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THE EFFECTIVENESS OF USING DATA ANALYSIS TECHNOLOGY IN ENHANCING DEEP LEARNING

Taha Mansor Khawaji[1] and Abdellah Ibrahim Mohammed Elfeky[2]

[1]Umm Al-Qura University, Makkah, Saudi Arabia, tmkhawaji@uqu.edu.sa
https://orcid.org/0009-0001-9889-6866
[2]Kafrelsheikh University, Kafrelsheikh, Egypt, abdalah.elfeqi@spe.kfs.edu.eg
https://orcid.org/0000-0001-9208-8537

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ABSTRACT

The aim of this research is to determine whether applying data analysis technology may enhancing deep learning among Postgraduate students in the educational technology master's program. The sample consisted of fifty postgraduate students in the educational technology master's program in the College of Specific Education. Additionally, they were split into two equal experimental groups at random. The first experimental group learned through an e-learning platform with the use of data analysis technology. While the second experimental group learned through the electronic educational platform without using data analysis technology. The results of the study showed that the use of technology of data analysis in the electronic educational platform had a significant positive impact on enhancing deep learning aspects (linking concepts, critical thinking, and forming new concepts) for master's learners in educational technologies.

KEYWORDS: Data Analysis Technique, Big Data, Electronic Educational Platforms, Deep Learning, Education Technologies.

1. INTRODUCTION

The process of looking at a lot of data to find undiscovered correlations, obscure patterns, and other relevant information that can be utilized to make better decisions is known as data analysis technology (Taru & Shri, 2021). Data analysis technology provides many opportunities to achieve significant progress in many areas, given that it is of great benefit in making decisions that aim to increase productivity (Sharma, Tiwari, & Anand, 2017). This technology also helps analysts and researchers reach new results that allow them to make faster decisions using previously inaccessible data (Elfeky, Hassanein, Zayed, Khalladi, & Elbyaly, 2025; Taru & Shri, 2021). Many educational institutions have also been interested in taking advantage of the high potential of data analysis technology in the past few years (Elfeky, Hassanein, Zayed, Mahmoud, & Elbyaly, 2025), this gives academic scholars the chance to examine intricate educational issues broadly utilizing cutting-edge methods and technologies. (Masada, 2017; Mayer-Schönberger, 2016).

In addition, the technique of analyzing data related to the interaction generated by learners with learning management systems (LMSs) is a current trend in university education (Cantabella, Martínez-España, & Ayuso, 2019). LMSs are a major source of data on student behavior on the one hand, and on the other, data analysis technology enables researchers to better comprehend how participants learn in online learning environments (Elfeky, Hassanein, Zayed, Mohamed, & Elbyaly, 2025). More specifically, analytics technology provides data collected from digital learning platforms such as LMSs contain crucial data that can help students and lecturers to academic goals development (Cantabella et al., 2019; Elfeky, Hassanein, Zayed, Mohamed, et al., 2025). An example of data that can be collected from a learning management system (LMS) is video interaction events (Hassanein, Elfeky, Ismail, & Elbyaly, 2025; Masada, 2017). Video interaction events are cognitive interactions that involve pausing, watching slowly, and going backwards to get information from a video (F. K. Alzahrani & Alhalafawy, 2023; Li & Baker, 2018).

Deep learning allows the learner to relate previous experiences and knowledge to new ideas and topics. This leads to greater academic success in courses that require the integration and application of expertise (Alt & Boniel-Nissim, 2018; Hassanein, Elfeky, khttab Madkour, & Elbyaly, 2025; Kamyab, Azimifar, Sabzi, & Fieguth, 2022). Previous studies also indicate that deep learning activates the learner's awareness of cognitive phenomena (Belcaid, Martinez, & Leigh, 2022; Elfeky, Najmi, & Elbyaly, 2024a; Filius et al., 2018). There are two main types of learning that students can use: surface learning and deep learning (Filius et al., 2018; Javed, Awais, Shoaib, Khurshid, & Othman, 2023). Deep learning is a learning process that takes place because of learners' collaboration, reflection, and social negotiation on their own practices of learning. It is a process supported by constructivist learning theory (Elfeky, Najmi, & Elbyaly, 2024b; Liu & Zhu, 2016; Najmi, Alhalafawy, & Zaki, 2023). Deep learning is an approach to complex personal development that involves changing learning habits, beliefs and cognitive concepts. Deep learning focuses on main ideas, core meanings, principles, themes, and emphasizes the significance of using evidence across contexts, refining ideas, and applying knowledge (Donnison & Penn-Edwards, 2012; Elbyaly & Elfeky, 2022a; Suganthi et al., 2022). On the other hand, superficial learning is passive processing of information and lacks thinking (Elfeky, Najmi, & Elbyaly, 2023; Lee & Baek, 2012). It treats the course as routine memorization of facts and execution of procedures. Surface learning focuses on irrelevant parts of knowledge and on the lowest course requirements (Alanzi & Alhalafawy, 2022; Alzahrani, Alshammary, & Alhalafawy, 2022; Donnison & Penn-Edwards, 2012).

As a formative learning activity, deep learning necessitates that students relate topics and concepts to their existing knowledge and experiences. This alludes to the notion that information acquired before learning should be considered while understanding content and skills. (Alt & Boniel-Nissim, 2018; A. Elfeky, 2017). Meanwhile, learners who engage in superficial learning - which is restricted to memorization of information by heart - must repeat or memorize study material in order to succeed (Alharbi, Elfeky, & Ahmed, 2022; Filius et al., 2018). Only the basics of the courses are learned through it (Elbyaly & Elfeky, 2022b; Rozgonjuk, Saal, & Täht, 2018). It should be noted that deep learning consists of three main aspects, which are critical thinking, linking concepts, and forming new concepts (Elbourhamy, Najmi, & Elfeky, 2023; Filius et al., 2018). Deep learning also leads to the development of success and academic performance (Elfeky & Elbyaly, 2023; Karaman, Demirci, & Özdemir, 2019). Deep learners can be efficiently supported in professional settings, where online tools are used. Despite the fact that numerous research on the use of data analysis technology to improve teaching and learning have been carried out

(Elfeky & Elbyaly, 2021; Huda, Maseleno, & Atmotiyoso, 2018), research on the effectiveness of using data analysis technology to enhance deep learning are still insufficient. Therefore, the current research attempts to bridge this gap by examining the effectiveness of using data analysis technology in enhancing deep learning among postgraduate students in the educational technology master's program.

Besides, the researchers' observation during teaching is that there is a shortcoming in achieving the goals of the "research project" course among a large percentage of postgraduate students in the educational technology master's program. Since this course requires the integration and application of experience, deep learning is one of the requirements for success in this course, which allows the student to link new ideas and topics with previous experiences and knowledge. To confirm the previous observation, open interviews were conducted through a virtual classroom via the Blackboard system with (20) students who had completed the course in the previous semester to conduct the study. On the basis of the aforementioned, the problem of this study can be formulated in an attempt to identify the effectiveness of using data analysis technology in enhancing deep learning among postgraduate students in the educational technology master's program.

2. METHODOLOGY

The quasi-experimental approach was used in order to find out utilize of data analysis technology in enhancing deep learning among postgraduate students in the educational technology master's program, which required utilize of the pre-post-experimental design, by applying it to two groups of equal learners.

Table 1: Quasi-experimental Design.

	Pre-test	Treatment	Post-test
The first group	The deep learning evaluation card	Data analysis technology in Blackboard	The deep learning evaluation card
The second group		Blackboard	

2.1. Research Tool (The Deep Learning Evaluation Card)

In order to evaluate aspects of deep learning (depending on the research plans submitted by the study sample and related to the "research project" course), the researchers prepared an evaluation card. This is done by referring to previous studies and reviewing the educational literature that dealt with deep learning measures. Such as Elbyaly (2016); Elbyaly and El-Fawakhry (2016); Jung, Shin, and Zumbach (2019); Pegrum, Bartle, and Longnecker (2015).

The evaluation card consisted of three main aspects represented in critical thinking, linking concepts and forming new concepts. These aspects were identified by reference also to previous studies and literature such as Alt and Boniel-Nissim (2018); (Elfeky et al., 2024b); Filius et al. (2018).

To confirm the authenticity of the evaluation card, it was shown to a panel of experts and specialists. Experts were asked to give their opinions on the scorecard as to how appropriate the scorecard items were to measure each aspect of deep learning. Moreover, the extent of its language integrity and clarity, and what can be added or deleted from those paragraphs, and any other observations or suggestions. The researchers considered that the agreement in the opinions of (80%) of the experts and specialists is sufficient to accept the paragraph, and during the final preparation of the evaluation card, the experts and specialists' observations were taken into account. The deep learning evaluation card in its final form consisted of (8) items for critical thinking, (6) items for linking concepts, and (6) items for forming new concepts. A five-point Likert scale (from 5 = very much to 1 = very little) was used for each sub-skill of the scorecard.

In addition, by applying the card to the research plans submitted by an exploratory sample not included in the actual study (25 students). Moreover, using Cronbach's Alpha for the internal consistency of card paragraphs to check the stability of the card. The stability coefficient value was (0.87) for the card as a whole.

Thus, the deep learning evaluation card is ready to evaluate the research plans submitted by the study sample and related to the "Research Project" course. So that each research plan is evaluated three times by three specialized and impartial faculty members. The researchers then calculate the average score of the assessors for each research plan to be the final score for each student.

2.2. Ensure That the Two Groups are Equal in Deep Learning

Each student participating in the study was assigned through an announcement in the Blackboard system at the beginning of the first week of the study (Sunday) with a research plan (to be completed within a maximum of one week and submitted electronically via the Blackboard system). By evaluating the initial research plans by an independent faculty member using the deep learning scorecard, evidence for the pre-application of deep learning is obtained. The homogeneity of the two study groups can be confirmed by analyzing the extracted data through SEM using Multiple-group (CFA) aspects of deep learning (critical thinking, linking concepts, and forming new concepts).

Figure (1) reveals that deep learning in the first experimental group was weakly affected by both the critical thinking aspect ($p > 0.05$; ß = 0.31), the conceptual linking aspect ($p > 0.05$; ß = 0.19), and the formation of new concepts ($p > 0.05$; ß = 0.26). Likewise, deep learning in the second experimental group was weakly affected by critical thinking ($p > 0.05$; ß = 0.28), linking concepts ($p > 0.05$; ß = 0.23), and forming new concepts ($p > 0.05$; ß = 0.32). That is, the students in both experimental groups were homogenous in deep learning before exposure to the experiment.

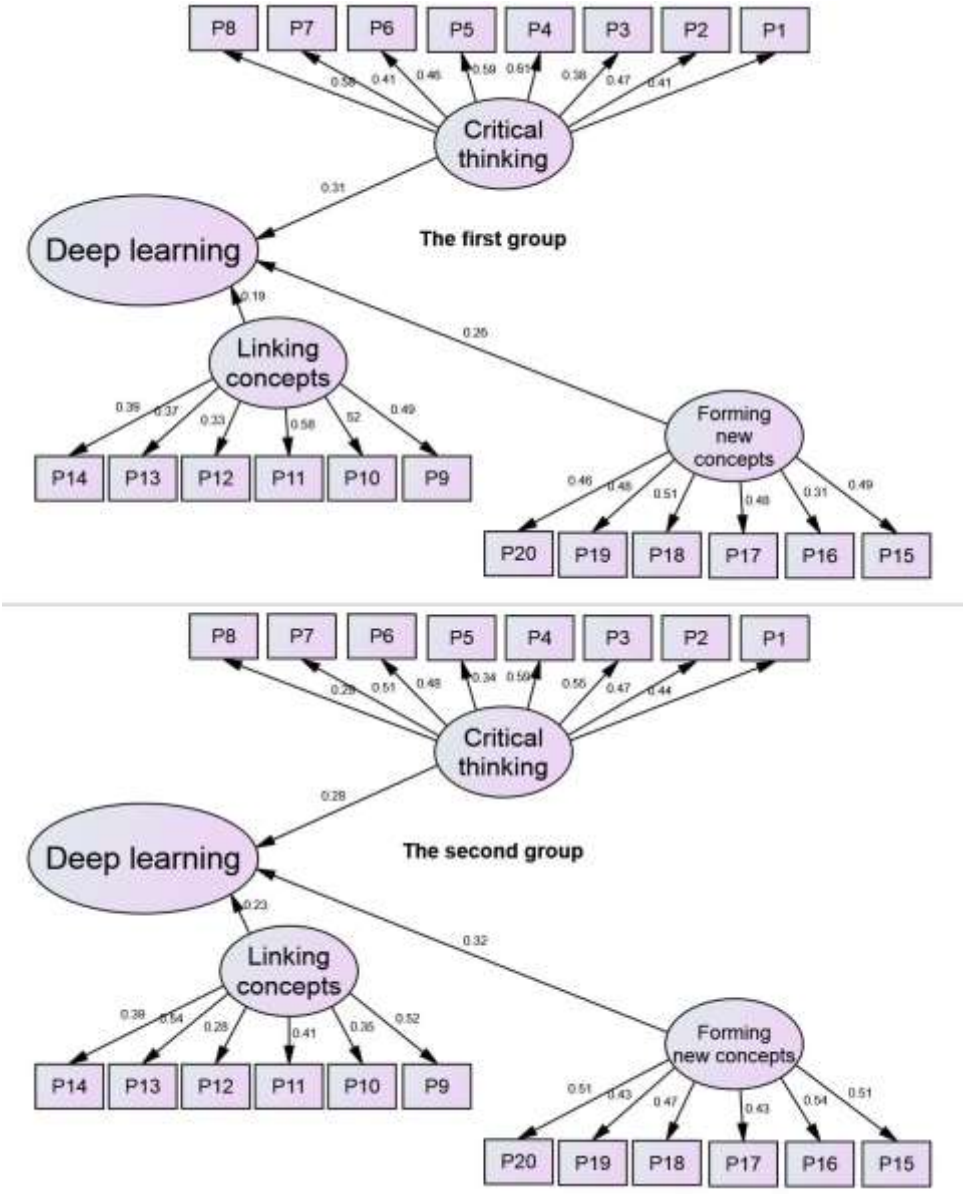

Figure 1: Multiple-Group Pre-CFA for the Aspects of Deep Learning for the Two Study Groups, and the Indicators of Model Suitability Are: CMIN = 188 (p = 0.715; CMIN (χ2)/df = .95; df = 196), IFI = 96 PRATIO = .94, CFI = 0.97 RMSEA = 0.037

2.3. Experimental Processing Material

The sample of the current study, as mentioned, was randomly divided into two equally sized groups. On the Blackboard system, they all watched video lectures to learn. Each learner had to study each video lecture individually online, in addition to using Blackboard's own tools such as course messaging, email, chat room, and discussion board. All the learners of the second experimental group receive equal assistance from the lecturer through the Blackboard tools. The first experimental group's students, On the other hand, were split into three subgroups: inactive (likely to fail), active, and very active. This is done by using data analysis technology for video interaction events each week through the detailed statistics of the student associated Follow-up Center and its Overview for Single Course report. Students rated inactive (likely to fail) were further assisted by the instructor through the aforementioned Blackboard tools. With the aim of improving interaction with the video lectures provided.

2.4. Consent Form

We received informed consent from participants of our study, and that it was written consent.

3. RESULTS

Post application scores for aspects of the deep learning assessment card (critical thinking, linking concepts, and forming new concepts) were extracted for the two study groups. Then also using SEM using Multiple-group CFA for statistical analysis and extraction of results. Figure (2) shows that the critical thinking of the participants in the first experimental group was affected significantly positively because of using the data analysis technique in the Blackboard system ($p < 0.05$; ß = 0.93). This aspect also significantly positively affected deep learning ($p < 0.05$; ß = 0.89). This is compared to the critical thinking of the learners in the second experimental group, which was influenced by using the Blackboard system (without benefiting from data analysis technology) weakly ($p > 0.05$; ß = 0.46). This aspect also had a weak effect on deep learning ($p > 0.05$; ß = 0.43). The aspect of linking concepts in the first experimental group was also affected significantly positively because of using the data analysis technique ($p < 0.05$; ß = 0.87).

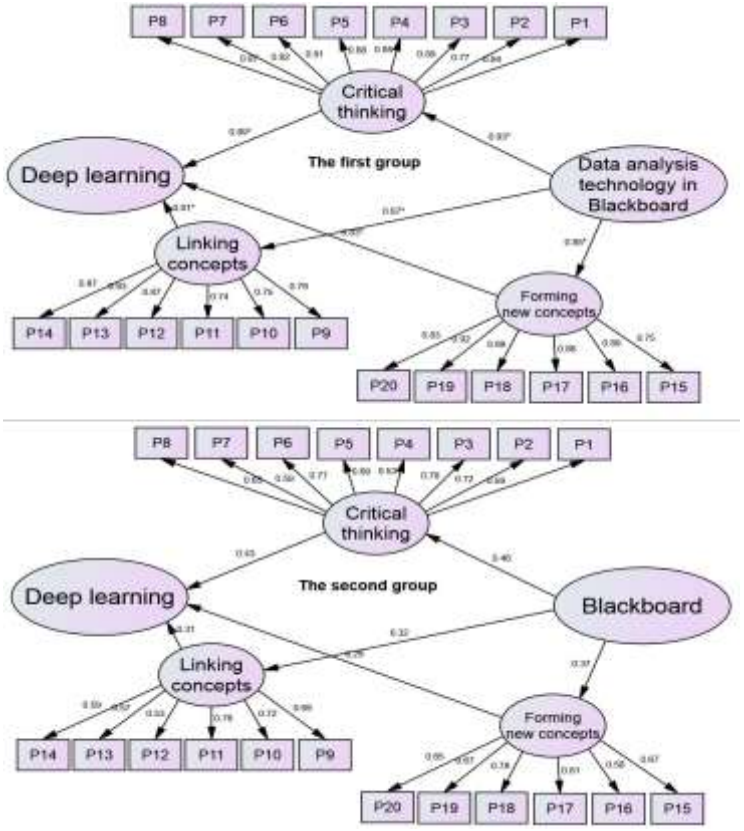

Figure 2: Multiple-Group CFA Posttest for Aspects of Deep Learning for the Two Study Groups, and the Indicators of Model Suitability Are: CMIN = 190 (p = 0.814; CMIN (χ2)/df = .94; df = 194), IFI = 97□ PRATIO = .95, CFI = 0.96□ RMSEA = 0.046

This aspect significantly benefited deep learning as well ($p < 0.05$; ß = 0.81) compared to the aspect of linking concepts in the second experimental group, which was weakly influenced by utilize of the Blackboard system ($p > 0.05$; ß = 0.32). This aspect also had a weak effect on deep learning ($p > 0.05$; ß = 0.31,). Finally, the formation of new concepts in the first experimental group was significantly affected because of using the data analysis technique ($p < 0.05$; ß = 0.85,). This aspect also significantly positively affected deep learning ($p < 0.05$; ß = 0.83). This is compared to the formation of new concepts in the second experimental group, which was affected weakly as a result of using the Blackboard system only ($p > 0.05$; ß = 0.37). This aspect also had a weak effect on deep learning ($p > 0.05$; ß = 0.29).

4. DISCUSSION

The results of this study also indicated that utilize of data analysis technology had a significant positive impact on the development deep learning aspects (linking concepts, critical thinking, and forming new concepts) for learners. The result of this study agreed with other previous studies that examined the effect of using modern techniques and methods on deep learning development. Including the study of Jung et al. (2019) that indicated that pre-directed training in a computer-assisted cooperative learning environment is more effective in achieving deep learning. The study of Pegrum et al. (2015) when comparing results over two years to an enhancement in deep learning from utilize of creative podcasts. Likewise, the study of (Van der Spek, van Oostendorp, & Ch. Meyer, 2013) that utilize of shock event-enhanced didactic games enhanced deep learning.

Moreover, according to the study's findings, the LMS's data analysis technology had a substantial influence on the development of learners' critical thinking, making it a necessary component of cognitive growth for the development of critical thinking. Likewise, this technology also had a great impact on the development of the aspect of linking concepts, that is, linking new knowledge to what they already know. This finding confirms that data analysis technology can provide participants with the support to how to coherently build their new ideas and on build appropriately on their previous ideas. What is most intriguing is that this study's findings support the idea that applying data analysis technologies can improve participants' capacity to create new concepts (as aspect of deep learning). Hence, the learners of the first group, as reported by Elfeky, Masadeh, and Elbyaly (2020); Redondo, López, and Cárdenas (2018), were able to deal with new processes, exercise their intellectual capacities, and innovate.

5. RECOMMENDATIONS

- Training faculty members on the skills of utilizing data analysis technology in educational platforms.
- Conducting similar studies on groups of boys and girls, to confirm the success of using data analysis technology in educational platforms.
- Further studies to be conducted to explore the possibility of enhancing deep learning through other educational technologies.

6. CONCLUSION

The aim of this research is to determine whether applying data analysis technology may enhancing deep learning among postgraduate students in the educational technology master's program. The study's goal was attained using the deep learning evaluation card. The results of the study showed that the use of technology of data analysis in the electronic educational platform had a significant positive impact on enhancing deep learning aspects (linking concepts, critical thinking, and forming new concepts) for postgraduate students in the educational technology master's program. Research importance is directing the interest of faculty members and researchers towards benefiting from data analysis technology when relying on LMS in university education. In addition, deep learning development in the "research project" course for postgraduate students in the educational technology master's program.

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