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Connectivism and E-Collaborative learning: A Framework for Enhancing Digital Self-Efficacy in Higher Education through Big Data Organization

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Abstract

Background/purpose. The current study aimed to investigate the extent to which collaborative educational applications based on connectivism theory are used to organize big data and their impact on university students' digital self-efficacy.

Materials/methods. The researcher adopted a descriptive survey approach to examine the effectiveness of the independent variable (collaborative educational applications) on the dependent variables (big data organization and digital self-efficacy). The study used two main tools: a questionnaire to measure the extent of the use of collaborative educational applications in big data organizations, and a digital self-efficacy scale for university students. The study sample included 424 students from public and private universities in Jordan. The sample was obtained via a random selection method in which the two tools were sent via a link.

Results. The study found that collaborative educational applications grounded in connectivism theory were being widely used in big data organizations. There were noteworthy discrepancies in students' responses to the questionnaire, favoring students in scientific fields and postgraduate students, with no differences attributed to the type of university attended. It was also found that students demonstrated a high level of digital self-efficacy with significant differences in favor of students from scientific disciplines and postgraduate students, and no differences by university type. The last finding was that there was a significant correlational relationship between the level of big data organizational collaborative educational applications and digital self-efficacy.

Conclusion .Collaborative connectivist educational apps are widely used for big data organization and are strongly linked to higher digital self-efficacy among university students (especially science and postgraduate students). Therefore, universities should integrate these apps more often.

1. Introduction

The contemporary learning environment integrates technology into education and uses cooperative digital tools to deliver content in an organized manner, thereby improving student engagement and participation (Wang & Wang, 2022). In this setting, Big Data is an essential element: enormous, diverse, and fast-temporal data that, when analyzed, reveals patterns that can aid learning. There is an increasing focus on students' digital self-efficacy due to specific changes that accompany this shift in education, particularly mobile learning and smart technology (Benali et al, 2018; Moreira & Dias-Trindade, 2025). In educational institutions, there is an inclination to adopt a modern learning paradigm, such as Connectivism, which views learning as the construction of knowledge through variable, overlapping information networks and stresses the interfacing and linking of many elements in a fluid setting (Seitan & Al-Jarah, 2021). Therefore, this study aimed to determine the extent of use of collaborative educational applications for organizing big data and their impact on digital self-efficacy among Jordanian university students, in accordance with Connectivism theory.

1.1. Collaborative Digital Educational Applications

The use of cloud computing and web-based applications is fundamental in online collaboration, work, and education. These technologies can effectively handle and tailor large volumes of information and knowledge and, thus, are regarded as among the best in educational technology. Through their many functions, collaborative digital multimedia aids, for instance, help deliver curricula effectively and engagingly (Fakhruddin, 2018). In addition, these digital aids help manage students' time and effort, improve focus, and engage their attention, while addressing their needs. Since these tools aim to enrich scholars' experiences, they also help students prepare and learn better, thus aiding in establishing and reinforcing knowledge. In addition to enriching students' experiences, collaborative digital applications also eliminate the problem of verbalism. The verbalism problem occurs when a teacher uses expressions without tangible, sensory explanations. Through the application of these digital aids, vocabulary and explanations lose their distance and become tangible. This helps many instructors to help students understand and bridge the gap between (Fakhruddin, 2018).

The application of cooperative, collaborative digital multimedia remains one of the most important and current advancements in technology, while still preserving the essence of schooling. Through digital multimedia, students can have all the components of a learning environment located in a single setting. This multi-source learning environment serves to unify the education system and assist students in attaining their objectives. One of the best and fastest ways to engage students collaboratively is using cooperative digital multimedia. It also transforms the teacher from a passive to an active conductor of the curriculum and moves the entire process onward with the progress of science.

It addresses problems that traditional methods cannot resolve, such as working with diverse learners, managing time constraints, and fostering collaboration among learners (Castillo, Ochoa & Cabrera, 2022). According to Trisnaningsih & Adha (2020), e-collaborative learning is a type of e-learning focused on students and ensures that learners participate in the learning process, especially concerning skill development, which is not possible without group work. Such a group approach will increase learners' ability to appreciate different points of view.

Among the key digital innovations that have made collaborative learning more effective are Google Educational Applications. Google offers this suite of collaborative productivity tools free to educational institutions. These applications include Gmail, Google Calendar, Google Drive, Google Docs, and Google Sites. They also provide access to dozens of other supported or owned collaborative tools, such as YouTube, Google Slides, Google Forms, and Google Groups. All these applications are accessible directly via the internet and can be stored using Google's cloud storage service, Google Drive (Chiablaem, 2021). In addition to the findings, other studies (Dello, 2022; Geesa, Robbins & Shively, 2022; Aldalalah et al, 2023) confirm the active and positive role of employing e-collaborative learning across various subjects and academic levels.

1.2. Big Data

It is defined as "vast data sets that, in terms of their volume, capacity, or complexity, exceed the traditional capabilities of conventional database tools for capture, storage, management, and analysis." This type of data has led to a qualitative and radical shift in decision-making mechanisms, including in the education sector. Integrating big data into primary and continuous education is of utmost importance due to its ability to enhance the effectiveness and efficiency of teaching and learning (Judijanto & Aini, 2025).

Due to the rapid development of information and communication technology, big data has become one of the most well-known contemporary ideas. This data refers to the vast amounts of information produced by many sources and comes in a variety of formats, each distinguished by a few key characteristics (Aydın, 2023; Naghib et al., 2024).

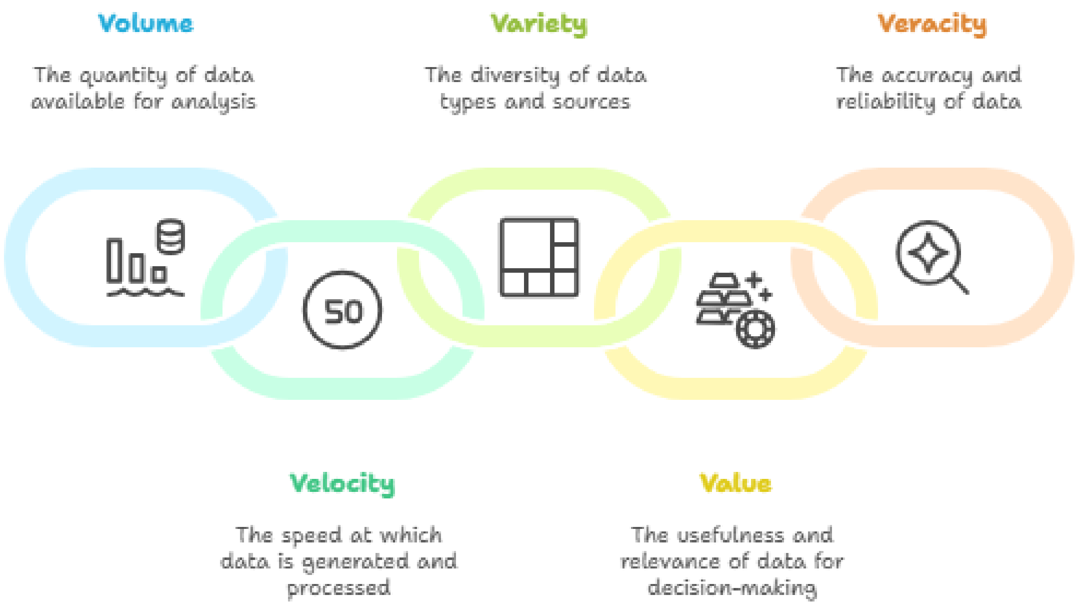

Figure 1. Characteristics of Big Data

Big data has now become an important aspect of the education sector and has assisted in evidence-based decision-making. A deep examination of data on learners' academic performance, behavioral patterns, and interaction with learning resources enhances the quality of the educational process and learning outcomes. This creates new opportunities for developing a teaching strategy and customizing the educational experience (Aqouni, 2024). There are also unexplored opportunities to discover latent patterns and predict future learning needs using big data, thereby enhancing the effectiveness of learning institutions.

The benefits of big data in education, especially in universities, are characterized by diversity and breadth, which directly affect academic and administrative aspects. Big data enables the derivation of valuable analytical information that aids decision-making and addresses challenges, leading to informed decisions and real-world solutions (Al-Ajmi, 2022). It can also be important to curriculum development and educational policy, as these roles provide universities with the option to apply their analysis to design high-level curricula and establish educational policy foundations. Its advantages also include improving the student services offered and the strategies for managing academic assessment and evaluation, both at and after academic sessions (Howley et al., 2021). With the aid of big data, learning can be tailored to students' specific needs. Faculty members can detect students' specific cognitive and behavioral patterns and can, therefore, provide tailored educational content that meets their abilities and requirements. As a result, it improves the effectiveness of the teaching process and learning outcomes. It also greatly enhances the teaching process. It can accurately analyze student data, measure performance, identify gaps, and offer timely remedial support, in addition to creating a flexible e-learning environment that can adapt to the specific needs of learners (Ma, 2021). In addition, big data enables a thorough and timely evaluation of students' responses to a wide range of educational problems.

Furthermore, big data provides quick feedback and a thorough, understandable examination of students' answers to a range of educational problems. To take appropriate action and make recommendations about the best study routes and courses for students, it helps monitor student performance (Shah, 2021). Beyond this, its uses include enhancing educational activities, evaluating acquired skills, and supporting scientific research by providing access to rich, trustworthy datasets. It also enables identifying positive learning behaviors and tracking students' educational paths to match them with their preferred learning styles. Additionally, it makes it easier for knowledge to circulate and information to be shared widely. Khalil (2020)

Digital libraries, learning management systems, and e-learning platforms are important sources of big data in the academic setting, providing comprehensive insights into student interactions and learning trends. Accurately assessing students' needs and providing them with educational support are two benefits of analyzing this data. Additionally, it enables academic assessment and educational policies, curricula, and student services to be improved. It enables teachers to create individualized learning experiences that enhance learning outcomes and increase teaching effectiveness (Zhao & Li, 2022).

1.3. Digital Self-Efficacy

Due to changing economic and societal trends, digital competency is becoming increasingly fundamental in the twenty-first century. Digital competency is now a crucial skill and a prerequisite for university students, given the extensive digital transformations enabled by information and communication technology, particularly with the rise of distance education. By improving cognitive integration, facilitating access to scientific knowledge, and reducing time and effort spent handling data and conducting research, these abilities also help increase economic efficiency. Furthermore, having digital skills makes it easier for people to communicate, access information, and use digital services, thereby improving their involvement in the global knowledge society (Zhou et al., 2023). These skills become particularly important when combined with students' and researchers' academic skills, as they are central to their educational pursuits. Given the current shift towards digital platforms, having these skills ensures that education will in no way be disrupted (Getenet et al., 2024).

Digital competence in education is defined as students possessing the skills, culture, and digital and technical mindset that enable them to employ them effectively in educational activities. This competence includes the ability to re-formulate digital knowledge to produce creative information in diverse digital environments. According to the European Framework, digital competence is an integrated set of knowledge, skills, attitudes, and abilities necessary for the optimal use of ICT and digital media. Its goal is to improve the teaching and learning processes in well-thought-out, flexible, and secure ways, and to support other teaching activities in online environments (Ulfert-Blank & Schmidt, 2022). Digital competence is also based on scientific thinking, with a focus on discovery and innovation in education and on improving educational performance, aiming to produce innovations that modify learners' behavior within the educational and social systems (Zakir, 2025).

Based on the above, digital competencies represent a system that integrates knowledge, information, and creativity, and their applications in the field of developing educational processes. To accomplish the educational institution's objectives, these skills comprise tools, facilities, a range of subjects, educational services, and talents that work well together.

Three primary categories can be used to classify digital competency skills: Basic abilities and everyday use make up the first category. Examples of this include using gadgets, managing files, retrieving information, browsing the internet, using email, and interacting with basic digital services. It also covers evaluating information sources, understanding digital citizenship concepts that ensure the ethical and responsible use of technology, and understanding privacy and information security. Advanced and specialized talents make up the second category: Analytical and applied talents, including the capacity to produce digital content, handle and evaluate data, comprehend digital transformation strategies, and leverage technological advancements. It also includes advanced skills such as scientific publishing via the web and keeping up with successive technological developments. Professional and High-Tech Skills: This is concerned with deep and specialized skills required in purely technical fields, such as programming, computational thinking for problem-solving, artificial intelligence, cybersecurity, network management, digital entrepreneurship, and decryption. These skills are often acquired through specialized and advanced education (Al-Dhanibat, 2023). Digital skills are also distinguished by their ability to provide high flexibility in meeting users' needs for searching, storing, publishing, and exchanging information, supported by a massive capacity to handle data. Their importance is also reflected in their breadth of use, especially in the educational field, as they encompass all educational activities and enable users to interact with high precision and super-fast performance (Suzer & Koc, 2024).

Based on the European Framework for the Digital Competence of Citizens (DigComp), five key areas are the focus of digital self-efficacy. According to the European Commission (2025), this framework is the primary global resource for outlining the attitudes, skills, and knowledge required to use digital technology in all facets of life in an efficient, self-assured, and responsible manner.

Figure 2. Digital Competency Areas (European Commission, 2025)

1.4. Connectivism Theory

Siemens (2004) put out the connectivism theory, which aims to explain how learning takes place in social and digital networks. He described it as a theory that seeks to comprehend how social

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interactions and technology settings affect learning. Accordingly, one philosophy associated with recent technological advancements is connectivism, which aims to situate learning through networks within a productive social framework (De Leon et al., 2025). This theory is one of the most well-known modern educational ideas that addresses the demands of 21st-century learning by utilizing digital technology to facilitate student connection and communication. In contrast to traditional models that position the learner as a passive recipient of information, these digital tools enable students to participate in dynamic, collaborative learning environments, thereby strengthening their active role in knowledge construction (Maganga & Srivastava, 2025).

Another educational approach is connectivism, which aims to go beyond the constraints of conventional theories such as constructivism, behaviorism, and cognition, which emphasize structured learning in formal contexts. This theory's emphasis on learning processes in informal settings, such as social networks, educational games, digital platforms, cloud computing, and other interactive media, underscores its significance amid the rapidly unfolding digital and social transition. Furthermore, in a knowledge-based world, being able to access and produce information has become a lifelong skill. As a result, even outside the conventional educational framework, the learner is seen as an active participant in creating and applying information rather than a passive recipient. Because of this, learning is a dynamic, interrelated process that depends on the creation of cognitive networks and ongoing interaction with them (Al-Salmi et al., 2023). It helps us comprehend how we learn. In other words, we learn when we connect facts, particularly when we engage with like-minded individuals. Since the learning community is a part of a wider information network where knowledge is saved and shared via digital media, this engagement enables us to discuss, think, and exchange ideas (Goldie, 2016).

Connectivism theory provides a new framework for education, shifting the emphasis from content to "how knowledge is learned." This is accomplished by creating a personalized learning network for every student, which gives them access to a variety of viewpoints and resources and improves their decision-making capacity. These networks are facilitated by digital technology, which turns students into active researchers in virtual spaces that emphasize "where to find knowledge" over "how or what" (Shrivastava, 2018). This theory states that learning is a network of nodes that represent facts and information, connected by links. These nodes and connections can be textual or audio media. Networks also consist of individuals, each representing a sub-learning network. Connections are the essence of learning and represent the effort made to connect nodes. This aligns with the development of the social web, which facilitates connection, interaction, and knowledge exchange (Aldalalah, 2023; Hendricks, 2019). Connectionist theory also distinguishes itself from traditional theories in that it views learners' cognitive capacity as limited to processing all information individually, which makes it a pressing need to outsource learning, whether to individuals or non-human tools, as parts of the learning process occur outside the learner's own scope. Thus, it goes beyond focusing solely on what is in the learner's mind, extending to include their ability to access, evaluate, and connect information within a wide network of sources and people (Liu & Li, 2021). Based on the above, George Siemens proposed eight basic principles of connectivism, which provide a comprehensive framework for understanding learning in the digital age, as shown in Figure 1.

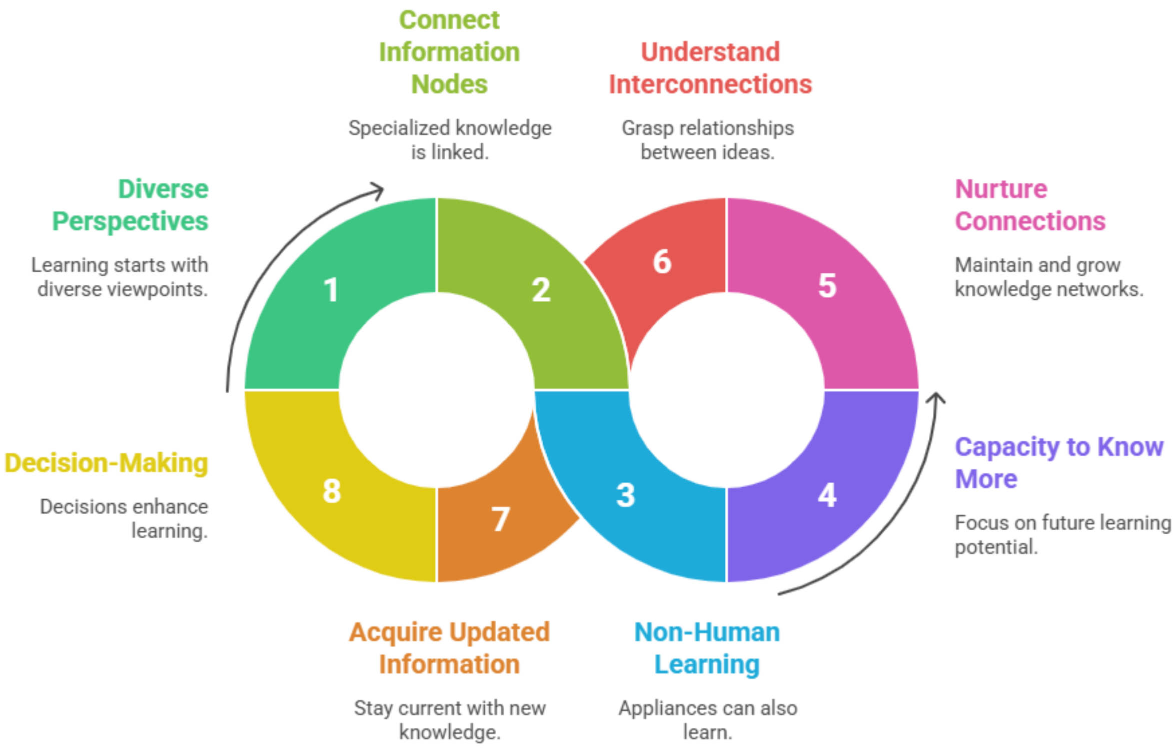

Figure 3. Principles of Connectivism Theory

1.5. Problem Statement

The nature of knowledge and learning has changed dramatically in the modern digital era. Effective methods for organizing and using big data are necessary because it has become a massive educational resource (Judijanto & Aini, 2025). According to Alsaeedi and Alamiri (2024), collaborative educational applications are particularly promising tools that help students comprehend and organize this massive amount of knowledge. The capacity to manage big data has shifted from an optional, value-added skill to a requirement for improving students' academic and professional credentials, especially at the university level, where institutions aim to keep up with global trends. Collaborative educational technologies have become essential in higher education settings due to the rapidly evolving digital landscape and the requirement for purpose-driven big data management (Al-Madhouni et al., 2023).

Despite the immense value of collaborative educational technologies in organizing big data, the extent to which students at Jordanian universities leverage these technologies remains a matter that warrants thorough investigation. This study aims to define the students' level of interaction with these tools and their ability to analyze, classify, interpret, and interact with big data as well as complex, voluminous datasets, as well as define the interplay between students and these systems, focusing on the implications for their competence (Arabyat et al., 2023).

The impact of these applications on the digital self-efficacy of Jordanian university students is a primary focus of this study. This is investigated in the context of connectivism, which emphasizes the importance of networks and connections in learning and developing skills in the digital age. According to connectivism, learning occurs when connections are made among various information sources, and the core of digital competency is the ability to traverse these networks and develop self-awareness. It is necessary to understand how this theory can be used to organize big data in ways that improve university students' digital self-efficacy, given the rise of connectivism as a cognitive framework that emphasizes learning through digital networks and ongoing interaction.

Therefore, this study was designed to answer the following questions:

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- What is the degree to which Jordanian university students utilize collaborative educational applications, based on connectivism theory, to organize big data during the educational process?
- Are there statistically significant differences in big data organization among Jordanian university students' use of collaborative educational applications (based on connectivism theory) due to variations in their university, Major, and academic level?
- What is the degree of digital self-efficacy among Jordanian university students when they use connectivism-based collaborative educational applications to organize big data during the educational process?
- Are there statistically significant differences in the degree of digital self-efficacy among Jordanian university students when using collaborative educational applications based on connectivism theory, attributable to variations in university, Major, and academic level?
- Is there a correlational relationship between the use of collaborative educational applications for organizing big data and digital self-efficacy among Jordanian university students?

1.6. Study Scope and Limitations

The scope and limitations of this study are defined as follows:

- Spatial Scope (Geographical Boundary): The study was applied in public and private universities in Northern Jordan.
- Temporal Scope (Time Boundary): The study was conducted during the second semester of the academic year 2024/2025.
- Human Scope (Sample/Population Boundary): The study was limited to students enrolled in universities in Northern Jordan, specifically: Yarmouk University, Jordan University of Science and Technology (JUST), Al-Balqa Applied University (BAU), Al al-Bayt University, Jerash Private University, Irbid National University, Jadara University, and Ajloun National University.
- Thematic Scope (Subject Matter Boundary): The research's thematic scope is centered on the utilization of a specific category of collaborative educational applications (such as collaborative tools and Web 2.0 applications) for Big Data organization and processing tasks.
- The primary goal is to evaluate the impact of this use on students' Digital Self-Efficacy, or their self-assurance in their digital abilities. This study includes only Jordanian university students, and using the Connectivism theory as a conceptual framework is essential for understanding how learning occurs in this complex, networked, and information-rich environment.
- Methodological scope and generalizability: The Big Data Organization Questionnaire via Google Collaborative Educational Applications and the Digital Self-Efficacy Scale are the two psychometric tools used in the study, and their validity and reliability are what allow the results to be generalized.

2. Methodology

2.1. Research Design

For this study, a descriptive-analytical approach was used, as it was a perfect fit for the objectives and nature of the inquiry. The ability of this method to accurately collect and evaluate data related to a certain behavior or occurrence allows the researcher to provide a comprehensive and comprehensible explanation of the phenomenon’s current, actual condition. In the end, this produces accurate answers to the research questions and solutions to the problem raised.

2.2. Study Population and Sample

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The study's population consisted of all students at government and private universities in northern Jordan. The study sample comprised 424 students, selected via random sampling and distributed across all universities, colleges, and academic years.

2.3. Study Instruments

Data collection for the study was conducted using two instruments. Reviewing previous works, including those by Al-Madhouni et al. (2023) and Arabyat et al. (2023), inspired the researcher to develop a comprehensive big data questionnaire on Google educational applications, comprising 19 items. The researcher also crafted the items using a five-point Likert scale where answers ranged from strongly agree (5) to strongly disagree (1). Her second instrument was a self-rated digital competence, which was modified from the European digital competence framework. This scale had 25 items and five dimensions, also using a five-point scale where one indicated very low and five very high responses.

2.4. Expert Review Validity (Arbitrator Validity)

Through a Consulting Panel of Experts and Arbitrators, the researcher aimed to gather feedback and strengthen the study instruments (The Questionnaire for Organizing Big Data Through Participatory Google Educational Applications and the Digital Self-Efficacy Scale) to align with the study's critical concepts and to frame evaluation queries.

The panel comprised seven faculty members from Jordanian universities in the fields of educational technology, computer science, and psychology. The researchers made changes to both instruments that all the experts considered appropriate, based on their suggestions and comments.

2.5. Construct Validity

The researchers administered the study instruments (The Questionnaire for Organizing Big Data Through Participatory Google Educational Applications and the Digital Self-Efficacy Scale) to a pilot sample of 21 university students from the study's population but outside the main sample. The purpose was to confirm the correlation coefficients of all items and dimensions of the two instruments with the total score. This was done by calculating Pearson correlation coefficients. The results are shown in Table 1.

Table 1. Item-Total Correlation Coefficients for the Big Data Organization Questionnaire via Google Collaborative Educational Applications.

No.	Items	Correlation Coefficient
1	I use Google Classroom to organize course content related to big data analysis and to communicate with students.	.634**
2	Google Meet helps me attend lectures and educational meetings discussing big data organizations.	.816**
3	I find Google Docs effective for collaboratively editing documents related to big data projects.	.784**
4	I use Google Slides to create presentations that illustrate the results of big data analysis.	.754**

No.	Items	Correlation Coefficient
5	Google Forms helps me get a lot of information from participants for my research.	.732**
6	In academic settings, I utilize Google Sheets to manage and analyze huge datasets.	.721**
7	Google Drive is helpful, in my opinion, for securely and efficiently storing and sharing large data files.	.893**
8	For group brainstorming on big data organization techniques, I utilize Google Jamboard.	.738**
9	I disseminate the findings of my big data analysis in research or teaching initiatives using Google Sites.	.756**
10	I use Google Translate to translate scholarly articles about big data from a variety of sources.	.909**
11	I plan timetables and activities for large data projects using Google Calendar and Google activities.	.793**
12	When working on huge data projects, I find Google Keep helpful for taking notes and organizing my thoughts.	.882**
13	I communicate academically about big data organizing and analytic initiatives using Gmail.	.767**
14	Google Lens helps me with big data projects by allowing me to extract text from documents or photos.	.857**
15	I use Google Search and Google Scholar to find information and specialized studies in the field of big data.	.875**
16	I use YouTube (by Google) to follow tutorials on tools and techniques for big data analysis.	.846**
17	I benefit from Google News in keeping up with developments in big data.	.858**
18	I observe that the Google Assistant helps me organize daily tasks for big data projects.	.636**
19	I benefit from AI features in Google tools (such as Docs and Gmail) in my work on big data projects.	.905**

It is evident from Table 1 that all Pearson correlation coefficient values between each item and the total score for the "Organizing Big Data through Collaborative Google Educational Applications" questionnaire were statistically significant at the 0.05 level. These are positive and strong correlation values, indicating that the scale demonstrates internal consistency across all its items, except for three items that were removed from the scale.

Table 2. Item-Total Correlation Coefficients for the Self-Efficacy Scale Items with the Total Scale Score

No.	Statement	Correlation Coefficient
	Domain 1: Information and Data Literacy	
1	I can recognize what I need and efficiently obtain trustworthy facts, knowledge, and digital content from a variety of internet sources.	0.655**
2	I can save and arrange digital materials so that they are easily accessible and retrievable.	0.702**
3	I handle and analyze digital data using tools and software (e.g., sorting, filtering, conducting computations).	0.728**
4	I assess data, information, and content in digital settings.	0.767**
	Domain 2: Digital Communication and Collaboration	
5	I connect and communicate effectively in digital contexts by abiding by behavioral guidelines and ethical norms.	0.681**
6	I use cloud services for collaboration and content sharing, and I actively participate in professional and educational networks and platforms.	0.753**
7	I can conduct and record virtual meetings, workshops, and training sessions from a distance (online).	0.735**
8	I have good online communication skills and help create vibrant, encouraging online learning communities.	0.707**
	Domain 3: Digital Content Creation	
9	I can design and develop digital instructional text files using programs like Google Docs and Word.	0.689**
10	I can create multimedia and interactive presentations with text, pictures, audio, and video.	0.761**
11	I can create original and creative digital materials (such as films and animations) and edit open-source digital assets.	0.784**

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No.	Statement	Correlation Coefficient
12	I think about reusing copyright and legal constraints on digital content.	0.652**
13	I consider the qualities of my students when creating interactive exercises, assignments, and digital chores.	0.749**
	Domain 4: Digital Safety and Security	
14	In digital surroundings, I can safeguard my personal information and technological equipment against malicious files and dangers.	0.700**
15	I use digital devices in a green way because I understand the threats to my physical and mental health that come with them.	0.603**
16	I know how to defend myself against unwanted circumstances and dangerous content, and I can handle internet threats effectively.	0.726**
17	I can retrieve digital content and data from a backup.	0.677**
18	I use two-step verification and solid password management techniques.	0.710**
19	I advocate for myself and others against unfair issues or cyberbullying in digital environments.	0.658**
	Domain 5: Digital Problem Solving	
20	I can identify and solve common technical problems encountered when using digital environments and devices.	0.731**
21	I can find solutions online and apply them to resolve technical issues.	0.704**
23	I can modify the operating system settings of my digital devices to solve problems.	0.685**
24	I can identify the digital skills I lack and work on developing them.	0.750**
25	I am eager to explore new digital devices and applications and try them whenever possible.	0.624*

From the previous Table 2, it is evident that all correlation coefficients between each item and the total score, as well as the sub-axes of the Digital Self-Efficacy Scale, were statistically significant at the 0.05 level. These values represent positive and good correlations, indicating that the scale's items possess strong internal consistency.

2.6. Reliability of the Study's Scales

The researcher distributed the two study scales (the Digital Well-being Scale and the Mind-Wandering Scale) to a sample of 21 students from Jordanian universities. The researcher then re-administered the two instruments to the same sample and calculated the correlation coefficients between the sample's scores on both applications. The researcher also calculated the reliability of the two study scales using Cronbach's alpha coefficient, and the results are presented in Table 3.

Table 3. Reliability Coefficients of the Study Instruments and Their Subdomains

Subdomain	Test–Retest Reliability Coefficient	Cronbach's Alpha Coefficient
Questionnaire Organizing Big Data through Collaborative Google Educational Applications		
Questionnaire	0.823	0.854
Digital Self-Efficacy Scale		
Information and Data Literacy	0.709**	0.765**
Digital Communication and Collaboration	0.784**	0.804**
Digital Content Creation	0.734**	0.674**
Digital Safety and Security	0.757**	0.743**
Digital Problem Solving	0.724**	0.774**
Scale	0.741**	0.747**

It is clear from Table 3 that all reliability coefficients for the sub-axes and the total score of the study's two scales were high, making them suitable for application.

2.7. Data Collection Procedures

Data was collected during the second semester of the 2024/2025 academic year after obtaining the necessary official approvals. University students were contacted via official email, direct contact, and through an intermediary. Strict procedures were implemented to ensure consent and protect the privacy and confidentiality of participants. The following procedures were part of the data collection process: semi-structured in-person interviews and online questionnaire distribution. To make sure the sample was representative of the community, the researcher went to great lengths.

2.8. Analytical Techniques

Based on Connectivism theory, the purpose of this study is to examine how collaborative educational applications are used to organize huge data and how they affect Jordanian university students' digital self-efficacy. This was done through a set of statistical methods with SPSS (Statistical Package for the Social Sciences). Among them were the following:

1. Correlation coefficients: To determine the degree of relationship as well as the direction of correlation between the variables under study.

2. Cronbach's alpha coefficient: This is used in a way to ensure the study instruments have a high degree of internal consistency and validity in ensuring the quality of data.

3. Means: To ascertain the average responses of the sample members to the research statements and their various axes, therefore explaining the general pattern of the data

4. Standard deviations: To give a notion of the variance in the sample's answers, standard deviations quantify how dispersed or homogeneous the data are around the mean.

5. Multivariate analysis of variance: To compare the averages of two or more groups while controlling for the influence of a concomitant variable that may affect the results, increase the accuracy of the analysis, and allow for more effective isolation of the influence of independent variables.

This diversity of statistical tools allowed the researcher to process quantitative data comprehensively, ensuring the accuracy of the results and their ability to test the study's hypotheses and answer its questions efficiently.

2.9. Study Variables

- Independent Variable:

Collaborative educational applications

- Dependent Variables:

Big data organization

Digital self-efficacy

- Demographic Variables:

University (Government, Private)

Major (Scientific, Humanities)

Academic Level (Postgraduate, Undergraduate)

3. Results and Discussion

Results for Research Question 1: What is the degree to which Jordanian university students utilize collaborative educational applications, based on connectivism theory, to organize big data during the educational process?

To answer this question, means and standard deviations were calculated for students' responses to the questionnaire on the utilization of collaborative educational applications for organizing big data according to connectivism theory, as shown in the figure below:

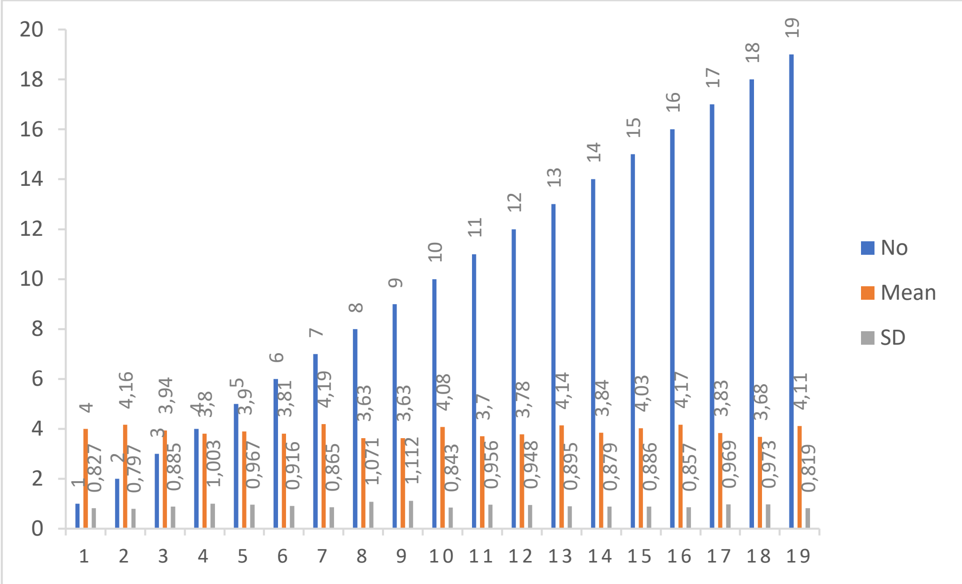

Figure 4. Means and SDs: Collaborative App Use in Big Data Organizing

The results indicate a high level of use of collaborative educational applications for managing big data among students at Jordanian universities. This finding can be attributed to several factors, most notably the development of university infrastructure. High-speed internet, advanced processing capabilities, and large-scale cloud storage have been provided to meet the demands of big data. Furthermore, cognitive and methodological factors played a crucial role, as many students and faculty members recognized the genuine benefits of these applications thanks to targeted training programs and an academic curriculum that focuses on practical skills. Consequently, students' use of available tools (such as Google Workspace and Microsoft Teams) was not limited to superficial purposes. Instead, they were effectively employed in big data analysis, which reflects students' possession of the necessary statistical and technical skills (Dello, 2022; Geesa, Robbins & Shively, 2022; Aldalalah et al, 2023).

According to connectivism theory, this high usage indicates the existence of an advanced learning environment that promotes cooperation and the development of knowledge networks. Learning is no longer seen as a solo endeavor at Jordanian universities (De Leon et al., 2025) . Rather, they are emphasizing networked learning, which enables ongoing contact and the sharing of information between students and teachers. Students' ability to forge close bonds between concepts, resources, and people is demonstrated by their usage of collaborative big data management apps. Students develop collaborative learning networks through working together on large data analysis projects, which improves their capacity for group decision-making and problem-solving as well as their research skills. This trend reflects the universities' response to the demands of the digital age, where learning has become a continuous process based on building connections between different knowledge sources, rather than simply receiving information.

Results for Research Question 2: Are there statistically significant differences in big data organization among Jordanian university students' use of collaborative educational applications (based on connectivism theory) due to variations in their university, Major, and academic level?

To answer this question, the means and standard deviations of the study sample's responses to the questionnaire on employing collaborative educational applications in big data management according to connectivism theory were calculated, as shown in figure 5.

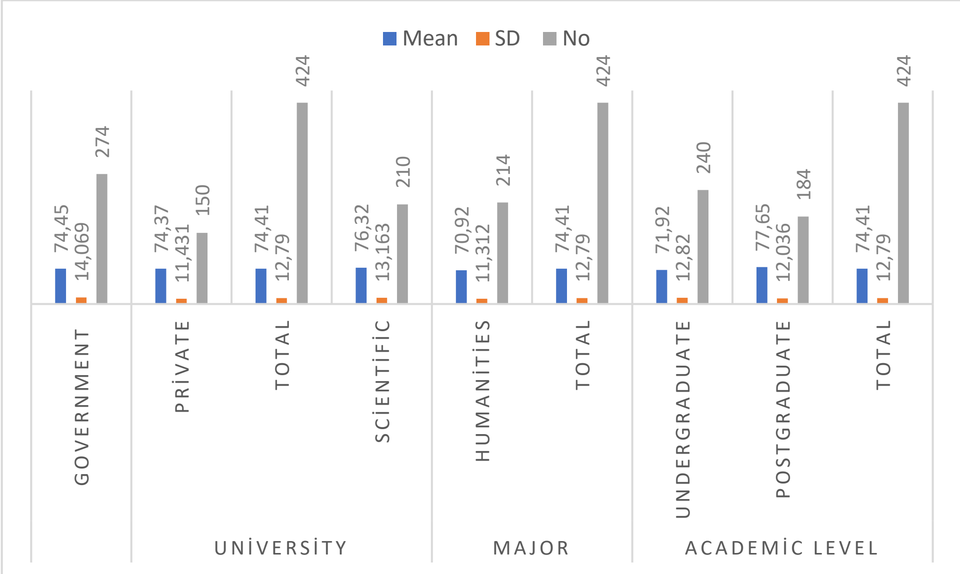

Figure 5. Means and SDs: Collaborative App Use in Big Data Organizing of Demographic Variables

Figure 5 presents notable differences in the means and standard deviations of participants' responses to the survey on implementing collaborative educational applications for big data organizations, guided by connectivism theory. A Multivariate Analysis of Variance (MANOVA) was conducted to determine the statistical significance of these inter-group differences, with the results presented in Table 4."

Table 4. Significance of Mean Differences among Demographic Variables.

Variables	Sum of Squares	df	Mean Square	F	Sig.
University	.654	1	.654	.004	.950
Major	2831.640	1	2831.640	18.004	.000
Academic level	3411.236	1	3411.236	21.880	.000

The results showed that students at government and private colleges did not significantly differ in how big data was organized when using collaborative educational programs. This outcome can be explained by the fact that students, irrespective of their academic institution, possess comparable levels of digital abilities. Technology and digital skills training are becoming more important to both public and private universities. The extensive use of standardized collaborative educational tools and software by both kinds of colleges, which gives students comparable experiences and aids in the development of the same fundamental data organization abilities, may also be a contributing factor.

The results also showed that there are variations in the organization of big data while utilizing collaborative educational programs, with a distinct advantage for postgraduate students and students with a scientific focus. This variation can be explained by several factors. Strong logical, analytical, and problem-solving abilities are necessary in scientific domains, including engineering, computer science, medicine, and the sciences. This way of thinking is in line with the abilities required to arrange and examine vast volumes of data. In addition, postgraduate students and scholars in scientific fields are likely more familiar with using collaborative education tools in class. These students’ experience with digital tools and scientific research, including an acquaintance with methodological and data processing frameworks, supports their work with big data. Also, because postgraduate scholars have researched topics that require meticulous information exploration, they are likely more motivated to examine and organize information intelligently.

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Connectivism theory explains that the much more pronounced ability to organize big data that benefits postgraduate students and students with scientific Majors stems from the fact that their style of learning reasonably demands the creation of ever more sophisticated and managed networks of knowledge. These students integrate diverse knowledge “nodes,” including big data, analytical software, and research methodologies, in ways that go beyond the application of technologies. Their capacity and skills to navigate the networks improve because of the purposeful and deep network development motivated by their research and analytical thought.

Their practical application of connectivism concepts in an academic setting that promotes the efficient linkage and exploitation of information is the reason behind their ability to organize huge data, which goes beyond a simple technical talent. Additionally, connectivism theory presupposes that everyone has access to standardized tools thanks to technology and that learning in the digital era happens through interconnected networks. Therefore, rather than being a feature of their educational institutions, students' acquisition of big data organization abilities is a direct result of their interaction with these technologies and networks (Aldalalah, 2023).

Results for Research Question 3: What is the degree of digital self-efficacy among Jordanian university students when they use connectivism-based collaborative educational applications to organize big data during the educational process?

To answer this question, means and standard deviations were calculated for students' responses to the digital self-efficacy scale, as shown in the figure below:

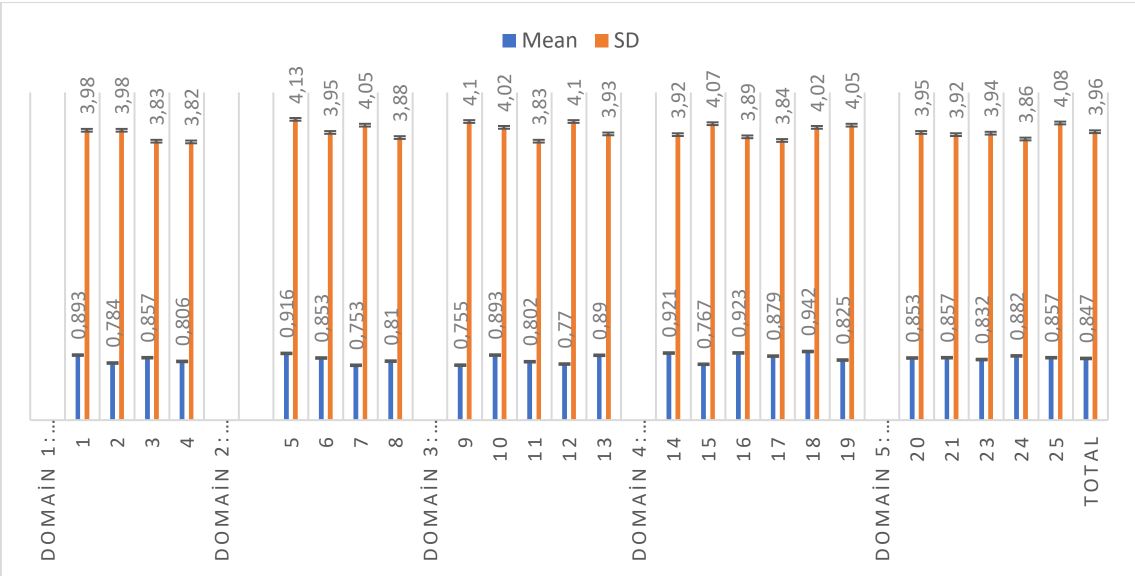

Figure 6. Means and SDs: Digital Self-Efficacy Among Jordanian University Students

The study's results indicate a high degree of digital self-efficacy among Jordanian university students, particularly when they use collaborative educational applications to organize big data within the educational process. This finding is attributed to the digital transformation of the educational system, which has necessitated the continuous use of technology and its tools by students. This use has included interaction with synchronous and asynchronous lectures, completing assignments, taking exams, and communicating with faculty members and peers (Suzer and Koc, 2024; Getenet, et al., 2024).

According to connectivism theory, the high digital self-efficacy among Jordanian university students is interpreted as a direct result of the networked learning environment imposed on them. Also, learning happens when networks of connections between various knowledge sources, whether technical or human, are created and maintained. In addition to learning new material, students are honing critical digital-age skills like accessing, evaluating, and connecting information when they use collaborative educational applications to organize massive data. Their sense of self-efficacy is raised, and they become qualified to learn in a changing digital environment because of the ongoing interaction within virtual learning communities, which also helps them handle knowledge dispersed across networks and boosts their confidence when using digital tools.

Results for Research Question 4: Are there statistically significant differences in the degree of digital self-efficacy among Jordanian university students when using collaborative educational applications based on connectivism theory, attributable to variations in university, Major, and academic level?

To answer this question, the arithmetic means and standard deviations of the study sample's responses on the digital self-efficacy scale were calculated, as shown in figure 7.

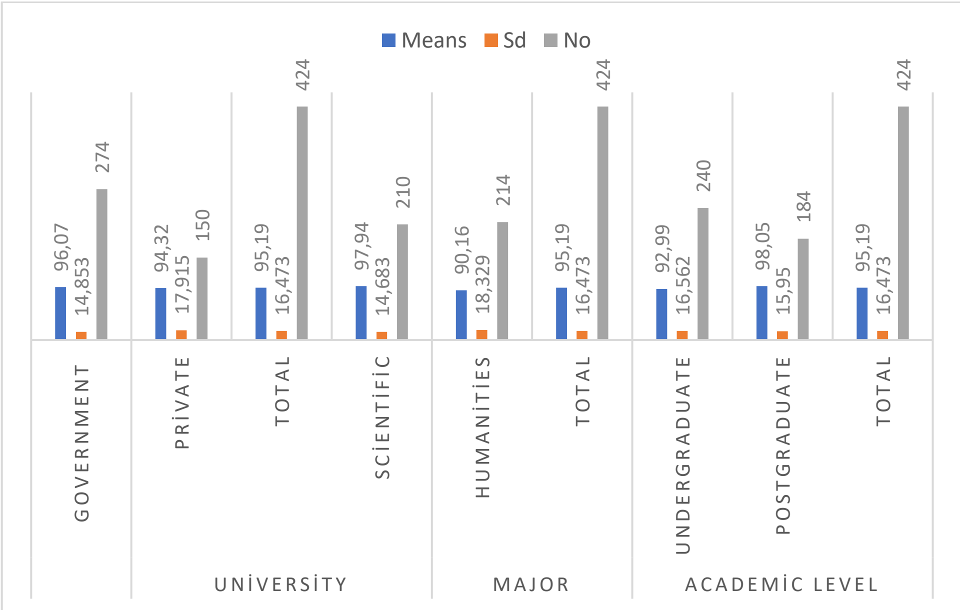

Figure 7. Means and SDs: Digital Self-Efficacy Scale of Demographic Variables

Figure 7 shows clear differences in the arithmetic means and standard deviations of the study sample's responses to the digital self-efficacy scale. To determine the statistical significance of these differences between the means, a Multivariate Analysis of Variance (MANOVA) test was applied, as presented in Table 5."

Table 5. Significance of Mean Differences among Demographic Variables.

Variables	Sum of Squares	df	Mean Square	F	Sig.
University	322.495	1	322.495	1.189	.276
Major	5875.187	1	5875.187	22.762	.000
Academic level	2675.200	1	2675.200	10.069	.002

The findings show no significant difference in digital self-efficacy between students at government and private universities. This is attributed to two main factors. First, the standardization of the digital environment, where all students use the same educational tools and platforms (such as Google Classroom), requires them to acquire identical skills in handling technology and data. Second, according to connectivism theory, learning has become a networked process that is self-directed and independent of the educational institution. Students learn by interacting with knowledge networks and open-source resources online, which reduces the impact of the university type on their skills and makes digital proficiency a direct result of their continuous engagement with technology.

A key reason for the statistically significant difference in digital self-efficacy favoring students in scientific Majors and postgraduate students is that the nature of their majors and academic requirements compels a deeper and more complex use of technology. Students in scientific fields gain extensive practical experience through their continuous use of advanced digital programs and tools in their tasks and projects, which aligns with their analytical thinking style. The historical coursework and research demand of postgraduate students encourage them to study alone and use statistical and data analysis packages, which makes them more skilled in digital technologies and comfortable using technology. The fact that they have higher digital self-efficacy can be attributed to their rich and specialized exposure to the specialized digital environments. The connectivism theory can explain the statistically significant difference in digital self-efficacy between postgraduate and science students. It is related to the learning styles that fulfil the assertions of the theory. In these classes, students use external resources, such as databases, research products, and even programs to analyze, which become increasingly more complicated systems of knowledge. Their incessant desire to engage with the different tools and enormous amounts of data greatly increases their ability to successfully pass through this network. Moreover, the postgraduate students must form these networks themselves to perform research and to get access to knowledge that enhances their feeling of self-sufficiency and mastery as a part of their learning activity. Their information networks swiftly accumulate the required resources, and conducting the research is nearly straightforward due to the high quality and simplicity of access. Students' self-efficacy results from this, as well as their confidence (Chiablaem, 2021).

It is not merely the outcome of their use of tools. Through the united knowledge networks that technology makes accessible to all, regardless of the type of university, students acquire digital skills. They are forced to learn how to link and connect information through these networks, which is a basic component of digital competency. Students' experiences with self-directed learning and skill development become more uniform as they engage in the same worldwide networks and utilize the same digital resources, thereby removing any potential disparities that may result from attending different educational institutions.

Results for Research Question 5: Is there a correlational relationship between the use of collaborative educational applications for organizing big data and digital self-efficacy among Jordanian university students?

To answer this question, Pearson's correlation coefficient was calculated to determine the relationship between the use of collaborative educational applications for organizing big data and digital self-efficacy among Jordanian university students, as shown in Table 6

Table 6. Correlation Coefficient between the Use of Collaborative App Use in Big Data Organizing and Digital Self-Efficacy

		Collaborative App	digital self-efficacy
Collaborative App	Pearson Correlation	1	.625**
	Sig. (2-tailed)		.000
	N	424	424
digital self-efficacy	Pearson Correlation	.625**	1
	Sig. (2-tailed)	.000	
	N	424	424

**. Correlation is significant at the 0.01 level (2-tailed).

A strong correlation exists between the use of collaborative educational applications for organizing big data and digital self-efficacy among Jordanian university students. This is mostly due to the experience these students have with tools that improve their confidence. By applying these tools, students can engage in collaborative activities, helping them to develop knowledge networks while exchanging experiences. Therefore, their sense of self-efficacy increases as they can solve problems together. The self-efficacy principles are also supported by the immediate feedback given to students in evaluations and self-assessments, and by the students' continual evaluation and improvement of their performance. In addition, the confidence students have in their abilities and their belief in their digital abilities is reinforced by these applications, confirming their ability to handle and resolve big data challenges.

The connectivism theory's framework of collaborative educational applications in big data organizations and students' digital self-efficacy is based on the theory's view of networks, which is learning as a process of connecting ideas, tools, and people. The applications enhance the technical self-efficacy of students, and students create knowledge networks that strengthen their belief in enhancing their contribution to the networks. Therefore, the theory of connectivism can be used to support the self-efficacy angle as well.

The ever-present connected learning opportunities that go beyond the class bolster students' adaptability to a sophisticated and ever-shifting digital landscape. This, in return, enhances their self-efficacy and ability to learn anywhere and at any time.

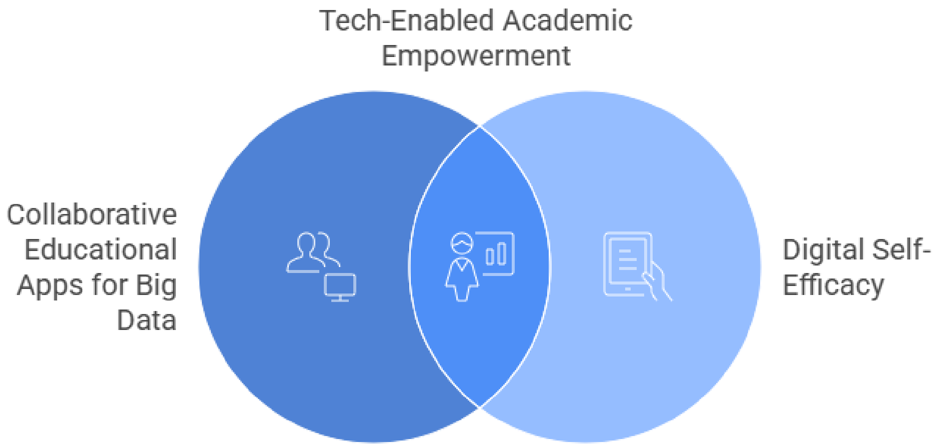

Figure 8. Empowering Students Through Collaborative Technology

4. Conclusion

As per the research, collaborative educational applications based on connectivism theory are widely used in big data enterprises. Student cohort backgrounds revealed some impressive outcomes in the fact that no distinguishable differences in the pattern of response to the questionnaires could be observed in the pattern of responses based on the type of university, and those inclined towards postgraduate students and science students. Similarly, digital self-efficacy was highly expressed among students; there was no difference between types of universities, and there were significant differences in favour of postgraduate and scientific students. Notably, the results revealed that there was a close relationship between digital self-efficacy and the extent of utilization of big data organizational collaborative educational applications.

5. Suggestion

According to one paragraph of suggestions that summarizes the findings of the study, the institutions should be keen to introduce collaborative educational applications, especially those that promote teamwork and organization of big data into the curriculum. Having a focus on an undergraduate and humanities curriculum, on which the study identified a significant skills gap with the graduate and scientific majors, professors and students should get specialized training on the use of these tools. Also, to address the demands of the modern labor market, students should put a special effort into training their skills in big data management. To learn more about the factors that influence digital self-efficacy, the research ends with a recommendation that further research should be conducted to explore more influencing factors or conduct comparative studies in different learning settings.

Declarations

Conflicts of Interest. The authors declare no conflict of interest.

Funding. No Funding

Ethical Approval. The research adhered to ethical standards for university students.
Authorization was secured from the relevant Jordanian universities, and all participants gave informed consent. Confidentiality and anonymity were guaranteed, and participation was voluntary with no academic consequences.

Data Availability Statement. The data supporting this research are available upon reasonable request to the corresponding author.

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