

The effect of big data technologies usage on social competence

Abdellah Ibrahim Mohammed Elfeky¹, Ali Hassan Najmi² and Marwa Yasien Helmy Elbyaly³

¹ Department of Curriculum and Instruction, College of Education, Najran University, Najran, Saudi Arabia

² Department of Educational Technology, King Abdulaziz University, Jeddah, Saudi Arabia

³ Centre for Sharia, Educational and Humanities Research, Najran University, Najran, Saudi Arabia

ABSTRACT

The learning management system is a digital environment that enables the tracking of learner activities, allowing special forms of data from the academic context to be explored and used to enhance the learning process. This study aims to identify the effect of using big data technology in digital environments on the development of electronic social competence among optimal investment diploma students. An experimental method was used to explore the effect of big data technologies usage on social competence. The sample for this study consisted of (120) students in the Department of Curriculum and Teaching Methods, divided into two equal groups through random selection. The first group studied the course through a digital environment with the use of big data technology, while the second group studied the course through the digital environment without using big data technology. The electronic social competence scale was further utilized as a tool to meet the study's goal. The experimental findings showed that big data technologies in the used digital environment significantly improved the electronic social competence of Optimal Investment Diploma students (personal skills, self-management skills, and academic skills). The results provide significant proof of the advantages of big data technology in social competence studies and development.

Subjects Human-Computer Interaction, Computer Education, Data Science, Databases, Social Computing

Keywords Big data technology, Digital environments, Electronic social competence, Optimal investment, Big data

INTRODUCTION

Social competence is a key quality for college students, as it increases their social cohesion and meets their needs as important members of the classroom, family, and community. Academic success and social competence are related, as improving social competence enhances academic success (*Elbyaly & Elfeky, 2023; Tabassum, Akhter & Iqbal, 2020*). Social competence is the ability to successfully achieve personal goals while using social behaviors that are appropriate for the social contexts in which they are used. This includes the ability to interact effectively with teachers and peers, navigate social situations, communicate effectively, manage emotions, adapt to different contexts, accept others, and self-evaluate one's effectiveness in social interactions (*Martinez et al., 2021; Saltz & Krasteva, 2022; Romera et al., 2017; Almalki & Elfeky, 2022*). Social competence also helps students meet their long- and short-term developmental needs in social environments (*Seitz, 2021*). In the

Submitted 20 June 2023
Accepted 19 October 2023
Published 17 November 2023

Corresponding author
Abdellah Ibrahim Mohammed Elfeky,
abdalah.elfeqi@spe.kfs.edu.eg

Academic editor
Bilal Alatas

Additional Information and
Declarations can be found on
page 10

DOI 10.7717/peerj-cs.1691

© Copyright
2023 Elfeky et al.

Distributed under
Creative Commons CC-BY 4.0

OPEN ACCESS

educational environment, social competence helps students to successfully access courses, meet associated personal, social, and emotional needs, and develop skills and attitudes that are applicable outside the educational institution (*Elbyaly & Elfeky, 2023*).

Recently, the term electronic social competence has surfaced with the shift towards e-learning in many higher education institutions using different educational technologies. With the development of e-learning platforms, electronic social competence in electronic environments has become increasingly important for social adaptation. Electronic social competence is defined as a balance of social skills that help the individual to communicate with others, achieve a kind of social acceptance, and the ability to perform behavior that achieves desirable results. This can be done by using the capabilities and tools of the participatory e-learning environment (*Elfeky, 2017*). Social competence is a broad and relevant field (*Blanca, 2021*), and it is related to the ability of learners to be able to effectively communicate and interact in the educational environment (*Maharani & Usman, 2019*). Learners with high electronic social competence are more integrated into the electronic environment, accepting and sharing knowledge, and have a desire and motivation for more sharing and learning. They are also more adaptive, open-minded, and integrated with digital learning elements compared to learners with low electronic social competence (*Alharbi, Elfeky & Ahmed, 2022*).

The acceleration of digital transformation and improvements in information and communication technologies (ICTs) mean that different sectors must respond more efficiently to new challenges (*Abarca, Palos-Sanchez, & Rus-Arias, 2020; Mora-Cruz, Saura & Palos-Sanchez, 2022*). As a result, there have been many changes in teaching approaches and instructional structures in educational institutions around the world. Analysis is a process through which data is transformed into knowledge that helps make informed decisions (*Wang et al., 2018*). Big data analysis technology is an essential tool that can be used to extract valuable conclusions from data (*Elbyaly & Elfeky, 2023; Javed, Zeadally & Hamida, 2019; Kühn et al., 2018; Rahmani et al., 2021*). Big data analysis technology is a tool that combines mathematics, statistics, computer science, and a specific applied field. Another developing area of research that can offer stakeholders, such as educators and students, some understanding of the learning process is that of big data technologies (*Ahmed, Alharbi & Elfeky, 2022; Binsawad, Abbasi & Sohaib, 2022*). This technology aims to accurately analyze data, enhance creative online learning, and draw conclusions in order to derive insightful knowledge (*Elfeky & Elbyaly, 2019; Javed, Zeadally & Hamida, 2019*).

The digital revolution in social sciences should be taken into consideration, as new methods of information exchange are emerging in digital ecosystems (*Muniesa, Saura & Díaz-Garrido, 2021; Reyes-Menendez, Saura & Filipe, 2019*). Big data usage in higher education also allows us to understand the academic challenges facing learners and defining strategies to address them (*Kamupunga & Chunting, 2019; Zhou et al., 2023*). It gives educational researchers the opportunity to use automated methods and technology to examine a complex educational phenomenon on a large scale (*Daniel, 2019; Elbourhamy, Najmi & Elfeky, 2023*). The objective of this research work is to contribute to a better understanding of the adoption of this technology and service (*Palos-Sanchez, Reyes-Menendez & Saura, 2019*). In addition, the use of an approach based on big data analytics

to develop the online learning process improves the quality of learning by detecting the learner's pattern and improving training courses (Elfeky & Elbyaly, 2021; Masada, 2017; Song et al., 2017). Interactions in learning environments can be effectively modeled and quantified by capturing the actions of students participating in online video lectures and then using machine learning algorithms to analyze the outcomes (Farhan et al., 2018; Saeed, Al Aghbari & Alsharidah, 2020). Student behaviors while engaging with video lectures are called video interaction events, which include slow watching, pausing, and back searching. Access to learners' data has never before been so easy due to pervasive technology advancements in recent years (Blasco-Arcas et al., 2022).

Furthermore, detailed records of student behavior, performance, and other learning-related activities are collected through digital learning platforms (Aguilar, 2018; Saltz & Krasteva, 2022). Learning management systems are considered digital learning platforms that include web-based technologies and software applications used by students for accessing educational content (Ahmed, Alharbi & Elfeky, 2022; Masada, 2017). On this basis, the Blackboard learning management system has been adopted as a platform for managing educational resources and facilitating both synchronous and asynchronous interaction in all courses at Najran University (Elfeky & Elbyaly, 2021). Blackboard records learner interactions meticulously by documenting all learners' activities (Granić & Marangunić, 2019; Song, Zhang & Duan, 2017). Lecturers can easily access detailed reports on learners' activities for specific actions (Elfeky, Alharbi & Ahmed, 2022), such as video interactions and events (slow watching, pausing, and back searching). These reports include graphical representations that course instructors can review. The Blackboard system's reports also display learners' activity on a daily basis or for specific periods. Complex and unstructured learner interaction data can then be transformed into actionable information of value to higher education institutions (Cantabella, Martínez-España & Ayuso, 2019).

Big data analysis technology also has a set of properties that have been summarized in the code (7V), which include velocity, volume, veracity, variety, visualization, value, and variability (Ahad et al., 2021; Elfeky & Elbyaly, 2023). Additionally, the data provided by the Blackboard can encompass features of the "7Vs", including velocity. Data on all learners are accumulated in real-time at a high velocity. The exponential growth of the data accumulation rate defines velocity, contributing to high processing costs and complexity (Duda, Kuanets & Matsiuk, 2018). Unlike traditional data warehouse analytics, which rely on periodic data loads and daily, weekly, or monthly updates, complex data volumes are analyzed and processed in real-time (Kumari, 2018). Volume refers to the continuous generation and compilation of records of all learners' activities, resulting in a complex data volume. Blackboard data's complex volume includes video interaction events (slow watching, pausing, and back searching). Veracity pertains to data consistency and accuracy (Duda, Kuanets & Matsiuk, 2018), which is relatively simple to achieve in the Blackboard platform since data originate from a single source, ensuring consistency and compliance. Variety characterizes the data types collected by the Blackboard platform, encompassing detailed statistics on interactive tools such as blogs, discussion forums, and video interaction events in unstructured or structured formats. Visualization, where the Blackboard platform is equipped with big data analytics techniques (as intelligent tools

integrated into Blackboard), is utilized to generate reports for lecturers, who use them to make decisions on improving student learning. Such reports are based on algorithms and methods for real-time visual analytics (Kumari, 2018). Value implies the potential to generate economic value and new knowledge by leveraging the data. In other words, unstructured, complex data can be converted into actionable information and valuable insights using big data analytics techniques within the Blackboard platform, guiding decisions to enhance student learning. Variability refers to data whose meaning constantly changes (Choi, Ahn & Shin, 2019), such as video interaction data that can vary over time.

The rest of this article is organized as follows: a 'Literature Review' section, which provides a brief review of the relevant literature, is followed by the 'Methodology' section, presenting the approach adopted for the current study. The 'Results' section reports the findings, and finally, the article concludes with the 'Discussion', 'Recommendations', and 'Conclusion' sections.

LITERATURE REVIEW

Despite numerous research on using big data technology to improve teaching and learning (Elfeky & Elbyaly, 2017; Huda et al., 2018; Masadeh & Elfeky, 2016), there remains an insufficient focus on studying the impact of big data technology resulting from interaction in digital environments (Elfeky & Elbyaly, 2016; Shorfuzzaman et al., 2019; Wong, 2017). This gap in the literature may have implications for learning outcomes, particularly in terms of social competence. Consequently, our work aims to bridge this gap by examining the effect of using big data technologies in digital environments on the development of electronic social competence among optimal investment diploma students.

Najran University has adopted the Blackboard system as a digital environment for resource management and collaboration across all teaching methods and methods. This transformation has turned the educational community at the university into an electronic society, especially with the digital changes that accompanied COVID-19. In addition, online interaction and collaboration require improving students' electronic social competence to enhance their ability to socialize in the new digital environment (Elbyaly, 2016; Reich, 2017). As we mentioned, improving social competence enhances academic success (Elbyaly & El-Fawakhry, 2016; Tabassum, Akhter & Iqbal, 2020). Moreover, upon reviewing the results of students' tests in previous semesters, which indicated the low levels of achievement for a large percentage of students in the "Multimedia Programs" course. So, it becomes evident that there is an issue need to be addressed. Furthermore, none of the studies in the previous literature dealt with the study of variables related to this technology in digital environments to develop electronic social competence. This leads to the following research question:

RQ: What is the effect of using big data technology in digital environments on the development of electronic social competence among optimal investment diploma students?

Methodology

In this study, our goal was to determine the effect of using big data technology in digital environments on the development of electronic social competence among optimal investment diploma students. The research tool (Electronic Social Competence Scale)

Table 1 The experimental design.

	Pre-test	Treatment	Post-test
The first group	Electronic Social	Big data technology in the digital environment	Electronic Social
The second group	Competence Scale	Digital environment	Competence Scale

was introduced. Subsequently, steps have been taken to ensure the equalization of the two groups in terms of electronic social competence and the provision of experimental processing materials. [Table 1](#) shows that the researchers employed the experimental method, utilizing a pre-post design with two equal experimental groups to explore the effect of using big data technology on electronic social competence.

Research tool (Electronic Social Competence Scale)

To evaluate the electronic social competence, the researchers develop a scale based on previous studies and educational literature that focused on measuring social competence, including works by [Deptula et al. \(2006\)](#), [Gómez-Ortiz, Romera-Felix & Ortega-Ruiz \(2017\)](#) and [Zwaans et al. \(2008\)](#). The electronic social competency scale consisted of three main dimensions: personal skills, self-management skills, and academic skills. These dimensions were also identified in previous studies and literature such as [Alzahrani, Alshammary & Alhalafawy \(2022\)](#) and [Hocking et al. \(2017\)](#).

To ensure the validity of the scale, it was also reviewed by a panel of experts and specialists. These experts were requested to assess the scale's statements concerning their suitability for evaluating electronic social competence, the accuracy and clarity of language expressions, suggested additions or deletions, and any other observations or recommendations. Acceptance of a statement was determined if at least 80% of the experts and specialists agreed. The final version of the scale incorporated the observations provided by professionals and specialists, resulting in 26 statements. Each statement on the scale was rated on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). In addition, the scale was applied to a pilot sample of (23 students) not included in the main study. Moreover, Cronbach's Alpha was used to assess the internal consistency of the paragraphs and the scale's stability. The stability coefficient value (0.84) was determined for the scale as a whole. The average time taken by the first and last student to complete the scale was calculated, revealing that it took approximately (23 min) to administer. Thus, the scale was deemed suitable for assessing the electronic social competence of the study sample.

Ensuring equalization of the two groups in electronic social competence

The homogeneity of the two study groups was also confirmed by analyzing the extracted data through SEM structural equation modeling using multiple-group (CFA) dimensions of electronic social competence (personal skills, self-management skills, and academic skills).

[Figure 1](#) shows that the electronic social competence in the first group was weakly affected by the personal skills dimension ($p > .05$, $\beta = .32$), the self-management skills dimension

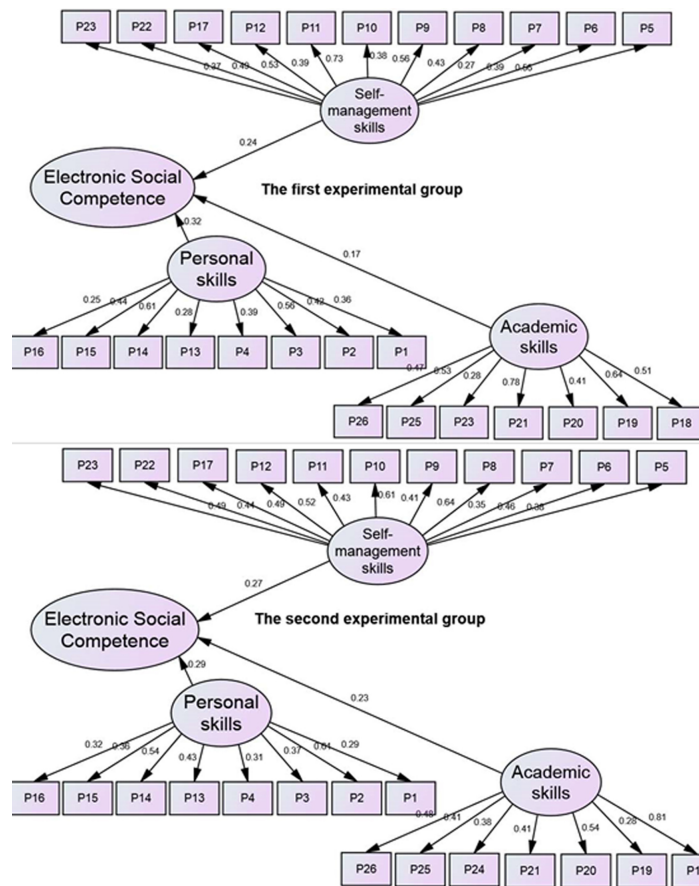


Figure 1 Multiple-group pre-CFA for the dimensions of electronic social competence for the two study groups. The indicators of the suitability of the model are: CMIN = 194 ($p = 0.382$; CMIN (χ^2)/df = .97; $df = 198$); IFI = 93, PRATIO = .91, CFI.

Full-size DOI: [10.7717/peerjcs.1691/fig-1](https://doi.org/10.7717/peerjcs.1691/fig-1)

($p > .05$, $\beta = .24$), and the academic skills dimension ($p > .05$, $\beta = .17$). Likewise, electronic social competence in the second experimental group was weakly affected by each of the interpersonal skills dimension ($p > .05$, $\beta = .29$), after self-management skills ($p > .05$, $\beta = .27$), and after academic skills ($p > .05$, $\beta = .23$). This indicates that the female students in both experimental groups were homogeneous and had equal abilities in electronic social competence before exposure to the experiment.

Experimental processing material

Digital environments provide data about students' interactions by keeping meticulous records of all of students activities (Cantabella et al., 2019). Administrators of digital environments have leveraged the advantage of big data analytics technology (as a smart tool) to generate reports that help lecturers in making decisions to improve students' online learning. For instance, with activities like video interactions, such as slow watching, pausing, and back searching, lecturers can easily access comprehensive reports on specific students or the entire student body (Elbaly & Elfeky, 2021).

The educational environment data was examined and saved in nine reports using this smart tool during the introduction of the “Multimedia Programs” course. These reports were carefully analyzed to determine their relevance to the study’s objectives. One of the selected reports was the “Student Overview of an Individual Course” displaying detailed statistics on video engagement events, including learners’ interactions with video lectures, arranged by date. The utilization of this report, in conjunction with the “tracking center” of the Blackboard system, facilitated the identification students who were at risk of failing in the course. In order to get the students’ attention and encourage them to actively participate in video lectures, the lecturer proactively engaged with the struggling students and provided immediate assistance using the tools available within the learning environment.

Ethical Statement

The Najran University Deanship of Scientific Research review board gave their approval (No.:444-45-22143-DS). The methods employed in this investigation adhere to the guidelines set forth in the Helsinki Declaration.

Consent form

We obtained informed written consent from all participants in our study.

RESULTS

Post application scores for the electronic social competency scale dimensions (personal skills, self-management skills, and academic skills) were extracted for the two study groups. Then SEM using multiple-group CFA for statistical analysis and extraction of results.

Personal skills

The usage of big data technology in the digital environment had a significant and positive impact on the participants in the first experimental group’s dimension of personal skills, as demonstrated in Fig. 2 ($p < .05$, $\beta = .87$). This dimension also had a significant positive effect on electronic social competence ($p < .05$, $\beta = .85$). In contrast, the personal skills dimension of the learners in the second experimental group ($p > .05$, $\beta = .42$) had no significant effect on electronic social competence ($p > .05$, $\beta = .33$).

Self-management skills

At the same time, the results showed that the dimension of self-management skills in the first experimental group was significantly affected *via* the use of big data technology in the digital environment ($p < .05$, $\beta = .88$). This dimension also had a significant positive impact on the electronic social competence ($p < .05$, $\beta = .84$). In contrast, the dimension of self-management skills in the second experimental group was weakly affected as a result of using the digital environment ($p > .05$, $\beta = .38$). This dimension also had a weak effect on the electronic social competence ($p > .05$, $\beta = .37$).

Academic skills

The usage of big data technologies had a significant impact on the academic skills dimension in the first experimental group ($p < .05$, $\beta = .91$). This aspect also had a significant positive

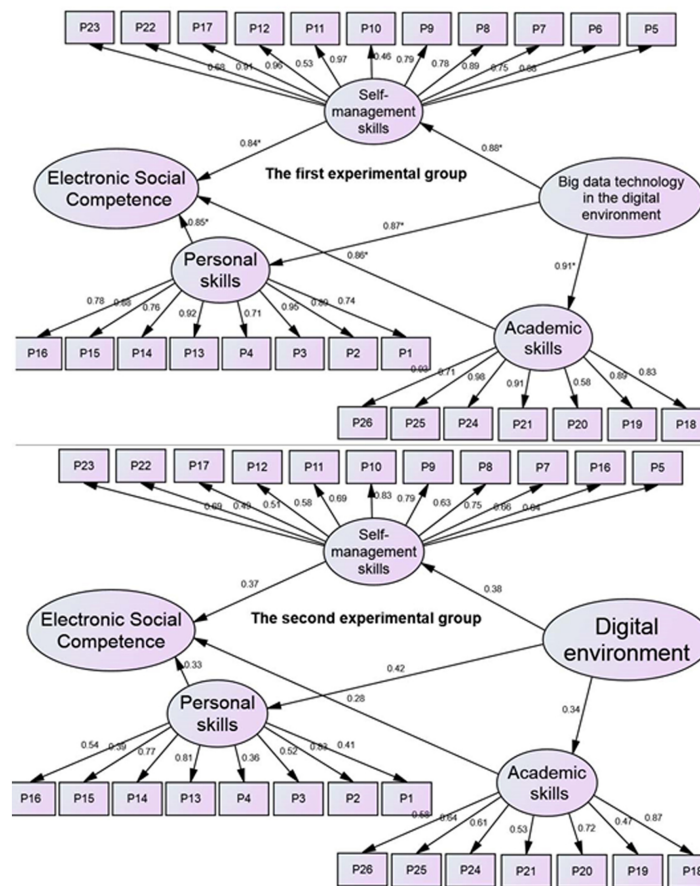


Figure 2 Multiple-group CFA for the dimensions of electronic social competence for the two study groups (Source: our own sources). The indicators of the suitability of the model are: CMIN = 192 ($p = 0.536$; CMIN (χ^2)/df = .98; df = 195;), IFI = 91, PRATIO = .90, CFI = 0.

Full-size DOI: 10.7717/peerjcs.1691/fig-2

impact on electronic social competence ($p < .05$, $\beta = .88$). In contrast, the use of the digital environment had little impact on the academic skills dimension in the second experimental group ($p > 0.05$, $\beta = 0.34$). Additionally, electronic social competency was only marginally impacted by this aspect ($p > .05$, $\beta = .28$).

DISCUSSION

The study's findings supported the idea that using big data technologies in a digital setting can help students strengthen their dimensions of electronic social competence (personal skills, self-management skills, and academic skills). These findings aligned with previous studies that have shown a positive relationship between big data technologies and different learning outcomes (Elfeky & Elbyaly, 2021; Qian et al., 2022; Sabaityte, Davidaviciene & Karpoviciute, 2020; Wei & Ren, 2022). They also agreed with other previous studies that examined the effect of using modern technologies and methods on social competence development. For example, Kim & Lee (2019), found that the amount of time children spend using smart media has a significant impact on their social skills, and Elfeky (2019)

found that there is a primary effect of the difference in the level of cognitive control power on the development of electronic social competence in favor of students with high cognitive control power of the second order (who studied with the electronic discussion strategy based on the Blackboard system). However, the results of this study do not agree with the results of the study by *Savelchuk et al. (2021)*, which found that social competence decreased during the COVID-19 pandemic. This suggests that the use of big data technologies may be more effective in promoting social competence in a face-to-face learning environment than in a distance learning environment. In summary, these results suggest that big data technologies can enhance the use of faculty members for the advantages of additional digital environments.

CONCLUSION AND RECOMMENDATIONS

In this study, the Blackboard platform data was examined and saved in nine reports using big data analytics technology during the introduction of the “Multimedia Programs” course. These reports were carefully analyzed to determine their relevance to the study’s objectives. One of the selected reports was the “Student Overview of an Individual Course” displaying detailed statistics on video engagement events, including learners’ interactions with video lectures, arranged by date.

The utilization of this report, in conjunction with the “tracking center” of the Blackboard platform, facilitated the identification students who were at risk of failing in the course. In order to get the students’ attention and encourage them to participate actively in video lectures, the lecturer proactively engaged with the struggling students and provided immediate assistance using the tools available within the learning environment.

The electronic social competency scale was further utilized as a tool to achieve the study’s goal. The experimental results showed that the development of electronic social competence, encompassing personal skills, self-management skills, and academic skills, was significantly improved by big data technology in the digital environment.

Our results provide meaningful practical implications for faculty members looking for advantages of additional digital environments. In additions, the study importance is directing educators’ attention to the importance of overcoming educational difficulties facing beneficiaries in digital environments using big data analytics technology. Based on the results of the current study, the researchers recommended that educators should be interested in developing the abilities of learners with advanced technologies. In addition, they requested that those in charge of the educational process work to boost students’ abilities to live in harmony with one another in the new electronic society, and that further studies be conducted to explore the possibility of developing electronic social competence through augmented reality.

THEORETICAL CONTRIBUTIONS

The current research contributes to the existing literature of big data technology in digital environments and social competence, as the development of electronic social competence was significantly improved by big data technology in the used digital environment. These

results align with numerous earlier studies such as *Elfeky & Elbyaly (2021)*, *Qian et al. (2022)*, *Sabaityte, Davidaviciene & Karpoviciute (2020)* and *Wei & Ren (2022)*.

PRACTICAL IMPLICATIONS

The current research also contributes to the existing literature on personal, self-management, and academic skills. Specifically, the use of big data technology in digital environments had a positive and significant influence on the development of these skills. The findings provide important evidence of the benefits of big data technology in skills development. These results also align with numerous earlier studies, including those conducted by *Elfeky (2019)* and *Kim & Lee (2019)*.

LIMITATIONS AND FUTURE DIRECTIONS

Even though the research was rigorous and thorough, there were certain limitations. Firstly, this research project focused on using big data technology in digital environments inside Saudi Arabia. Additional research with this technology is required in other countries or regions to assess its applicability and effectiveness in diverse educational settings. Secondly, while this research discovered positive results regarding the role of big data technology in digital environments, more research is needed to investigate the possibility of enhancing electronic social competence through other emerging technologies exploring the potential impact of technologies like artificial intelligence, virtual reality, or augmented reality on social competence development could provide valuable insights for educators and researchers. Finally, it is important to acknowledge that the sample size used in this study is limited. Conducting more extensive research with a larger and more diverse participant pool, encompassing various fields of study and institutions, could strengthen the generalizability and validity of the findings.

ADDITIONAL INFORMATION AND DECLARATIONS

Funding

The authors received funding from the Deanship of Scientific Research at Najran University for this work, under the General Research Funding program grant code NU/DRP/SEHRC/12/14. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Grant Disclosures

The following grant information was disclosed by the authors:
Deanship of Scientific Research at Najran University: NU/DRP/SEHRC/12/13.

Competing Interests

The authors declare there are no competing interests.

Author Contributions

- Abdellah Ibrahim Mohammed Elfeky conceived and designed the experiments, performed the experiments, prepared figures and/or tables, and approved the final draft.
- Ali Hassan Najmi conceived and designed the experiments, analyzed the data, performed the computation work, authored or reviewed drafts of the article, and approved the final draft.
- Marwa Yasien Helmy Elbyaly performed the experiments, prepared figures and/or tables, authored or reviewed drafts of the article, and approved the final draft.

Ethics

The following information was supplied relating to ethical approvals (*i.e.*, approving body and any reference numbers):

The Najran University Deanship of Scientific Research review board

Data Availability

The following information was supplied regarding data availability:

Raw data are provided as a [Supplemental File](#).

Supplemental Information

Supplemental information for this article can be found online at <http://dx.doi.org/10.7717/peerj-cs.1691#supplemental-information>.

REFERENCES

- Abarca VMG, Palos-Sanchez PR, Rus-Arias E. 2020.** Working in virtual teams: a systematic literature review and a bibliometric analysis. *IEEE Access* **8**:168923–168940 DOI [10.1109/ACCESS.2020.3023546](https://doi.org/10.1109/ACCESS.2020.3023546).
- Aguilar SJ. 2018.** Learning analytics: at the nexus of big data, digital innovation, and social justice in education. *TechTrends* **62**(1):37–45 DOI [10.1007/s11528-017-0226-9](https://doi.org/10.1007/s11528-017-0226-9).
- Ahad MA, Paiva S, Tripathi G, Haq ZA, Nafis MT, Feroz N. 2021.** Big data and modern-day technologies in COVID-19 pandemic: opportunities, challenges, and future avenues. In: Al-Turjman F, Devi A, Nayyar A, eds. *Emerging technologies for battling Covid-19. Studies in systems, decision and control*. Vol. 324. Cham: Springer, 79–106.
- Ahmed E, Alharbi SM, Elfeky A. 2022.** Effectiveness of a proposed training program in developing twenty-first century skills and creative teaching skills among female student teachers, specializing in early childhood. *Journal of Positive School Psychology* **6**(6):4316–4330.
- Alharbi SM, Elfeky A, Ahmed E. 2022.** The effect of e-collaborative learning environment on development of critical thinking and higher order thinking skills. *Journal of Positive School Psychology* **6**(6):6848–6854.
- Almalki ADA, Elfeky AIM. 2022.** The effect of immediate and delayed feedback in virtual classes on mathematics students' higher order thinking skills. *Journal of Positive School Psychology* 432–440.

- Alzahrani FK, Alshammary F, Alhalafawy W. 2022.** Gamified platforms: the impact of digital incentives on engagement in learning during Covide-19 pandemic. *Cultural Management: Science and Education* 7:75–87.
- Binsawad M, Abbasi GA, Sohaib O. 2022.** People’s expectations and experiences of big data collection in the Saudi context. *PeerJ Computer Science* 8:e926 DOI 10.7717/peerj-cs.926.
- Blanca MJ. 2021.** Social background, gender and self-reported social competence in 11- and 12-year-old Andalusian children. *Electronic Journal of Research in Educational Psychology* 1(2).
- Blasco-Arcas L, Lee H-HM, Kastanakis MN, Alcañiz M, Reyes-Menendez A. 2022.** The role of consumer data in marketing: a research agenda. *Journal of Business Research* 146:436–452 DOI 10.1016/j.jbusres.2022.03.054.
- Cantabella M, Martínez-España R, Ayuso B. 2019.** Analysis of student behavior in learning management systems through a Big Data framework. *Future Generation Computer Systems* 90:262–272 DOI 10.1016/j.future.2018.08.003.
- Cantabella M, Martínez-España R, Ayuso B, Yáñez JA, Muñoz A. 2019.** Analysis of student behavior in learning management systems through a Big Data framework. *Future Generation Computer Systems* 90:262–272 DOI 10.1016/j.future.2018.08.003.
- Choi W-W, Ahn J-W, Shin D-B. 2019.** Study on the development of geo-spatial big data service system based on 7V in Korea. *KSCE Journal of Civil Engineering* 23(1):388–399 DOI 10.1007/s12205-018-1764-1.
- Daniel BK. 2019.** Big Data and data science: a critical review of issues for educational research. *British Journal of Educational Technology* 50(1):101–113 DOI 10.1111/bjet.12595.
- Deptula DP, Cohen R, Phillipsen LC, Ey S. 2006.** Expecting the best: the relation between peer optimism and social competence. *The Journal of Positive Psychology* 1(3):130–141 DOI 10.1080/17439760600613685.
- Duda O, Kunanets N, Matsiuk O. 2018.** Fog computing and Big data in projects of class smart city. *ECONTECHMOD: An International Quarterly Journal* 7(3):7–12.
- Elbourhamy DM, Najmi AH, Elfeky AIM. 2023.** Students’ performance in interactive environments: an intelligent model. *PeerJ Computer Science* 9:e1348 DOI 10.7717/peerj-cs.1348.
- Elbyaly MYH. 2016.** Heritage Revival by the Use of Saudi Bedouin Textiles in the Gulf Mantle. *Journal of Home Economics* 26(4):127–143.
- Elbyaly M, El-Fawakhry E. 2016.** Online teaching course to develop students’ creativity in handmade embroidery. *British Journal of Education* 4(13):30–51.
- Elbyaly MYH, Elfeky AIM. 2021.** Investigating the effect of vodcast to enhance the skills of the Canadian smocking and complex problem solving. *Current Psychology* 41:8010–8020.
- Elbyaly MYH, Elfeky AIM. 2023.** The effectiveness of a program based on augmented reality on enhancing the skills of solving complex problems among students of the optimal investment diploma. *Annals of Forest Research* 66(1):1569–1583.

- Elfeky AIM. 2017.** Social networks impact factor on students' achievements and attitudes towards the computer in teaching course at the college of education. *International Journal on E-learning* **16(3)**:231–244.
- Elfeky AIM. 2019.** The effect of personal learning environments on participants' higher order thinking skills and satisfaction. *Innovations in Education and Teaching International* **56(4)**:505–516 DOI [10.1080/14703297.2018.1534601](https://doi.org/10.1080/14703297.2018.1534601).
- Elfeky AIM, Alharbi SM, Ahmed ESAH. 2022.** The effect of project-based learning in enhancing creativity and skills of arts among kindergarten student teachers. *Journal of Positive School Psychology* **6(8)**:2182–2191.
- Elfeky AIM, Elbyaly MYH. 2016.** The impact of learning object repository (lor) in the development of pattern making skills of home economics students. *British Journal of Education* **4(2)**:87–99.
- Elfeky AIM, Elbyaly MYH. 2017.** The use of CSCL environment to promote students' achievement and skills in handmade embroidery. *European Journal of Training and Development Studies* **4(2)**:19–32.
- Elfeky AIM, Elbyaly MYH. 2019.** Multimedia: different processes. In: *Interactive multimedia-multimedia production and digital storytelling*. Dragan Cvetković: IntechOpen DOI [10.5772/intechopen.81987](https://doi.org/10.5772/intechopen.81987).
- Elfeky AIM, Elbyaly MYH. 2021.** The use of data analytics technique in learning management system to develop fashion design skills and technology acceptance. *Interactive Learning Environments* **31(6)**:3810–3827.
- Elfeky AIM, Elbyaly MYH. 2023.** The impact of augmented reality technology on developing hand embroidery skills among students of the college of education. *Annals of Forest Research* **66(1)**:1584–1594.
- Farhan M, Jabbar S, Aslam M, Hammoudeh M, Ahmad M, Khalid S, Khan M, Han K. 2018.** IoT-based students interaction framework using attention-scoring assessment in eLearning. *Future Generation Computer Systems* **79**:909–919 DOI [10.1016/j.future.2017.09.037](https://doi.org/10.1016/j.future.2017.09.037).
- Gómez-Ortiz O, Romera-Felix E-M, Ortega-Ruiz R. 2017.** Multidimensionality of social competence: measurement of the construct and its relationship with bullying roles. *Revista de Psicodidáctica (English ed.)* **22(1)**:37–44 DOI [10.1387/RevPsicodidact.15702](https://doi.org/10.1387/RevPsicodidact.15702).
- Granić A, Marangunić N. 2019.** Technology acceptance model in educational context: a systematic literature review. *British Journal of Educational Technology* **50(5)**:2572–2593 DOI [10.1111/bjet.12864](https://doi.org/10.1111/bjet.12864).
- Hocking MC, Quast LF, Brodsky C, Deatrck JA. 2017.** Caregiver perspectives on the social competence of pediatric brain tumor survivors. *Supportive Care in Cancer* **25(12)**:3749–3757 DOI [10.1007/s00520-017-3805-6](https://doi.org/10.1007/s00520-017-3805-6).
- Huda M, Maselena A, Atmotiyoso P, Siregar M, Ahmad R, Jasmi K, Muhamad N. 2018.** Big data emerging technology: insights into innovative environment for online learning resources. *International Journal of Emerging Technologies in Learning (iJET)* **13(1)**:23–36.

- Javed MA, Zeadally S, Hamida EB. 2019.** Data analytics for cooperative intelligent transport systems. *Vehicular Communications* **15**:63–72
[DOI 10.1016/j.vehcom.2018.10.004](https://doi.org/10.1016/j.vehcom.2018.10.004).
- Kamupunga W, Chunting Y. 2019.** Application of big data in libraries. *International Journal of Computer Applications* **178(16)**:34–38.
- Kim J, Lee K. 2019.** Structural relationships among parents' media literacy, smart-media mediation, preschoolers' smart-media usage time, and social competence. *Korean Journal of Child Studies* **40(6)**:63–76 [DOI 10.5723/kjcs.2019.40.6.63](https://doi.org/10.5723/kjcs.2019.40.6.63).
- Kühn A, Joppen R, Reinhart F, Röltgen D, Von Enzberg S, Dumitrescu R. 2018.** Analytics Canvas—a Framework for the design and specification of data analytics projects. *Procedia CIRP* **70**:162–167 [DOI 10.1016/j.procir.2018.02.031](https://doi.org/10.1016/j.procir.2018.02.031).
- Kumari S. 2018.** Big data analytics for healthcare system. In: *Paper presented at the 2018 IADS International Conference on Computing, Communications & Data Engineering (CCODE)*.
- Maharani MR, Usman O. 2019.** Effect of family environment, discipline learning, readiness learning and social competence of teacher on motivation learning.
- Martinez JR, Waters CL, Conroy MA, Reichow B. 2021.** Peer-mediated interventions to address social competence needs of young children with ASD: systematic review of single-case research design studies. *Topics in Early Childhood Special Education* **40(4)**:217–228.
- Masada TSY. 2017.** Immediate versus delayed feedback in promoting student teachers skills for lesson plan implementation. *British Journal of Education* **5(8)**:43–58.
- Masadeh TSY, Elfeky A. 2016.** Efficacy of open-source learning management systems in developing the teaching skills of English language student teachers. *American Journal of Educational Research* **4(4)**:329–337.
- Mora-Cruz A, Saura JR, Palos-Sanchez PR. 2022.** Social media and user-generated content as a teaching innovation tool in university. In: Saura J, ed. *Teaching innovation in university education: case studies and main practices*. Hershey: IGI Global, 52–67
[DOI 10.4018/978-1-6684-4441-2.ch004](https://doi.org/10.4018/978-1-6684-4441-2.ch004).
- Muniesa RL, Saura JR, Díaz-Garrido E. 2021.** Adapting digital strategies to a new era: a delphi-based analysis in the fashion industry. In: *Advanced digital marketing strategies in a data-driven era*. Hershey: IGI Global, 192–209
[DOI 10.4018/978-1-7998-8003-5.ch011](https://doi.org/10.4018/978-1-7998-8003-5.ch011).
- Palos-Sanchez P, Reyes-Menendez A, Saura JR. 2019.** Modelos de adopción de tecnologías de la información y cloud computing en las organizaciones. *Información Tecnológica* **30(3)**:3–12 [DOI 10.4067/S0718-07642019000300003](https://doi.org/10.4067/S0718-07642019000300003).
- Qian Y, Li CX, Zou XG, Feng XB, Xiao MH, Ding YQ. 2022.** Research on predicting learning achievement in a flipped classroom based on MOOCs by big data analysis. *Computer Applications in Engineering Education* **30(1)**:222–234.
- Rahmani AM, Azhir E, Ali S, Mohammadi M, Ahmed OH, Ghafour MY, Ahmed SH, Hosseinzadeh M. 2021.** Artificial intelligence approaches and mechanisms for big data analytics: a systematic study. *PeerJ Computer Science* **7**:e488
[DOI 10.7717/peerj-cs.488](https://doi.org/10.7717/peerj-cs.488).

- Reich SM. 2017.** Connecting offline social competence to online peer interactions. *Psychology of Popular Media Culture* 6(4):291–310 DOI 10.1037/ppm0000111.
- Reyes-Menendez A, Saura JR, Filipe F. 2019.** The importance of behavioral data to identify online fake reviews for tourism businesses: a systematic review. *PeerJ Computer Science* 5:e219 DOI 10.7717/peerj-cs.219.
- Romera EM, Herrera-López M, Casas JA, Ortega-Ruiz R, Gómez-Ortiz O. 2017.** Multidimensional social competence, motivation, and cyberbullying: a cultural approach with Colombian and Spanish adolescents. *Journal of Cross-Cultural Psychology* 48(8):1183–1197.
- Sabaityte J, Davidaviciene V, Karpoviciute R. 2020.** Learning skills for enhancing the use of big data. *World Journal on Educational Technology: Current Issues* 12(1):23–36.
- Saeed MM, Al Aghbari Z, Alsharidah M. 2020.** Big data clustering techniques based on spark: a literature review. *PeerJ Computer Science* 6:e321 DOI 10.7717/peerj-cs.321.
- Saltz JS, Krasteva I. 2022.** Current approaches for executing big data science projects—a systematic literature review. *PeerJ Computer Science* 8:e862 DOI 10.7717/peerj-cs.862.
- Savelchuk I, Bybyk D, Horban Y, Koshelieva O, Karakoz O. 2021.** Social competence of student youth: the experience of formation in the educational environment of the university within the conditions of pandemic. *Laplace em Revista* 7(Extra-A):481–490.
- Seitz SR. 2021.** Youth profiles of program quality perceptions and their associations with social competence. Doctoral dissertation, Georgia State University.
- Shorfuzzaman M, Hossain MS, Nazir A, Muhammad G, Alamri A. 2019.** Harnessing the power of big data analytics in the cloud to support learning analytics in mobile learning environment. *Computers in Human Behavior* 92:578–588 DOI 10.1016/j.chb.2018.07.002.
- Song J, Zhang Y, Duan K. 2017.** TOLA: topic-oriented learning assistance based on cyber-physical system and big data. *Future Generation Computer Systems* 75:200–205 DOI 10.1016/j.future.2016.05.040.
- Song J, Zhang Y, Duan K, Hossain MS, Rahman SMM. 2017.** TOLA: topic-oriented learning assistance based on cyber-physical system and big data. *Future Generation Computer Systems* 75:200–205 DOI 10.1016/j.future.2016.05.040.
- Tabassum R, Akhter N, Iqbal Z. 2020.** Relationship between social competence and academic performance of university students. *Journal of Educational Research* 23(1):1027–9776.
- Wang Y, Chen Q, Hong T, Kang C. 2018.** Review of smart meter data analytics: applications, methodologies, and challenges. *IEEE Transactions on Smart Grid* 10(3):3125–3148.
- Wei L, Ren L. 2022.** Research on student achievement and employment flow based on apriori algorithm under the background of big data. In: *Paper presented at the EAI International Conference, BigIoT-EDU*.
- Wong M. 2017.** Learning analytics in higher education: an analysis of case studies. *Asian Association of Open Universities Journal* 12(1):21–40 DOI 10.1108/AAOUJ-01-2017-0009.

- Zhou X, Ge B, Xia Z, Xiao W, Chen Z. 2023.** BDMCA: a big data management system for Chinese auditing. *PeerJ Computer Science* **9**:e1317 DOI [10.7717/peerj-cs.1317](https://doi.org/10.7717/peerj-cs.1317).
- Zwaans A, Van der Veen I, Volman M, Ten Dam G. 2008.** Social competence as an educational goal: the role of the ethnic composition and the urban environment of the school. *Teaching and Teacher Education* **24**(8):2118–2131 DOI [10.1016/j.tate.2008.02.016](https://doi.org/10.1016/j.tate.2008.02.016).