, 2020).

For digital content to be highly effective, it must include a set of characteristics that contribute to this, represented in displaying information or data in a gradual, smooth, and orderly manner. This consists of the clarity and comprehensiveness of its presentation based on theoretical foundations that support it and be more suitable for and supportive of learning (Cruess et al., 2019). Digital contents are highly interactive, prioritizing content based on the pedagogical approach and connecting to real life. It facilitates understanding, embodying, and teaching abstract concepts in the physical environment and allows high flexibility to develop the scientific material through learners and address any possible error that may stem from high accessibility and instantaneous adjustment (Akbas and Cavus, 2020). On the other hand, technology acceptance is a model that reveals learners' perceptions of technology through embedded factors to measure the desire to

use that technology in the future. Its elements consist of internal behavioral factors represented in ease of use, benefits from it, the behavioral intentions of the individual, the actual use of the individual, and external variables: Represented by demographic variables (Granić and Marangunić, 2019).

In light of this literature review, and due to the scarcity of previous studies on cloud computing, its effects on cognitive and performance aspects, and technology acceptance among secondary school students, as well as calls for exploring the efficiency of such technology, it is necessary to use it appropriately to meet the educational objectives. Thus, the study departs from the principal research question. What is the impact of cloud computing on digital content skills and technology acceptance among secondary school students?

The following hypotheses, which surfaced from this central question, were verified:

- There are no statistically significant differences (at the level of 0.05) between the means of the experimental and control groups in the cognitive aspects of digital content skills among secondary school students.
- There are no statistically significant differences (at the level of 0.05) between the means of the experimental and control groups in the performance aspects of digital content skills among secondary school students.
- There are no statistically significant differences (at the level of 0.05) between the means of experimental group scores of the pretest and posttest regarding the technology acceptance scale among secondary school students.

2. Method

The quasi-experimental quantitative approach was used in this study. Two groups were assembled –an experimental group and a control group. The experimental group used cloud computing, and the control group was taught traditionally (Fig. 1).

2.1. Population and sampling

The target population of the present study comprised all secondary school students in public schools in Jeddah, Saudi Arabia. The sample consisted of 86 students distributed into two groups: An experimental group and a control group. The experimental group students were taught by using cloud computing, while the control group students were taught using the usual traditional method.

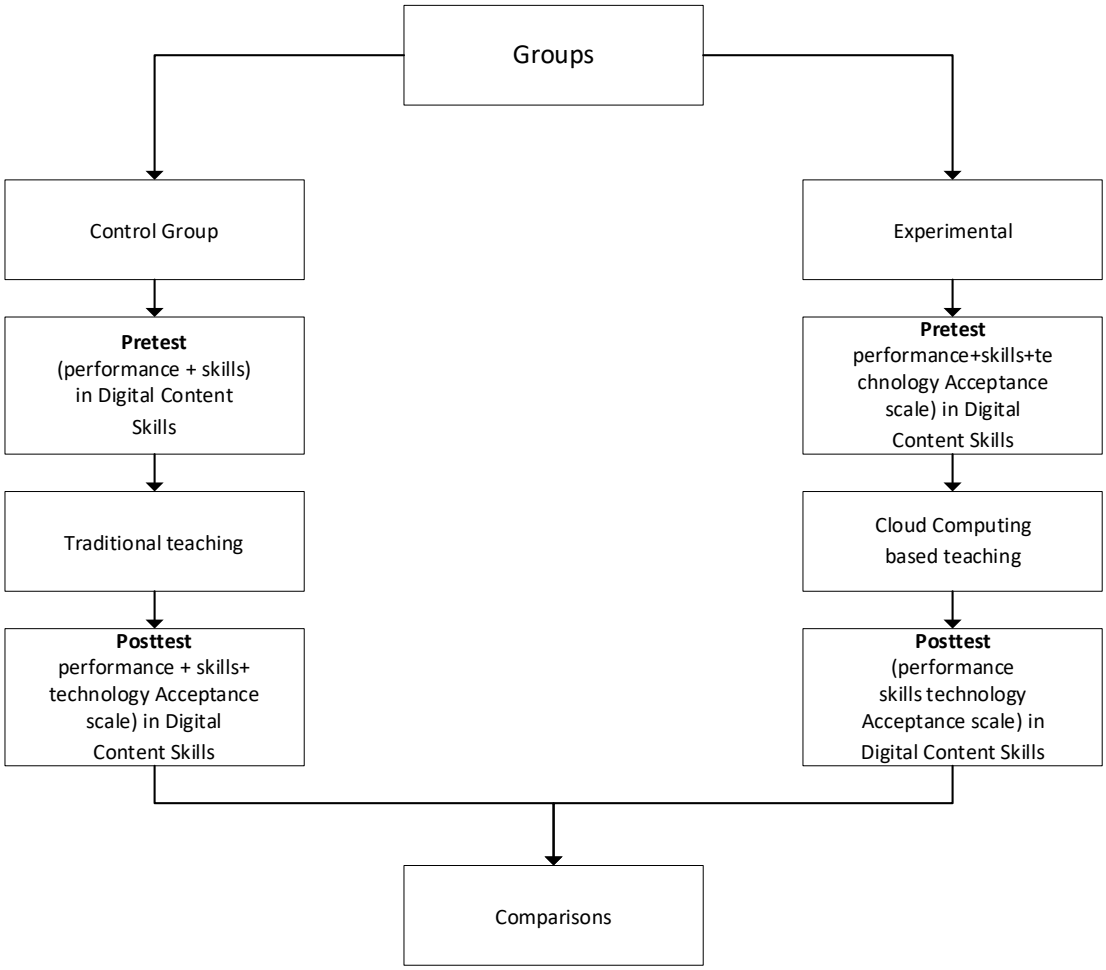

Fig. 1: Experience design (experimental vs control groups)

3. Data collection

Data were collected by using three tools: An achievement test of digital content concepts at the secondary school level, an observational sheet to measure skill aspects, and a scale of technology acceptance with regard to cloud computing. The following is a description of the steps followed in preparing these tools.

3.1. Achievement test

The researchers reviewed relevant literature on evaluation and assessment to familiarize themselves with the steps of achievement test preparation. In this light, the purpose of the test was determined: Measuring the concepts included in the 'Documents, Forms, and Reports' Unit in the digital content of secondary school students in the Kingdom of Saudi Arabia. The unit was analyzed, and concepts, terminology, facts, and principles were identified. The relative weight of each content element was given a percentage. The test included 15 items of four multiple choices. Each test item consisted of two parts: The introduction to the question and four alternatives. One of them represents the correct answer, and three alternatives represent the wrong answers (subliminal).

To verify the validity of the test, the researchers presented the test in its initial form to a group of computer teachers, experts in science teaching methods, and specialist evaluators to verify the clarity and accuracy of the items as well as the validity of the scientific materials/content, its relevance to the academic level, degree of harmony of each item with the goal of measurement, the extent to which the items cover the objectives of the unit, and the clarity of instructions. The experts unanimously agreed on the validity of the scientific content of the items, their relevance to the academic level, coverage of the cognitive goals that the target unit seeks to achieve, the consistency of the items with the goals they measure, and the clarity of instructions. The arbitrators suggested modifying the language of some phrases in the test, whether in the body of the items or their alternatives. Considering these suggestions, the researchers reviewed the items and made the proposed amendments.

When correcting the test, each item marked correct was given one point, and the wrong answer was given a zero point. The total score on the test ranged between zero and 15. The effectiveness of the items and the reliability of the test were ascertained. Having the test designed and modified in the light of the arbitrators' feedback, it was piloted on a random exploratory sample of 43 high school students in a school in the Jeddah Governorate during the third semester of the academic year 2022.

This pilot study helped to calculate the coefficients of difficulty of each item, estimate the reliability of the test, and determine the appropriate time for the test. The results revealed that all items had appropriate difficulty coefficients, ranging between 0.40 and 0.52. In contrast, the discrimination coefficients ranged between 0.40 and 0.59, which are acceptable discrimination indexes.

Cronbach's alpha equation confirmed the test's reliability. The Cronbach's alpha of all the test items was high, and the Cronbach's alpha of the tool was 0.85. This indicates the test has a very high-reliability score. This is considered an acceptable score of reliability of the test. As for determining the appropriate time for the test, the researchers calculated the test time taken by the first and last students who answered the test. The time required for answering the test was estimated at 40 minutes.

3.2. Observational sheet

The Skill Observation Sheet was based on quantitative estimation levels (namely, mastered, somewhat mastered, and not mastered). The performance evaluation scores were distributed according to the following: Two degrees for those who have 'mastered', one for 'somewhat mastered', and zero for 'did not master'. The validity of the observational sheet was verified by using the arbitrators' validity. The arbitrators' opinions were obtained to re-appropriate some of the items on the sheet to measure the required skills under scrutiny. The reliability of the sheet was also checked by following the arbitrators' agreement technique, and the coefficient of the agreement was calculated through the Cooper equation; the percentage of the agreement was 100%, which is considered a high-reliability rate, making the observational sheet suitable for the present investigation.

3.3. Technology acceptance scale

The technology acceptance scale was built in light of the literature (Salloum et al., 2019). To check the suitability of the scale in the current investigation, the authors checked its psychometric properties as explained below. The scale's validity was verified in two ways: The arbitrators' validity and the internal consistency's validity. The former was checked after completing the appropriateness of the questionnaire's items to the sample taken. It was presented in its initial form to some experts to obtain their opinions on the necessary amendment or deletion of some items in the questionnaire. The latter was checked statistically by calculating the scale's internal consistency and verified by calculating the correlation coefficients between each item and the total score for its axis. The results were as shown in Table 1.

As data in Table 1 indicates, all questionnaire items were consistent with the axis they belong to, as they were all significant at the significance level of 0.01. The correlation coefficient ranged between 0.50 and 0.75. This indicates that the correlation of the items with the total score in all axes was very high as the correlation coefficient for all items

exceeded 0.05 so all items became statistically significant at the level 0.01, which indicates that the scale has a high degree of validity.

As for the reliability of the scale, the researchers ensured the tool's stability with Cronbach's alpha, as the results indicate that the value of Cronbach's alpha for all paragraphs of the search tool was high, as the value of Cronbach's alpha for the tool was (0.90). This indicates that the resolution enjoys a very high and reassuring degree of stability, and this value was considered acceptable for conducting this research.

4. Results

The means and standard deviations of the participant's scores in the experimental and control groups were calculated on the pre and post-achievement tests, and the results are displayed in Table 2.

Table 2 shows the difference between the means of achievement in the control and experimental groups on the pre-achievement test. It is then necessary to determine the significance of the difference. For this purpose, the t-test of the independent groups was used to reveal the significance (Table 3).

As data in Table 3 shows, there is no statistically significant difference between the means of achievement in the control and experimental groups in the pre-test in digital content skills, which indicates that the two groups were identical before starting the experiment. Given the observation sheet in which all the groups scored zero, it could be inferred that there were no differences in skills between groups before the experiment.

Table 1: Internal consistency of the technology acceptance scale

Scale of technology acceptance								
Items	1	2	3	4	5	6	7	8
Coefficient	0.70	0.68	0.61	0.75	0.60	0.56	0.61	0.75
items	9	10	11	12	13	14	15	16
Coefficient	0.61	0.58	0.67	0.56	0.60	0.70	0.68	0.50

Table 2: Means and standard deviations of participants' scores in the experimental and control groups in the pre-post-tests

Test	Group	N	Mean	SD
Pretest	Control	43	5.7442	2.2896
	Experimental	43	6.2857	2.5689
Posttest	Control	43	9.4419	1.96762
	Experimental	43	10.8372	1.88894

Table 3: T-test results of the significance of the difference between the achievement means in the control and pre-experimental groups in the digital content skills

Group	N	Mean	SD	t	F	Sig.
Control	43	5.7442	2.2896	0.93	41	0.354
Experimental	43	6.2857	2.5689			

On the other hand, the means and standard deviations of the experimental groups' scores were calculated on the scale of technology acceptance towards the pre and post-digital content (Table 4).

Table 4: Means and standard deviations of participants' scores in the experimental group (pre-post-test) on the technology acceptance scale

Technology acceptance	group	N	Mean	St. D
Pre	Experimental (Pre)	43	51.2857	4.850
Post	Experimental (post)	43	61.3721	6.256

As Table 4 indicates, there is a difference between the mean scores of the experimental group (pre and post-test) on the pre-technology acceptance scale towards digital content, which calls for revealing the significance of this difference. Hence, the t-test of the independent groups was used, and the results are outlined in Table 5. As data in Table 5 shows, there is no statistically significant difference between the mean scores of the pre-experimental group on the pre-technology acceptance scale, which indicates that the pre and post-group scores were identical before the experiment.

Table 5: T-test results of the significance of the difference between the mean scores of participants in the experimental group (pretest) on the technology acceptance scale

Group	N	Mean	SD	t	F	Sig.
Experimental (pre)	43	51.2857	4.850	1.59	41	0.118

4.1. First hypothesis

H1: There is no statistically significant effect (α=0.05) of cloud computing on the achievement of secondary school students in digital content skills To test this hypothesis, the t-test of the independent groups was used to ascertain the significance of the difference between the average achievement of students in the control and experimental groups in the post-test in digital content skills (Table 6).

Noticeably, there is a statistically significant difference (α≤0.05) between the means of achievement of the control and post-experimental groups in digital content skills in favor of the

experimental group, meaning that the null hypothesis is rejected. That is, cloud computing has no statistically significant effect on students' achievement in digital content skills. In other words, the alternative hypothesis is accepted, meaning that cloud computing has a statistically significant impact (α=0.05) on the achievement of secondary school students in digital content skills in favor of the experimental group that experienced cloud computing.

Table 6: Results of the t-test of significance of the difference between the mean scores of the products of digital content skills of the control and experimental groups (post)

Group	N	Mean	SD	t	F	Sig.
Control	43	9.4419	1.96762	3.422	42	0.001
Experimental	43	10.8372	1.88894			

4.2. Second hypothesis

H2: There is no statistically significant effect (α=0.05) of cloud computing in digital content production skills among secondary school students. To test the second hypothesis, the t-test of the independent groups was used to ascertain the significance of the difference between the mean scores of participants' digital content production skills in the control and experimental groups in the post-test in digital content skills as summed up in Table 7.

Table 7 shows a statistically significant difference (α≤0.05) between the means of performance of the digital content production skills of the control and experimental groups in digital content skills and in favor of the experimental group. Hence, the null hypothesis is rejected, and the alternative hypothesis is accepted. That is to say, a statistically significant effect exists (α=0.05) of the use of cloud computing on the performance of digital content production skills among secondary school students in digital content skills and for the benefit of the experimental group that studied using cloud computing.

Table 7: Results of t-test of the significance of the difference between the mean scores of digital content skills of participants in the control and experimental groups (post)

Group	N	Mean	SD	t	F	Sig.
Control	43	12.2791	2.333	7.266	42	0.000
Experimental	43	14.6744	1.357			

4.3. Third hypothesis

H3: There is no statistically significant effect (α=0.05) of cloud computing on secondary students' technology acceptance of digital content. To test the third hypothesis, the t-test of the independent groups was used to ascertain the significance of the difference between the mean scores of the students in the experimental group (pre-post-test) on the post-technology acceptance scale toward digital content. Results are outlined in Table 8.

Table 8: Results of the t-test of the significance of the difference between the mean scores of participants in the experimental group (pre- and post-test) on the technology acceptance scale

Group	N	Mean	SD	t	F	Sig.
Pre-experimental	43	52.1395	5.574	6.941	42	0.000
Post-experimental	43	61.3721	6.256			

Table 8 indicates a statistically significant difference (α≤0.05) between the mean scores of the participants in the two experimental groups (pre and post-test) on the post-technology acceptance scale in favor of the post-experimental group. This attests to rejecting the null hypothesis (there is no statistically significant effect (α=0.05) for using cloud computing in improving students' technology acceptance among secondary school students towards digital content). Hence, the alternative hypothesis is accepted. That means the existence of a statistically significant effect (α=0.05) for using cloud computing improves students' technological acceptance of High school students toward digital content.

5. Discussion

Results revealed some benefits to using cloud computing Apps in the aspects of cognition, which is in harmony with previous findings such as Zheng et al. (2015), Ambrose and Palpanathan (2017), Wang (2017), and Liou et al. (2016). This could be attributed to several reasons:

1. Its flexibility in accessing the Internet according to the time and desire of the learner.
2. The fascination factor of technology contributes significantly to the demand for it by students.
3. The teacher's continuous and rapid feedback towards students during their completion of assignments during their use of this technique.
4. The activation of the participatory aspect by the students with each other and the transmission of information made it easier for them to access knowledge faster and suits their ability to comprehend, and this makes them build knowledge among themselves on the one hand and with their teacher who provides them with immediate nutrition, on the other hand, especially the support and services provided by cloud computing to beneficiaries at any time.
5. This generation's experience with technology gives them the skills of control, freedom, and attraction

towards technology, which makes it easier for new knowledge to settle in their memory and to adapt to it easily.

6. The competition among the participants through their achievement of work and their knowledge of the time when their colleagues completed the duties made this an internal test for them to complete faster and more effectively than their colleagues, which made this competition reflected on their knowledge progress on the one hand and skills on the other hand.

The results also showed a positive impact on students' technology acceptance. This may be because cloud computing Apps give way to an exciting learning environment and provide continuous reinforcement among colleagues and teachers. Perhaps, students' interaction with computers and students' command of PCs increase their self-confidence through self-reliance or self-learning. It may also stem from a change in the learning environment– a more flexible and exciting environment. Additionally, what the cloud computing environment offers is an important factor that underlies the good effect on students' technology acceptance. Such an environment is competitive and provides immediate and fair follow-up, giving them a feeling of comfort towards it. Moreover, this generation's inner submission to modern technologies instigates some of them to work with some effort so that this technology educationally wins over the traditional methods, which appear to be a boredom motivator as it barely fits their needs at this time. What is more, this generation's inner submission to modern technologies instigates some of them to work with some effort so that this technology educationally wins over the traditional methods, which appear to be a boredom motivator as it barely fits their needs at this time.

Given the results and discussion, the study suggests adopting cloud computing apps instead of traditional paper-based learning. It is strongly recommended to effectively adopt such technology by storing and working on the available applications provided by cloud computing. The study also suggests conducting more studies on other applications in the educational field.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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