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Research Article

The Effectiveness of Training Special Education Teachers on Fourth Industrial Revolution Innovations to Creating Digital Educational Content for Students with Intellectual Disabilities

Hanadi Hussain Alqahtani[1*], Sameer Mosa AlNajdi[2]

[1*]Professor of Special Education, University of Tabuk, Tabuk, Saudi Arabia, E-mail: hanadiq@ut.edu.sa
[2]Professor of E-Learning, University of Tabuk, Tabuk, Saudi Arabia, E-mail: salnajdi@ut.edu.sa, ORCID:0000-0002-4974-0507

***Corresponding Author:** Hanadi Hussain Alqahtani
*Professor of Special Education, University of Tabuk, Tabuk, Saudi Arabia, E-mail: hanadiq@ut.edu.sa

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ABSTRACT

In this research, we highlighted the effectiveness of a training program for enhancing the competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution, post-COVID-19, and its impact on creating digital educational content for students with intellectual disabilities. We used an exploratory sample of middle school special education teachers and students with intellectual disabilities to standardize the study tools and determine validity and reliability coefficients. The study comprised 40 teachers divided into a control and an experimental group. A scale of the competencies of Special Education Teachers in Utilizing the Innovations of the Fourth Industrial Revolution and the training program been designed, then participants used them for study purposes. The finding revealed that the training program effectively enhanced the competencies of special education teachers to utilize the Innovations of the Fourth Industrial Revolution post-COVID-19. Also, the program effectively created digital educational content for students with intellectual disabilities, which confirms the program's effectiveness through post-test and tracking (follow-up) test in the study sample.

Keywords: Competencies; The Fourth Industrial Revolution; Digital Content; Intellectual Disabilities; Training

1. INTRODUCTION

From late 2019 until the beginning of 2020, the emerging COVID-19 pandemic has begun to dominate the news, becoming the talk of people at the local and global levels. The education sector has been the most prominent on the global stage, which has faced a difficult challenge in providing learning effectively in the most troubled times. Therefore, the global educational community suggested in March 2020 that schools close their doors and switch education from school to home, even though the medical point of view favored the idea that children are the least vulnerable group to COVID-19. However, they could be a powerful tool in transmitting infection among themselves or their family at home. Therefore, the Chinese Ministry of Education launched "Suspending Classes without Stopping Learning" by providing flexible online education for more than 260 million students who learned from their homes independently (Huang et al., 2020).
Undoubtedly, we find that the independence of learners plays a crucial and fundamental role in the process of e-learning, and this requires support for teachers through the ability to interact with students and the absolute freedom to choose the method and approach that will achieve the desired goals, technological competencies and technical assistance possessed by teachers (Nayernia, 2020)

1.1 Background/Rationale

Teachers have a vital role in shaping learners' personalities considering the technological and informational revolution (Ahmad et al., 2017), which qualifies them to adapt to the requirements of the third millennium

with the skills they possess that enable them to interact effectively with these modern innovations. Electronic courses' use in teaching increases students' motivation to learn, especially students with disabilities, primarily if the educational mean relies on sound, image, and movement elements. Therefore, the content of teacher preparation courses must grasp the technological competencies needed in special education programs (Alqahtani & Schoenfeld, 2014; Al-Qahtani, 2018).
It is necessary to foster professional technological competencies that help teachers solve the most complex tasks associated with the rapid technological changes in the environment and utilize the innovations of the Fourth Industrial Revolution, including (critical thinking, creativity, creative thinking, the ability to communicate and work within a team, and constructive interaction with students and learners) (Liu, 2018).
In Saudi Arabia, education is vital during the rapidly changing Fourth Industrial Revolution. We find that the issue of nurturing the next generation of human resources is vital in facing the effects of the fourth industrial reform, such as rapid technological changes, and how digital learning could be able to empathize and think creatively, which is an essential part of the teacher's role in the classroom. Shortly, how completely replacing teachers with technology would be helpful educationally to learners and the educational process (Douse & Uys, 2020; Liu, 2018).
The Fourth Industrial Revolution, a revolution to reform the future education system, is an intelligent information society. Digital education has enabled educators to make notable educational endeavors, enabling them to use different teaching methods beyond the current ones (Schwab, 2016).

This study highlights the most critical implications of the emerging COVID-19 pandemic and its impact on digital transformation in education as one of the pillars of the Fourth Industrial Revolution. It also highlights how adequate special education teachers are in creating educational digital content suitable for students with disabilities. In addition, within the limits of our knowledge, the subject of digital learning and artificial intelligence for students with intellectual disabilities has not been addressed yet. Especially the concept of modernizing education provides for the principle that learners should have equal access to full-quality education according to their abilities, preferences, and individual differences, regardless of their families' wealth, residence, and what type of disability they have. One direction for implementing this requirement is to integrate new models into educational content and organize it. This includes developing distance education. The experience of organizing distance education for children with disabilities has shown the success of this idea. Today, many people with disabilities are trained in this mode (Leclerc, 2021; Alqahtani & Schoenfeld, 2014; Liu, 2018).

2. THE RESEARCH PROBLEM

Educating children with intellectual disabilities and their social adaptation is one of the issues of priority, especially in the field of education, as many obstacles reduce their chances of success in the future life, including (health problems that prevent them from being in classrooms constantly and continuously, lack of participation in various recreational and cognitive activities, as well as communication with peers).
In the Fourth Industrial Revolution, the relationship between man and machine changed, and the foundations of coexistence and mutual integration between the real and virtual world and the human element. For that, we should develop and enhance the competence of teachers to face these changes and have smooth access to the digital world. The sense of the research problem stemmed from our field experience. She noticed a change in teacher preparation through our long teaching experience and frequent participation in teacher training programs during her service. Despite the rapid progress in life, especially technical progress, the traditional method of teaching is still the prevailing method in schools, and the reason for this may be the poor academic preparation of teachers and that the training courses they receive are considered ineffective stereotypical courses, and do not achieve the desired goals. Therefore, we tried to focus on enhancing the competencies of special education teachers in Utilizing the Innovations of the Fourth Industrial Revolution and the training program's impact on creating digital educational content suitable for students with intellectual disabilities.

2.1 Research Questions

1. What is a training program's effectiveness for enhancing special education teachers' competencies in utilizing the innovations of the Fourth Industrial Revolution, post-COVID-19?
2. What is the impact of creating digital educational content on the achievement of students with intellectual disabilities?

2.2 Research Hypotheses

1. No statistically significant differences exist in the competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution.
2. No statistically significant differences exist in the competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution between the mean scores of the post-test and follow-up.

2.3 Research Objectives

1. To investigate the effectiveness of a training program for enhancing the competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution.
2. To highlight some technological techniques required after the COVID-19 crisis.
3. To know the training program's impact on creating digital educational content suitable for students with intellectual disabilities from the viewpoint of their teachers.

2.4 Research Significance

The current research has two main areas of significance:

1. The Theoretical Significance

This research highlights the role of the emerging COVID-19 in digital transformation, its impact, and the extent to which the educational process has benefited from the technological innovations of the Fourth Industrial Revolution. Also, the theoretical significance of the research is shown in the importance of training and enhancing the educational and technological competencies of teachers of students with intellectual disabilities in creating digital educational content appropriate for this category.

Dhoundiyal et al. (2021) reviewed the effectiveness of the training program during COVID-19 and found that the Fourth Industrial Revolution innovations provide more tools for physical classroom instructions, online learning, and blended learning. These tools can prove highly beneficial for teachers because COVID-19 will also require their competencies as virtual leaders. Digital education content can accelerate the pace of learning, providing that the teachers have the potential to use digital tools and gadgets effectively.

Hanif and Iftikhar (2020) also confirmed that the post-Covid-19 world would rely on the tools of Industry 4.0. The study by Hanif and Iftikhar (2020) presented the concepts of Cobot, Chipbot, and Curbot. Automation is the fundamental concept of Industry 4.0, and the instruction delivery of teachers can improve significantly through intelligent tutoring systems (VanLehn, 2011).

2. The Practical Significance

This research sheds light on what the technological competencies of special education teachers should be like to design the curricula and courses provided to children with intellectual disabilities considering the Fourth Industrial Revolution and the time post-COVID-19 crisis, which contributes to their advancement and helps the developers of their educational programs creating digital educational contents suitable for this category of children. In addition, it contributes to designing a scale for measuring the effectiveness of a training program to enhance the competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution, post-COVID-19, to be applied to teachers as being an active factor in the process of digital transformation in the education of their students with disabilities. Also, to know the training program's impact on creating digital educational content suitable for students with intellectual disabilities.

3. LITERATURE REVIEW

This research discusses several basic concepts related to each other by relationships, none of which could be dealt with in isolation from the other relationships. Also, all of these are tributaries flowing into a large river, which is putting special education teachers in the focus of attention and care and enhancing their technological competencies considering the innovations of the fourth technological revolution and knowing the impact of this on creating good educational digital content suitable for students with intellectual disabilities.

3.1 The Technological Competencies of Special Education Teachers

The technological development in the twenty-first century has brought about a tremendous positive qualitative leap in the educational process of various types. It has helped deliver scientific, educational, and even behavioral information and data to learners, which has led to achieving the desired goals by relying on the outcomes of the Fourth Industrial Revolution or the second digital revolution. This concept has been discussed on a global level, especially in education. This term, "The Fourth Industrial Revolution," was coined by the World Economic Forum in Davos, Switzerland, in 2016. The digital or electronic education method is one of the results of this technological development, spreading in most sectors of society. Future trends indicate that electronic education will impose itself on educational systems so that schools will become a source of learning, not a place for it, indicating fundamental educational changes (Newby et al., 2006).

Schwab (2016) defines the Fourth Industrial Revolution as the fourth significant industrial era since the first industrial revolution in the eighteenth century. It is characterized by integrating technologies that remove the boundaries between the physical, digital, and biological fields, collectively called cyber-physical systems.

Recent years have also witnessed significant development in the education and habilitation of special-needs individuals. During those recent years, one of the most important developments was the use of assistive technology with its various forms in the educational programs of those individuals, as many educational programs and educational applications have been developed using modern technologies in the field of intellectual disability (Al-Qahtani & Al-Juda 2018).

We define the competencies in the current research procedurally as the ability of special education teachers to utilize the innovations of the Fourth Industrial Revolution to create appropriate digital educational content for students with intellectual disabilities.

E-learning in the light of the Fourth Industrial Revolution is related to four broad areas, which are:
1. Competencies in designing instruction.
2. Competencies in using technology.
3. Competencies of encouraging students' interaction.
4. Competencies of promoting students' self-learning.

Al-Hamidi (2017) and Al-Qahtani (2018) suggest a set of competencies that special education teachers should master to be able to apply e-learning, which is divided into the following:
1. The general competencies, which include the competencies related to computer and information literacy:
- To learn about the various computer components and software.
- To learn about the advantages of using a computer.
- To utilize computers and the Internet in the educational process in general, particularly in special education, such as the competencies of basic skills of starting the Windows system, managing electronic files, and using word processing and Excel programs to prepare two-dimensional and three-dimensional diagrams.

2. The competencies of dealing with programs and services of the World Wide Web:
- Using the Internet effectively to obtain information helps develop learners' skills.
- The ability to use the Internet to browse, search, send, and receive electronic messages.
- Dealing with curriculum programs and books through uploading and downloading curriculum programs and books.

Despite the emergence of many studies on educational technology competencies, including those related to e-learning, it has covered it as a sub-subject within a list that addresses the various aspects of educational technology, such as the list of competencies proposed by Salem (2004), which includes:
- · Knowledge competencies in the field of educational technology.
- · Individualized instruction competencies.
- · Competencies in using educational devices.
- · Performance competencies related to the World Wide Web.

3. The competencies of designing and preparing online courses, according to Siddiqua (2022):
- · To identify courses' general and specific objectives and prepare them electronically.
- · To identify material and human requirements for preparing courses electronically.
- · To develop teaching strategies necessary to achieve course objectives.
- · To manage e-learning, considering the different capabilities of learners.

4. Electronic Education:

E-learning is one of the technical competencies teachers of students with intellectual disabilities should be interested in; al-mberek (2003) refers to many terms used to define e-learning as follows:
- Online Learning.
- Distance Education.
- Technology-based Training.
- Web-based Training.
- Computer-based Training.

3.2 The innovations of the Fourth Industrial Revolution and its role in creating digital educational platforms for students with intellectual disabilities in the post-COVID-19 era

Considering the COVID-19 pandemic and the subsequent impact on education by school closures, we can observe the indirect effects on education, largely due to the extended closure of schools. School closures due to COVID-19 have affected more than one billion students. According to statistics, 150 countries have reported school closures, which have increased rapidly since late February. Despite the low infection rates among children, school closures are a fundamental pillar of social distancing tools to reduce the disease spreading and avoid the rapid increase of cases that will lead to pressure on health services. Interrupted education that disconnects students from the learning process has adverse effects on learning outcomes, especially for students with educational challenges (academic, socioeconomic, students with various special educational needs, or persons with disabilities) who may not be able to approach distance learning strategies effectively or have no access to information (World Bank, 2020).

Hence, it has been necessary to have alternatives with great power to impact the educational process and students' learning outcomes.

The second digital revolution, or the Fourth Industrial Revolution, has been the best solution to provide an ideal alternative to the educational process in school through digital educational platforms for distance learning. Many countries have designed educational digital platforms and windows, such as Saudi Arabia. The educational platforms included in the accessible data tariff include:

1. The Unified Education System http://www.vschool.sa: It contains advanced digital solutions that provide advanced digital educational content and tools and the ability to complete school assignments and tests. In addition, it provides effective communication channels between students, school employees, and parents (AlNajdi, 2022).

2. iEN, an Arabic word that means eye (National Educational Channel); https://ien.edu.sa; it is a satellite broadcasting educational channel that provides opportunities for distance education to those who need it. In addition, it provides access to the university's knowledge stock and activities. It works on spreading the notion of knowledge society among all classes of Saudi society to contribute with distinguished global experiences in pursuit of competition and leadership. Hence, the Educational Channels Network (iEN) seeks to contribute to training and developing human cadres to reach professionalism. It also seeks to provide advisory services to academic bodies to help them improve how they provide and present their programs and promote their contents and technical levels, to exceed with the excellent quality and distinction of performance the horizons of local boundaries to the global horizons and competition (iEN, 2020).
3. The Educational Future Gate: The Future Gate, which the Saudi Ministry of Education is working on in cooperation with Tatweer for Educational Technologies Company to transform towards digital learning, is one of the most important initiatives undertaken by the ministry in the national transformation phase, which relates to the Kingdom's 2030 Vision that aims at transforming into an educational environment that works to make students benefit from modern technologies. This initiative has adopted student and teacher (the core of the educational process) as the focus to create a new educational environment that depends on technology to deliver knowledge to students and increase the outcome of learning. It also supports the development of teachers' scientific and educational capabilities (O'Keefe et al., 2019).
4. The Application of Blended Learning for Students with Special Needs: Blended learning helps students with special needs learn via the Internet and in class based on their needs, which many online or face-to-face learning do not provide (Al-Qahtani, 2018).

3.3 Disability in the era of the Fourth Industrial Revolution

Based on the digital revolution, the Fourth Industrial Revolution began at the beginning of this century. However, it is not only related to machines and intelligent and connected systems. The Fourth Industrial Revolution also combines digital, physical, and biological technologies and creates paradigm shifts that redefine our existence (Delgado, 2019).

3.4 The relationship between technology and how disabilities people can obtain their fundamental rights

- Disabled people have the right to complete independence and participation in all environments without limitations.
- Technology can reduce or remove environmental barriers for disabled people.
- Disabled people have the right to control their choices, direct them the way they want, and access information that enables them to make decisions based on the knowledge that suits their goals and interests.
- Disabled people have the right to utilize assistive technology tools and implement the training strategies necessary to increase their independence and productivity (Viner et al., 2020).

3.5 *The roles that the technological innovations brought about by the Fourth Industrial Revolution can play in innovative education and academic empowerment*

- Using smart boards in the classroom to display digital curriculum.
- Provide interactive experiences to students that make them enjoy learning and discovery activities in a school environment.
- Teachers provide learners with support and guidance by communicating with students and sending and evaluating answers electronically.
- Provide new and unconventional educational experiences using modern approaches such as the flipped classroom, adopting augmented and virtual reality.
- Help teachers present lessons better and more efficiently through modern presentation technologies.
- The educational process parties increased interaction between students, teachers, school administration, and parents on an easy and organized basis.

E-learning is of great importance to the upbringing and education of children with intellectual disabilities because of the limited capabilities of this group compared to their typical peers of the same age, insufficient attention, difficulties in concentration, and poor ability to remember, as well as the evident deficiency in skills of adaptive behavior. These characteristics necessitate an exceptional environment with many academic and educational activities, which e-learning provides (Luckasson et al., 2002).
Hawsawi (2007) indicates that employing e-learning in the educational process for students with mild intellectual disabilities does not conflict with the educational strategies used for them, such as dividing educational tasks, advancing from the easiest to the most difficult, and from concrete to abstract, the use of various methods of reinforcement, providing immediate feedback, and other methods and general foundations of teaching students with intellectual disabilities. In addition, e-learning allows materials to be presented in various ways, such as in an audible, readable, or practical form, and this considers the differences in learning styles among students.
In the context of maintaining uninterrupted education during the period of the COVID-19 crisis, it would be necessary to highlight several essential elements for effective online education in emergencies, namely:

Solid internet infrastructure is essential for accommodating millions of users simultaneously. Live videoconferencing for synchronous and asynchronous teaching, interactive learning resources such as videos and games, and viewing, downloading, and uploading tools can improve the learning experience (Huang et al., 2020; Favale et al., 2020). In addition, the development of digital technologies and social networks has led to an update in the basis of society's apparent suggestive value and the type of education it receives. A new type of learner who can independently shape their educational path with full awareness of self-learning, self-actualization, self-development, and linking study to work and personal development has emerged. Personalized learning facilitated by digital technologies is the future of education. This approach enables learners to access education anytime and anywhere while also allowing them to choose their preferred content, methods, and learning environments (Romanova, 2018).

According to (Rodrigo & Tabuenca, 2020; Chiner et al., 2022), Students with disabilities need more than one digital tool to do their activities via the Internet, as digital learning environments are inseparable from the educational learning environment. When designing digital environments for students, the needs of learners should be considered instead of looking at learners' ability or inability to learn through digital environments. Rodrigo and Tabuenca classified five learning environments according to disability-related loss, which: digital learning for students with hearing impairment, digital learning for students with visual impairment, digital learning for students with physical and motor disabilities, digital learning for students with intellectual disabilities, and digital learning for students with attention deficit hyperactivity disorder (ADHD). Students with intellectual disabilities are characterized by cognitive and affective changes as they face obstacles related to thinking, information, and communication skills. There are essential tools that should be provided to them in order they achieve full digital access, including:

- Providing accurate and clear instructions when conducting assessment tests and considering testing methods.
- Setting flexible deadlines for submitting assignments and assessment tests.
- Simple icons, bright colors, and simple shapes help them understand and memorize.
- Provide alternative assessment tests, such as multiple-choice questions or short questions.

3.6 E-learning goals for students with intellectual disabilities

Al-Maliki and Shaaban (2020) indicate that several considerations should be considered to ensure the achievement of utilizing technology goals for students with intellectual disabilities, namely:

1. Technology should be used according to each student's needs, capabilities, and abilities.
2. It provides teachers with the necessary technical skills and uses them to teach students.
3. The awareness of teachers and students of the importance and effectiveness of educational technology in the educational process.
4. The educational program team should cooperate to identify the capabilities and needs of students with intellectual disabilities, develop the appropriate curriculum for each student, and develop solutions to the difficulties likely to be faced to achieve their program goals.

In the same context, Al-hiela (2009) points out a sequence of steps that teachers should follow to ensure the achievement of e-learning goals, namely:

1. Making desired educational goals for students through electronic media clear.
2. Informing students of time available for learning through electronic media.
3. Providing students with the most important experiences that should be focused on and acquired during learning.
4. Making the steps that students should follow to accomplish learning clear.
5. Providing immediate and continuous feedback to improve their performance.

Barden (2017) believes that the goals of e-learning for people with special needs are:

1. Providing disabled students with time and space to work.
2. Enabling them to review materials and watch video lectures as often as needed.
3. Students with disabilities and visual processing disorders can process digital text by changing font style or size, which helps them process information effectively.

Teachers of students with intellectual disabilities possess skills in using and employing e-learning, and the necessity to change the education pattern of those students, improve their education, and meet their needs is of great importance. Also, educational experiences that those students are likely to be deprived of because of their limited capabilities must be provided; thus, increasing their educational opportunities with modern technology does not eliminate the role of traditional education; instead, it increases learning opportunities by integrating those means into regular class as a supportive element (Al-Maliki & Shaaban, 2020; Al-Zboon, 2022).

According to Al-Zboon (2020), during a crisis, it is essential to ensure that online learning programs are effective, such as ensuring accessibility and preparing teachers to teach students with intellectual disabilities (SWID) remotely. It is also crucial to provide easy-to-read versions of texts for SWID and accessible web content for students. Adapting the curriculum and instructions is necessary, and examples of adaptations include using universal design for learning or based on ADDIE and ARCS models to motivate students. In addition, teachers need to support families to help them and their children.

3.7 Preparing teachers of students with intellectual disabilities.

As intellectually disabled students face many problems, being one of the most detailed categories of special education, teachers of the intellectually disabled should be better prepared to possess additional competencies than any other teacher. Those competencies include the following:

1. To have academic and professional preparation in educating the intellectually disabled by obtaining a license that allows him to work in the profession of teaching the intellectually disabled and to have sufficient experience in teaching them.

2. The ability to analyze skills and tasks required of intellectually disabled children into small sequential steps to be quickly learned by intellectually disabled children. In addition, a teacher should have stamina and patience because educating those students relies mainly on repetition. Besides, it can stimulate their motivation and attract their attention and interest to the educational materials because the likelihood of intellectually disabled children being distracted is high, and their ability to focus is poor. Also, the teacher must continuously evaluate students' performance levels, use records to record their results, provide them with appropriate and immediate feedback in different educational situations, and approve individualized education plans.
3. To learn about the characteristics of the intellectually disabled (the physical, intellectual, emotional, and social) and the limitations imposed by the disability, as the intellectually disabled have deficiencies in cognitive, skill, and social processes.
4. To train on using modern-technology-based devices.
5. A teacher must adopt a teaching strategy that moves from concrete to abstract, from easy to difficult, and from known to unknown (Al-Morsi, 2019).

To achieve that, teachers need a pedagogical framework that focuses on the learner-centered approach rather than a teacher-centered approach by adopting innovative technology and following instructional design principles, such as the ADDIE model, to ensure these innovations more effective and suit the learners' characteristics as shown in detail in figure 1.

	Analyze	Design	Develop	Implement	Evaluate
Concept	Identify the probable causes for a performance gap	Verify the desired performances and appropriate testing methods	Generate and validate the learning resources	Prepare the learning environment and engage the students	Assess the quality of the instructional products and processes, both before and after implementation
Common Procedures	1. Validate the performance gap 2. Determine instructional goals 3. Confirm the intended audience 4. Identify required resources 5. Determine potential delivery systems (including cost estimate) 6. Compose a project management plan	7. Conduct a task inventory 8. Compose performance objectives 9. Generate testing strategies 10. Calculate return on investment	11. Generate content 12. Select or develop supporting media 13. Develop guidance for the student 14. Develop guidance for the teacher 15. Conduct formative revisions 16. Conduct a Pilot Test	17. Prepare the teacher 18. Prepare the student	19. Determine evaluation criteria 20. Select evaluation tools 21. Conduct evaluations
	Analysis Summary	*Design Brief*	*Learning Resources*	*Implementation Strategy*	*Evaluation Plan*

Figure 1. Common instructional design procedures organized by ADDIE (Branch, 2014).

In addition, the educational activities are more streamlined by following motivation models such as the Keller model (ARCS) Instructional Design, see Figure 1 and Figure 2.

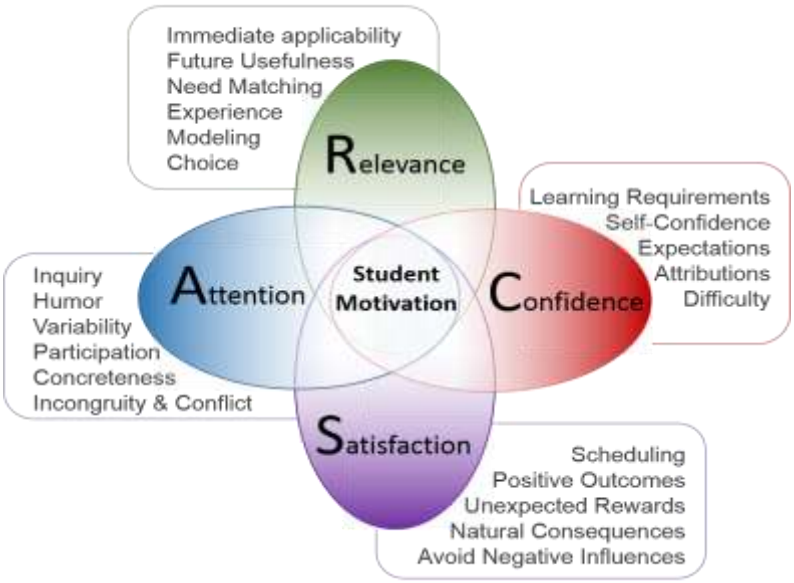

Figure 2. ARCS is an instructional design model focusing on motivation (Kurt, 2022).

4. METHODOLOGY

The research has benefited from all previous studies in the theoretical framework, preparation of tools, sample description, application procedures, and other procedures used in designing related research.
The study consisted of two direct samples: 50 teachers specialized in intellectual disability in the explorer group. Other participants joined a group of 40 teachers specializing in intellectual disability, divided into experimental and control groups; each group had 20 teachers.

4.1 The research method

In the current research, we used the quasi-experimental design that aims at knowing the effect of an independent variable (the training program based on enhancing and raising the competencies of special education teachers in utilizing modern technology innovations and its impact on creating digital knowledge content suitable for them) on a dependent variable (academic achievement) of children with intellectual disability from their teachers' point of view.

4.2 The demographic information about the sample

We have considered the consistency of the sample subjects by measuring the variables (specialization, academic degree, years of experience, taken courses). Table 1 shows the consistency of the sample.

Table 1. The consistency of the sample

Distribution of the study sample according to gender	Gender	N	%
	males	20	50
	females	20	50
	Total	40	100
Distribution of the study sample according to age	Age	N	%
	less than 35 years	14	35
	more than 36 years	26	65
	Total	40	100
Distribution of the study sample according to academic qualification	Specialization	N	%
	Bachelor's degree in special education	10	25
	Bachelor of Education with a Diploma in Special Education	30	75
	Total	40	100
Distribution of the study sample according to years of experience	Years of experience	N	%
	less than five years	12	30
	more than five years	28	70
	Total	40	100
Distribution of the study sample according to training courses taken in technological competencies	Taken courses:	N	%
	yes	0	0
	no	40	100
	Total	40	100

The students with an intellectual disability: The student sample of the study consisted of (40) male and female students with mild intellectual disabilities. Their mental age ranged between (13-16) years, and their chronological age ranged between (15-18) years. Their intelligence scores ranged from 50 to 70 on The Stanford–Binet Intelligence Scale, Fifth Edition, with a mean IQ score of (69,62). Those students are enrolled in integrated education programs in middle school (intermediate school), in which location/ spatial and social integration programs are applied in extracurricular activities, and they receive individual education services. In the post-test, the achievement scores were measured for the experimental sample of (20) male and female students, follow-up measurements, and the control group of (20) male and female students.
The consistency of the students' sample subjects was verified in terms of chronological age, level of intelligence, and socioeconomic level of family through students' files at school. The data were statistically processed to ensure the equivalence of the control and the experimental samples. The experimental sample of students was chosen randomly.
The pre-test of the achievement scores was applied to the experimental and control groups of students; then, the post-test was applied to the experimental and control groups. After 60 days of post-testing the program's application, the follow-up measurement of the achievement scores was applied to the sample subjects of the experimental group of students.

4.3 The research instruments

We designed a Scale of the Competencies of Special Education Teachers in Utilizing the Innovations of the Fourth Industrial Revolution. Also, we created a training program to enhance special education teachers' competencies in utilizing the innovations of the Fourth Industrial Revolution.
1. The Scale of the Competencies of Special Education
Teachers in Utilizing the Innovations of the Fourth Industrial Revolution:
The scale in the current study is a 5-point Likert scale (from Strongly Agree to Strongly Disagree) of 90 items that consist of two parts, which are:
a. The initial information is considered variables through which we ensure the consistency of the sample, such as (age, gender, and years of experience).
b. The scale dimensions: The scale consists of three dimensions, which are:
· First, the role of COVID-19 in the Fourth Industrial Revolution and digital transformation, which consists of (30) items, such as "Applying artificial intelligence is a real opportunity to achieve sustainable development goals in line with the requirements of the Fourth Industrial Revolution."
· Second is the technological competencies of teachers of students with intellectual disabilities, consisting of (30) items, such as "To learn about the effectiveness of using information technology with students with disabilities."
· Third, the role of the Fourth Industrial Revolution in creating appropriate knowledge content for people with disabilities consists of (30) items, such as “The Internet of Things-based smart classrooms will substitute the traditional classrooms.” The total items on the scale are (90) items. For preparing the scale, we reviewed some sources, such as (Al-Qahtani, 2018; Sheninger, 2019; Selwyn, 2016; Dowling-Hetherington et al., 2020).
The scale's psychometric properties have been verified by calculating the validity and reliability coefficients.
The validity has been calculated using the face validity method by using:
- The validity of the arbitrators: We presented the tool in its preliminary form to arbitrators from export faculty members in education technology, special education, and teachers, and then the instrument was revised based on the arbitrators' recommendations and suggestions.
- The scale reliability: The researcher has verified the reliability of the scale items using the method of:

a. Cronbach's alpha Coefficient: All items were (0,558). This reassures the researcher to use the study tool to collect information to answer the study questions and trust its application results.
b. Guttman Coefficient: Since the variance is equal here, Split-half Reliability has been used using the correlation method between forms, and the reliability coefficient was (0.615).
2. The training program
The competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution:
a. A training program based on enhancing the competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution has been prepared for teachers of students with intellectual disabilities to know the impact of this program after its application on teachers creating digital content suitable for their students and its impact on the academic achievement scores of students with intellectual disabilities.
b. The program offered training to the teachers on nine pillars of Industry 4.0. These include data analytics and extensive data management, simulation, horizontal/vertical integration, the Internet of Things (IoT), robotics, the cloud, cyber security, augmented reality, and additive manufacturing. These concepts were mapped to the competencies in digital content creation.
c. The program first provided an understanding of the theoretical concepts; its implementation was also demonstrated for digital content creation.
Researchers consider teachers' and students' characteristics in terms of skills, individual features, capabilities, and other issues that should be taken to know the impact of the teachers' training on the students with intellectual disabilities through the improvement of their achievement scores because of what the teachers

have learned in the program. During the development of the program, we considered individual differences among the study subjects in intellectual abilities, emotional, health, and social characteristics, and their willingness and desire to attend the sessions. Also, the program should have flexibility and diversity and suit everyone's needs despite individual differences. An educational platform has been created for teachers and students to meet indirect and live teaching through video conferencing and SCORM packages, named Special Education Classes. This educational platform serves all students from all environments. Teachers and students have been trained on the technological innovations of that platform to meet the research purposes.
The foundations upon which the program is based:
1. We got acquainted with the programs and references that addressed the competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution to create digital content suitable for students with disabilities.
2. We were provided training for teachers to ensure they are academically and scientifically qualified to educate students with intellectual disabilities. This includes teaching them how to access digital knowledge content and using the tools of the Fourth Industrial Revolution and artificial intelligence suitable for this student category.
3. The program aims to enhance teachers' competence in selecting technology tools to create appropriate digital content for their students in a way that is appropriate for them, which fits the characteristics of their development, which differs from their typical peers, especially in the cognitive, linguistic, and social aspects. It provides them the best way to access the Internet and interact with its content to increase their achievement.
4. After preparing the training program, we presented it to expert arbitrators. After their approval, we conducted a pilot study on a sample of teachers of students with intellectual disabilities (n = 50) other than those included in the final sample of the research, as the same conditions apply to them, to determine the appropriate number of the sessions, the appropriate treatment techniques for the sample, the appropriate duration for each session, and the required tools.
5. We have identified the program goals in the current research as the effectiveness of a training program for enhancing the competencies of special education teachers in utilizing the innovations of the fourth industrial revolution, post-COVID-19, and its impact on creating digital educational content for students with intellectual disabilities.

4.4 Goals of the program
Goals are the first step in preparing any program or academic unit. Those goals are derived from values, trends, the philosophy of society, and the need to train intellectual disabilities in a way that guarantees the quality of education and care provided to them. When determining the goals of this program, we relied upon a set of foundations that would help its success, and we summarized them as follows:
- The program should be consistent with the teachers' training goals for students with intellectual disabilities.
- Enhancing the competence of teachers in providing necessary educational skills and teaching strategies through building digital knowledge content that contributes to the education of those students.
- Creating motivation for teachers to use technology and utilize it when working with students with intellectual disabilities.
- Improving students' academic achievement with an intellectual disability by training their teachers and what their teachers provide.

4.5 The program design
The program was designed based on the ADDIE and ARCS models and run through six phases divided into (24) sessions so that each phase consisted of four sessions, each lasting two hours (120 minutes). The program took eight weeks, with three weekly interactive sessions presented in a virtual classroom. The researchers relied on these sessions in organized meetings. The presentation of the sessions was based on lecturing, discussion, dialogue, self-talk, emotional release, activities during the production and homework, role play, modeling, and workshops. The program was arbitrated by a group of professors of education technology, special education, and kindergarten, and it was approved in its final form.

4.6 The competencies and skills that the program involves
The ability to fully prepare the lesson, select and arrange goals, the ability to use modern technology, the ability to design a digital curriculum, and the ability to utilize time effectively.

4.7 The techniques used in the program
A set of techniques has been used in the program: lecturing, discussion, modeling, role-playing, brainstorming, reinforcement, direct teaching, scientific dialogue, and homework, which were used throughout the program phases; acquaintance between the participants to introduce the program, introduction and presentation, the inclusion of technology in educational curricula, complementing the previous session, open-source software, and finding appropriate digital knowledge content, even individually or collectively, see Table 2.

Table 2. The sessions of the training program

Duration	Phase	Sessions number	Phase title	Session target	Techniques used in the session
+120 m +120 m +120 m +120 m	The first phase	The first, second, third, and fourth sessions	Acquaintance between the researcher and the sample subjects	Making acquaintance with teachers, acquaintance among the teachers themselves, and familiarity between the researchers and the teachers who participated in the study. Exchanging experience among the teachers and distributing working drafts. Informing the teachers of what is required from them during this course. Explaining to the teachers how COVID-19 contributed to the well-utilizing of the tools of the Fourth Industrial Revolution and how COVID-19 has turned attention to digitalization.	Lecturing, discussion, and dialogue to clarify the program's goal.
+120 m +120 m +120 m +120 m	The second phase	The fifth, sixth, seventh, and eighth sessions	Introduction and presentation	Explaining the concept of competencies, technological competencies, their tools, their forms, and their importance for children in general and children with intellectual disabilities. Explaining how to utilize technological competencies in teaching students with intellectual disabilities, how technology would satisfy children's knowledge tendencies, and how COVID-19 has developed the technological capabilities of human resources.	Relaxation, lecturing, discussion, self-talk, use of PowerPoint presentations, brainstorming, digital searching, and collecting and writing information.
+120 m +120 m +120 m +120 m	The third phase	The ninth, tenth, 11th, and 12th sessions	Inclusion of technology in educational curricula	Explaining the role of the COVID-19 pandemic in developing and sharing tools and apps of artificial intelligence across social media platforms, which focus on education and self-training. Explaining the optimal use of artificial intelligence apps in developing education systems in general and distance education in particular.	Lecturing. discussion, dialogue, relaxation, and giving the teachers space for emotional release.
+120 m +120 m +120 m +120 m	The fourth phase	The 13th 14th,15th and 16th sessions	A complement of the previous session	Explaining search methods in digital library indexes and local and international educational sites. Learning about information security software and its role in educating people with disabilities. Using the Internet to support educational activities. Presenting some applications.	Lecturing, discussion, dialogue, relaxation, giving the teachers space for questions, and showing films about some programs.
+120 m +120 m +120 m +120 m	The fifth phase	The 17th 18th, 19th, and 20th sessions	Open-source software	Identifying aspects of curricula appropriate for technology applications and how they could be implemented. Learning about assistive technology, its applications, and how it could be integrated into a learning environment. Finding some smart device applications for teaching different subjects to students with disabilities.	Lecturing, discussion, dialogue, relaxation, production, and presentation.
+120 m +120 m +120 m +120 m	The sixth phase	The 21st, 22nd 23rd and 24th sessions	Finding appropriate digital knowledge content	Explaining how to employ multimedia application platforms of social networks such as Facebook, Instagram, and YouTube in interactive teaching. Explaining how to design and produce various interactive educational activities using some applications (Scratch, E-book) and presenting some valuable applications. Also, an educational platform has been created for research meanings.	Discussion, dialogue, relaxation, giving the teachers space for emotional release, imagination role play, modeling, and interacting.

4.8 Evaluation of the program

We evaluated the program by following the following steps:

- Applying the pre-test: The Scale of the Competencies of Special Education Teachers was applied to the experimental and control groups before the program's implementation to identify the level of competencies of the subjects of the two groups.
- Applying the post-test: The program was evaluated by applying the Scale of the Competencies of Special Education Teachers, then comparing the results of the experimental group in the pre-test to their results in the post-test, then comparing the results of the control group to the results of the experimental group in the post-test.
- Applying the follow-up measurement: The Scale of the Competencies of Special Education Teachers was applied to examine the continuation of the program's effectiveness by comparing the experimental group's post-test results to their follow-up measurement results.
- The follow-up measurement of the competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution was applied to the sample subjects of the experimental group 60 days post-test the program's application.

5. RESULTS

In this section, we addressed the statistical analysis results to test the hypotheses' validity to answer the research questions, discussed its findings regarding the theoretical framework and previous research, and provided some recommendations.

5.1 Presentation of the research results

This study had two questions; these questions are:

1. What is a training program's effectiveness for enhancing special education teachers' competencies in utilizing the innovations of the Fourth Industrial Revolution, post-COVID-19?
2. What is the impact of creating digital educational content on the achievement of students with intellectual disabilities?

To answer the first question, compare the pre-test and post-test for both groups; there were no significant differences between the control and experimental groups in the pre-test as the T value was 1.88, but not significance at $\alpha \leq 0.01$, which means both groups in the same stage as shown in table 3.

Table 3. Results of the pre-test in the control and the experimental groups

Groups	N	M	SD	df	T	Sig.
The control group	20	207.40	14.34	38	-1.88	.79
The experimental group	20	217.70	16.48			

Instead, there are significant differences between the groups in the post-test. It was evident from the results is a statistically significant difference between the control and the experimental groups in the post-test of the competencies of the study sample of the teachers, as the T value was 4.88 at a significance $\alpha \leq 0.01$ (Mean Difference: 411.20- 257.80= 153.4), that answer the first research question by ensure the difference between the two groups, which means the training program was effective and enhance special education teachers' competencies in utilizing the innovations of the Fourth Industrial Revolution, see table 4.

Table 4. Results of the post-test in the control and the experimental groups

Groups	N	M	SD	df	T	Sig.
The control group	20	257.80	148.68			
The experimental group	20	411.20	91.63	38	-4.88	.00*

* α≤0.05

On the other hand, to answer the second question, what the impact of is creating digital educational content on the achievement of students with intellectual disabilities?

To find the question answer to the results of the experimental group, the pre-test and post-test were compared, and the findings showed there is a significant difference between the pre-and post-test, which agree on the program's effectiveness in enhancing special education teachers' competencies in utilizing the innovations of the Fourth Industrial Revolution, see table 5.

Table 5. Results of the pre-test and post-test of the experimental competencies

Groups	N	M	SD	df	T	Sig.
The experimental group (pre-test)	20	217.70	16.48			
The experimental group (post-test)	20	411.20	91.63	39	10.240	0.00

* α≤0.05

In addition, to verify the hypotheses of the study, we processed the data statistically through several methods as follows:

The first hypothesis: No statistically significant differences exist in the Competencies of Special Education Teachers in Utilizing the Innovations of the Fourth Industrial Revolution.

A T-test was used for the unrelated groups to verify the validity of the first hypothesis.

It was evident from the results in Table 4 that there is a statistically significant difference between the control and the experimental groups in the post-test on the scale of the competencies of the study sample of the teachers, as the T value was 4.88 at a significance $\alpha \leq 0.05$ (M= 411.20- 257.80= 153.4), that answer the first research question by ensure the difference between the two groups, which means the training program was effective and enhance special education teachers' competencies in utilizing the innovations of the Fourth Industrial Revolution. Also, we rejected the first null hypothesis with the experimental group outperforming the control group. We proved a statistically significant difference in special education teachers' competencies in utilizing the innovations of the Fourth Industrial Revolution in favor of the experimental group, see Table 6.

Table 6. Results of the post-test and follow-up test of the experimental competencies

Groups	N	M	SD	df	T	Sig.
The experimental group (post-test)	20	411.20	91.63	39	-2.20	0.04*
The experimental group (follow-up test)	20	504.10	182.61			

* α≤0.05

The second hypothesis: No statistically significant differences exist in the Competencies of Special Education Teachers in Utilizing the Innovations of the Fourth Industrial Revolution between the mean post-test and follow-up test scores.

The T-test was used for the related groups to verify the validity of the second hypothesis. Table 4 shows this. It was evident from the results in the table that there is a statistically significant difference between the mean scores of the pre-test and post-test on the scale of the competencies of the experimental sample of the teachers in favor of the mean scores of the post-test, as "T" value was 10.24 at a significance level less than 0.01, as shown in Table 5.
It was evident from the results in the table that there is a statistically significant difference between the mean scores of the post-test and follow-up test on the scale of the competencies of the teachers in the experimental sample in favor of the follow-up measurement, as "T" value was -2.198 at a significance $\alpha \leq 0.05$ (M= 504.10-411.20= 92.9). The current research has addressed the effectiveness of a training program for enhancing the competencies of special education teachers in utilizing the innovations of the Fourth Industrial Revolution, post-COVID-19, and its impact on creating digital educational content for students with intellectual disabilities.

6. DISCUSSION AND CONCLUSION

The first hypothesis states that no statistically significant differences exist in the Competencies of Special Education Teachers in Utilizing the Innovations of the Fourth Industrial Revolution. Results showed a statistically significant difference between the mean scores of the control and the experimental groups in the post-test on the scale of the competencies of the study sample of the teachers in favor of the mean scores of the post-test.

This difference confirms that the program significantly enhances the teachers' competencies in the experimental group. This result is consistent with the study (Al-Dahshan, 2019), which concluded that the Fourth Industrial Revolution would bring about fundamental changes in the goals and method of teaching and learning of our children, which has imposed on teachers' new roles and responsibilities by including their preparation programs with appropriate courses in the fields of artificial intelligence and its applications, and the philosophy of artificial intelligence, and other skills. Results also agreed with the study results (Al-Youssef, 2017) regarding the degree to which Islamic education teachers possess the competencies of using innovative technology for those with higher educational qualifications and more years of experience, without considering the gender of teachers. The result of the hypothesis agreed with the study of Al-Shorman & Bawaneh (2018), which strongly recommended the necessity of providing intense training courses for academic staff and teachers' educational content management because of its positive impacts on the educational process. However, the results of the first hypothesis differed from the study of Ventayen (Ventayen, 2019), which addressed the teachers 'competencies in applying technological tools in teaching. All teachers (the subjects of the study sample) focused on the level of teachers' competence needed to use technological tools in terms of knowledge, cultural competencies, technical and technological competencies, practical competencies, teaching methods, and instructional designing competencies as functional competencies show, a very high competency. Results showed a statistically significant difference between the mean scores of the pre-test and post-test on the scale of the competencies of the experimental sample of the teachers in favor of the mean post-test scores, see Table 5, which means that there are significant differences between the experimental and control groups. The results of this hypothesis are consistent with many studies that emphasize the importance of training teachers to enhance their various educational technology competencies, such as (Al-Qahtani, 2018), which noted that it is necessary to enhance technical competencies and use education technology tools and employ them through social media amongst teachers to keep up with updated trends in education.

The results also agreed with the study results (Bani Hamad, 2019), as the results revealed that the degree to which special education teachers in the southern region of the Kingdom of Saudi Arabia possess technological competencies is excellent. The results of this hypothesis are also consistent with the results of the study of Foulger et al. (2017), which emphasized the need for a standard set of technical competencies specifically for teachers who are chosen to teach by using technology to support them as they prepare to become teachers who use technology.

It also agrees with the results of Farjon et al. (2019). The general objective of this study was to identify technology integration for pre-service teachers at the beginning of teacher education and preparation programs, as junior teachers had indicated that they felt they needed more preparation to integrate technology effectively in the classroom. That study has centered on attitudes and beliefs towards technology (will), the experience of learning using technology (experience), competency of using technology (skill), and access to technology (tool).

The second hypothesis states that no statistically significant differences exist in the Competencies of Special Education Teachers in Utilizing the Innovations of the Fourth Industrial Revolution between the mean post-test and follow-up test scores.

Teachers in Utilizing the Innovations of the Fourth Industrial Revolution in the experimental sample of the teachers. The finding indicates a statistically significant difference between the post-test and follow-up test on the scale of the teachers' competencies in the experimental group in favor of the follow-up measurement, see Table 4. This finding confirms the program's effectiveness and continuation during and after implementing the application on the participants and the educational process.

Results agreed with Tondeur et al. (2017) results, as the main objective was to measure the impact of a tool that identifies the structure of technological competencies and information and communications competencies, such as (1) competencies needed for supporting students to use information and communications technology (ICT) in a classroom, and (2) competencies needed for using ICT for instructional design. Results also agree with Barak (2017) in explaining the twenty-first-century competencies. An overlapping explanatory study of mixed methods was conducted to:

a. Examine the prevailing educational methods and techniques used by teachers,
b. identify the features of learning and teaching in the twenty-first century
c. , and develop pedagogical frameworks to promote the utilization of advanced technologies.

That study also emphasized the features of teaching in the twenty-first century, the importance of developing a pedagogical framework to promote advanced technologies and providing educational courses for teachers to ensure the continued success of utilizing the innovations of the Fourth Industrial Revolution in education.

7. RECOMMENDATIONS

In the current research, the researchers recommend the following:

- Giving importance to utilizing the innovations of the Fourth Industrial Revolution in stimulating mental capabilities.
- Giving importance to enhancing technological competencies for teachers of intellectual disability.
- Paying attention to the need to stimulate children's imagination with an intellectual disability through artificial intelligence tools and use it in education.
- Giving importance to working on designing programs based on e-learning and distance education for people with intellectual disabilities.
- Giving importance to digital learning for children with intellectual disabilities.
- Holding seminars and workshops on that topic to benefit teachers in training and developing their talents.

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