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Mind Mapping as a Learning Tool: A Course Design Example for Higher Education

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Abstract

The aim of this study is to provide information about the mind mapping technique and to develop its use as a learning tool in higher education. In this context, a course concept has been developed. The usage guidelines and evaluation criteria for this concept are detailed in the study. This technique, which is generally expected to be taught at the primary and secondary education levels, is anticipated to create opportunities for individuals who have missed the learning process. Thus, a design has been developed to enable individuals to take control of their own learning, enhance the retention of acquired knowledge and skills, and use them more actively in business development processes after graduation. A review of existing studies provides evidence that this technique can be used effectively and contributes to increased success in the learning process at all education levels. In this study, various mind mapping software programs used worldwide have been examined, and the course has been designed using the Foramind software, which is the most suitable for the conditions in Türkiye.

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INTRODUCTION

A Mind Map is a visual organizational tool that branches out from a central idea and encompasses related subtopics. It presents information in a hierarchical structure and is typically enriched with colours, symbols, and visuals. Its primary purpose is to make information more comprehensible and memorable. By mirroring the brain's natural functioning, a Mind Map facilitates learning and thinking processes. Concept maps and mind maps are visual tools for organizing information, differing in structure and purpose. Concept maps, developed by Novak (1970s), use labelled links to depict relationships between concepts, often hierarchically, aiding education (Novak & Cañas, 2008). Mind maps, popularized by Buzan (1974), feature a radial structure with a central idea and branches, ideal for brainstorming (Buzan & Buzan, 1993). Concept maps focus on understanding known relationships, while mind maps generate new ideas. Their distinct designs-hierarchical versus radial-support varied applicants in learning and creativity. A Concept Map, while similar to a Mind Map, more explicitly delineates the relationships between concepts (Açıkgöz-Akkoç, 2019; Akınoğlu & Yaşar, 2007; Alkış-Küçükaydın, 2020; Chen, 2008; Chiou, 2008; Chularut et al.2024; Çakmak, Gürbüz, & Oral, 2011; Evrekli & Balım, 2010; Güleç, 2019; Erdogan, 2008; Erdoğan, 2008; Hill, 2006; Iche, 2000; Morrison & Grammer, 2016; Novak, Gowin, & Johansen, 1983; Sani, Darmadi, Nurgan, & Kamaluddin, 2025).

Mind Mapping is effectively utilized across a wide range of fields:

- Education: Students prefer mind mapping to organize lecture notes, enhance comprehension of topics, and prepare for examinations.
- Business: It is widely employed in processes such as project planning, strategic planning, problem-solving, and documenting meeting notes.
- Personal Development: Individuals utilize it for goal setting, time management, and planning personal projects.
- Creative Thinking: It aids in visually organizing ideas during brainstorming sessions, creative writing, and artistic projects.
- Healthcare: Clinicians use mind maps for diagnostic reasoning, patient education, and treatment planning.

Mind Mapping varies depending on the format and purpose for which it is employed:

- Hand-Drawn Mind Map: Created manually using paper and pencil. It encourages creativity and offers a personal touch.
- Digital Mind Map: Prepared using specialized software on computers or mobile devices. It provides ease of editing and sharing capabilities.

The modern use of Mind Mapping was developed in the 1960s by Tony Buzan. Buzan argued that traditional linear note-taking methods were incompatible with the brain’s natural functioning and introduced Mind Mapping as a solution to this issue. Since then, Mind Mapping has gained popularity in both education and the business world. With the advent of the twenty-first century, online platforms and mobile applications have made Mind Mapping more accessible. Today, efforts are underway to transform Mind Mapping into a more dynamic and intelligent tool by integrating it with artificial intelligence and machine learning.

The main advantages of Mind Mapping are:

- Visual Learning: Facilitates learning by presenting information visually (Faste, 1997; Farrand et al. 2023; Zhao et al. 2024).
- Encouraging Creativity: Supports creative thinking using colours, symbols, and visuals (Akınoğlu & Yaşar, 2007; Taş, 2003, Tonga, 2022).
- Strengthening Memory: Enhances retention by presenting information in a hierarchical and relational structure. Studies on cognition and strategy, in particular, substantiate this claim (Fındık Tanrıbuyurdu & Güler Yıldız, 2014; Fjell et al., 2012; Gao et al. 2025; Garner & Waajid,

2012; Iriogbe-Efionayi, 2020; Korucu et al., 2022; Magat, 2013; MacKenzie, 2015; McClelland & Tominey; Öztabak & Özyürek, 2018; Posner & Rothbart, 2000; Robson, Allen, & Howard, 2020; Salminen et al., 2021; Sani et al., 2025; Şen, 2012; Temiz, 2020; Zimmerman, 2020; Smith-Donald, Raver, Hayes, & Richardson, 2007; Ural, Gültekin Akduman, & Şepitci Sarıbaş, 2020; Webster, 2015; Yılmaz, 2020; Zhou, Chen, & Main, 2012; Zimmerman, 2000). Furthermore, research supporting brain-based learning also positively influences this process (Buzan & Buzan, 1997; Fjell, 2012; Taştan, 2017; Türksoy-Alkım, 2022). Recent neuroimaging studies demonstrate that mind mapping activates both hemispheres of the brain, enhancing associative thinking and long-term memory encoding (Budd, 2021). The visual-spatial arrangement of ideas aligns with the brain's preference for non-linear information processing, as shown in fMRI studies comparing mind maps to linear notes (Farrand et al., 2023).

- Time Efficiency and Flexibility: Enables rapid organization and summarization of information while being suitable for both individual and group work(Fun and Maskat, 2010).
- Academic Achievement: Numerous studies indicate that Mind Mapping enhances academic success (Ateş & Bangir-Alpan, 2022; ; Baran, 2022; Bawaneh, 2019; Gömleksiz & Fidan, 2013Bayık, 2016; Çakmak, Gürbüz, & Oral, 2011; Çalışkan, 2022; Çevik 2023; Evrekli & Balım, 2010; Gömleksiz & Yetkiner, 2012; Hu et al. 2025; Karadeniz, Tangülü, & Faiz, 2013; Kartal, 2011; Kavak, 2016; Keskinkılıç-Yumuşak, 2013; Selçuk, 2015; Şimşek, Berekecioğlu, & Hamzaoğlu, 2020; Ünalır, 2019; Yeniceli, 2019; Yetkiner, 2011). Additionally, research exists demonstrating its role in increasing the retention of learned material (Aydın, 2010; Bayık, 2016; Buzlu, 2019; Gömleksiz & Fidan, 2013; Gömleksiz & Yetkiner, 2012; Kartal, 2011; Kavak, 2016; Yetkiner, 2011).

Attitude and Motivation: Studies demonstrate that learning with Mind Mapping positively influences attitudes toward learning (Bayık, 2016; Buzlu, 2019; Çalışkan, 2022; Gömleksiz & Fidan, 2013; Gömleksiz & Yetkiner, 2012; Izard et al., 2020; Kartal, 2011; Korucu et al. 2022Öztabak & Özyürek, 2018; Selçuk, 2015; Şimşek, Berekecioğlu, & Hamzaoğlu, 2020; Uysal & Sidekli, 2020; Yeniceli, 2019; Yetkiner, 2011) and motivation (Garner & Waajid, 2012; Ünalır, 2019;).

To effectively utilize a Mind Map, one should begin with a central idea, placing the main topic at the center of the map. Subsequently, related subtopics should be branched out from the central idea and consistent colour codes should be used to reinforce visual memory. While doing this, it should be avoided cognitive overload and limiting branches to 5-7 sub-topics makes it better. The use of colours and visuals to make information more engaging and memorable is one of the most distinctive aspects of this method. To this end, short and concise keywords or phrases should be used for each branch. Additionally, the map should be regularly updated to reinforce the information.

Mind Mapping caters to diverse learning styles. Its structure is ideal for individuals with a visual learning style. However, for learners with an auditory style, verbal repetition while creating or reviewing the map can be beneficial. For kinesthetics learners, hand-drawn paper-and-pencil maps may prove more effective for individuals with this style (Ergürtuna & Babadoğan, 2023).

Mind Mapping is an effective method for visually organizing information and facilitating learning. Initiated by Buzan in the 1960s, this technique is employed across various domains, from education and business to personal development and creative thinking. Available in both hand-drawn and digital versions, it addresses the needs of users. Today, it is expected to be further enhanced through integration with technologies such as artificial intelligence and three-dimensional virtual reality. Specifically:

- Integration of artificial intelligence to enable the automatic creation and analysis of Mind Maps (Zeybek, 2020),
- Offering an interactive experience in a 3D environment through Virtual Reality (VR),
- Implementation with tools that facilitate real-time collaboration on online platforms,

- Supporting a personalized learning approach through self-directed learning (Koç-Damgacı & Karataş, 2015; Min, Yunxia, & Zhuo, 2009; Saraç, Karakelle, & Whitebread, 2019; Senemoğlu, 2012; Tarım, 2003), it continues to evolve in tandem with technological advancements (Jung et al., 2025; Okada, 2025).

Various software applications related to the topic have been developed for digital platforms. The software is presented in Table 1:

Table 1. *Mind Map Software's of Teachers*

Software	*Owner*	*Link*	*Description*
Ayoa	OpenGenius Ltd.	www.ayoa.com	An AI-powered mind mapping and task management tool. Designed for organic maps, brainstorming, and team collaboration.
Bubbl.us	LKCollab, LLC	bubbl.us	A simple and easy-to-use web-based tool, ideal for basic mind maps and collaboration.
Cacoo	Nulab Inc.	cacoo.com	An online diagramming and mind mapping tool focused on teamwork. Notable for its cloud integrations.
Canva	Canva Pty Ltd.	www.canva.com	Versatile design platform. Allows you to create visually appealing maps with mind map templates.
ClickUp	Mango Technologies, Inc.	clickup.com	It offers an integrated mind map feature within the project management platform. It is used to transform ideas into tasks.
Coggle	Coggle.it (Başağıl Ltd.)	coggle.it	A minimalist, web-based tool. Known for its real-time collaboration and clean interface
Collaboard	IBV Informatik Büro und Verkehr AG	www.collaboard.app	GDPR compliant online whiteboard and mind map software. Security focused.
ConceptDraw MINDMAP	CS Odessa Corp.	www.conceptdraw.com	Professional desktop software. Provides advanced features for business and project planning.
Creately	Cinergix Pty Ltd.	creately.com	Web-based diagramming and mind mapping tool. Features templates and collaboration.
EdrawMind	Wondershare Technology Co., Ltd.	www.edrawsoft.com/edrawmind/	It offers professional mind maps with cross-platform support. It contains visually rich options.
FigJam	Figma, Inc.	www.figma.com/figjam/	Online whiteboard tool. Suitable for mind mapping and team brainstorming.
Foramind	Zihinler Fora EdTech	www.foramind.com	It is designed to facilitate learning and thinking processes. It can use artificial intelligence and pdf text.
FreeMind	Christian Foltin ve topluluk	freemind.sourceforge.net	A free, Java-based tool that meets basic mind mapping needs.
Freeplane	FreeMind	www.freeplane.org	It Offers more customization.
GitMind	Apowersoft Ltd.	gitmind.com	A free and elegant web-based tool. Easy to use and offers templates.
Goconqr	ExamTime Ltd.	www.goconqr.com	An education-focused platform that combines mind maps and learning tools.
IdeaFlip	Greater Good Technology Ltd.	ideaflip.com	A web-based mind mapping and brainstorming tool fo teamwork.
iMindQ	Seavus Group	www.imindq.com	Visual thinking tool for business and education. Desktop and web-based.
LiquidText	LiquidText, Inc.	www.liquidtext.net	Focused on note taking and document analysis. Provides mind map-like organization.
Lucidspark	Lucid Software Inc.	lucidspark.com	Virtual whiteboard. Provides a dynamic space for mind mapping and brainstorming.
Mind42	IRIAN Solutions GmbH	mind42.com	It's a free, web-based tool. It's simple and ad-supported.
MindGenius	MindGenius Ltd.	www.mindgenius.com	Business-oriented mind mapping software. Stands out with its project management features.

MindManager	Corel Corporation (Alludo)	www.mindmanager.com	A professional desktop tool for mind maps and strategic planning.
MindMeister	MeisterLabs GmbH	www.mindmeister.com	Popular web-based tool. Known for its real-time collaboration and presentation mode.
MindMup	MindMup Ltd.	www.mindmup.com	A free and simple web tool. Provides integration with Google Drive.
Mindomo	Expert Software Applications SRL	www.mindomo.com	A versatile tool for education and business. Provides web and desktop support.
MindView	MatchWare A/S	www.matchware.com/mind-mapping-software	A business-oriented software. It draws attention with its Microsoft Office integration.
Miro	Miro	miro.com	Online whiteboard platform. Ideal for mind mapping and collaboration.
Mural	Tactivos, Inc.	www.mural.co	Visual collaboration tool. Used for mind mapping and teamwork.
OpenMind	MatchWare A/S	www.matchware.com	A tool with basic mind mapping features.
Padlet	Padlet Inc.	padlet.com	A collaborative platform. Provides visual organization similar to a mind map.
Scapple	Scrintal Oy	www.scrintal.com	Visual knowledge base and mind map platform. Makes it easy to link notes.
SimpleMind	SimpleApps	simplemind.eu	A simple and effective mind mapping tool with cross-platform support.
SmartDraw	SmartDraw Software, LLC	www.smartdraw.com	Creates mind maps and diagrams with automation features.
Textografo	Textografo Inc.	textografo.com	Creates mind maps and flowcharts with text-based inputs.
TheBrain	TheBrain Technologies LP	www.thebrain.com	A software designed for dynamic and complex mind maps.
Thortspace	Gooisoft Ltd.	www.thortspace.com	It offers a unique experience with its 3D mind map creation feature.
VUE (Visual Understanding Environment)	Tufts University	vue.tufts.edu	A free mind map and concept map tool focused on education.
WiseMapping	WiseMapping	www.wisemapping.com	A free, web-based and open source mind mapping tool.
XMind	XMind Ltd.	www.xmind.net	A popular and versatile tool. It offers extensive features with desktop and mobile versions.

In this design, the use of the Foramind software has been preferred. Foramind stands out with its Turkish language support and distinguishes itself as a mind mapping software integrated with artificial intelligence (AI). Its provision of a platform that is easily accessible to users from anywhere, coupled with its rich mind mapping content aimed at enhancing the learning journey, emerges as the primary factors justifying its selection. The AI support enables the provision of ready-made templates and allows users to quickly create mind maps, offering an educational and engaging experience. Its availability on platforms such as Microsoft AppSource, a free trial period (15 days) that enables users to test its features, further contribute to the reasons for its preference. Additionally, its cloud-based nature, capability to facilitate the creation of educational materials, user-friendly and intuitive interface, pricing policy suited to conditions in Türkiye and its suitability as a national software for educators, students, and professionals seeking to organize their ideas have all been influential in its selection (Çinar, 2023; Foramind, 2024;).

METHOD

At the higher education level, this course was first implemented online at Ankara University under the name "EGUS 1014 How Do I Create a Mind Map?" Over a period of approximately two years, approximately one thousand students enrolled in the course. An analysis of the distribution of learners across faculties and programs reveals participation from approximately 90 programs spanning 18 faculties. Learners are first provided with general information and subsequently encouraged to

develop their products in a manner tailored to their specific fields of study. This approach facilitates the creation of examples that connect the course content with their respective academic disciplines.

As is known, course design uses systematic methods to develop effective learning experiences. The most preferred of these is the ADDIE model (Allen, 2006). In this study, this model, which includes analysis, design, development, implementation and evaluation stages, was used. In addition, the Backward Design (Wiggins & McTighe, 1998) model was used to determine learning outcomes to shape evaluations and teaching activities.

Within this framework, the course flow plan and the developed rating-based scoring key, as presented below, are utilized throughout the process.

SCALE DEVELOPMENT

As illustrated in Table 2, in the course titled "How to Create Mind Maps", the course objective was first established, and related goals were outlined. The relevance of each content component to the overall course objective and goals were determined, and weekly breakdowns were accordingly developed. Consequently, the content was structured over a 14-week period. The course is conducted entirely online. Viewed from this perspective, the activities designated for each week have been shaped in accordance with both the competencies of the affiliated program (program learning outcomes) and the course's specific outcomes (course learning outcomes). Subsequently, learners are directed toward detailed readings using the provided bibliography. Particularly in the evaluation process, how the learner or instructor can effectively utilize this process has also been specified. Additionally, while the general framework for how assessments will be conducted is outlined in these evaluation measures, the subsequent content, as shown in Table 2, is assessed using a rating-based scoring key. Two fundamental aspects are emphasized in the course flow: the first pertains to the evaluation of the process involving paper-and-pencil drawing, and the second involves the use of a system executed through software designed in a digital environment. In the relevant weeks, support is obtained from the individual(s) responsible for the software, with direct questions posed to them. In the final week of the course, feedback regarding the course is also collected from the learners.

Table 2. *How Do I Create a Mind Map? Course Description*

Aim	Mind maps have functions such as developing critical thinking skills, emphasizing hierarchical relationships, organizing and reorganizing information, visualizing written or verbal information, using the right and left hemispheres of the brain together, establishing connections between concepts, moving away from memorization, revealing reflective thinking, using information in new situations, increasing student success, identifying learning deficiencies, facilitating evaluation and creative knowledge production. The aim of this course is to ensure the application of the mind mapping technique in different areas by first using paper and pencil and then using the Foramind software to prepare a mind map.
Course learning Outcomes	– Summarizes the conceptual development of mind maps – Analyzes the basic principles of Tony Buzan's mind mapping work – Examines publications about mind mapping – Compare the differences between mind and concept maps – Explain the benefits and limitations of mind maps – Examines Mind Map related software in the world – Reviews Foramind - Mind Map software – Reveals the similarities and differences between the Mind Map software in the world and the Foramind software – Creates a mind map related to his/her field using the paper-pencil technique – Prepares sample studies using the Paper-Pencil technique in his/her field regarding the use of mind maps – Creates a mind map related to the field using Foramind Mind Mapping Software – Prepares a report on the achievements made during the course

Weekly Contents	1. Explanation of the purpose, scope and technique of the course 2. Historical development of mind mapping 3. Mind maps and learning strategies - interaction between styles 4. Types of mind maps, their benefits and limitations 5. Similarities and differences between mind and concept maps 6. Basic principles of pen-paper mind mapping 7. Preparing a mind map in your own field by applying the pen-paper mind map technique 8. Intra-term performance study evaluation 9. Evaluation of mind maps prepared with the pen and paper technique 10. Features of Foramind mind mapping software 11. Creating mind maps in your own field with Foramind mind mapping software 12. Areas of use of mind maps 13. Mind maps in business life 14. Evaluation of mind maps prepared with Foramind software 15. End-of-term performance study evaluation
Type of Course Delivery	Online
Necessary infrastructure for the course	Coloured Paper and Pencils, Computer, Foramind Mind Mapping Software
Period	Learning Activities: Homework, Presentation, Project, Report, Event, Application, Methods: Lecture, Question Answer, Problem Solving, Case Study Discussion, Demonstration, Techniques: Brainstorming, Six Thinking Hats, Buzz Groups
NK/ECTS	2/3

Evaluation

Criterion	*Number*	*Contribution %*
Intra-term Performance Study	1	30
Continuity	1	10
Contribution to the course	1	10
End of Term Performance Study	1	30
Report based assignment	1	10
Presentation based homework	1	10
Total	6	100

Recommended references for the course

Akınoğlu, O ve Yasa, Z. (2007). The effects of note taking in science education through the mind technique on students' attitudes, academic achievement and concept learning, journal of baltic science education, vol. 6, no. 3, 34-42.

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In this study, the Rating-Based Scoring Key (Rubric) developed based on the framework utilized by the Ministry of National Education (MoNE) in its curriculum has been employed (Table 3) (MoNE, 2024).

Table 3. *How Do I Create a Mind Map? Course Criteria Used*

Criteria	*Criterion description*	*Comment*	*Score*
Contents	Disciplines related to the given topic are not included.	*Not Good*	1
	A limited number of disciplines related to the given topic are included.	*Can be improved*	2
	Disciplines related to the given topic are partially presented, focusing on the main disciplines.	*Middle*	3
	Disciplines related to the given topic are presented in a comprehensive manner, and sub-disciplines are ignored.	*Good*	4
	Disciplines related to the given topic are presented in a comprehensive manner.	*Very good*	5
Relationship Between Concepts	The relationships established between concepts are faulty and no hierarchical structure is included.	*Not Good*	1
	The relationships established between concepts are faulty and the hierarchical structure is not taken into account.	*Can be improved*	2
	Many incorrect connections were made between concepts, and little attention was paid to the hierarchical structure.	*Middle*	3
	The relationship between the concepts has been partially established correctly and the hierarchical structure has been adopted.	*Good*	4
	The relationship between concepts has been established correctly and the hierarchical structure has been adopted.	*Very good*	5
Distribution	The information does not include the given subject.	*Not Good*	1
	No information is distributed in a logical and systematic manner.	*Can be improved*	2
	Very little information is distributed in a logical and systematic manner.	*Middle*	3
	Some information is distributed in a logical and systematic manner.	*Good*	4
	Information is distributed in a logical and systematic manner.	*Very good*	5
Visuality	There are no visual elements.	*Not Good*	1
	It does not contain visually impressive and eye-catching elements.	*Can be improved*	2
	In terms of visual elements, it is less impressive and attention-grabbing.	*Middle*	3
	It is partially impressive and eye-catching in terms of visual elements.	*Good*	4
	It is very impressive and eye-catching in terms of visual elements.	*Very good*	5
Symbol Usage	Symbols are not used.	*Not Good*	1
	Symbols were used sparingly and not in a way that was appropriate for the purpose.	*Can be improved*	2
	Symbols were used in small numbers but lacked meaning and variety.	*Middle*	3
	Symbols are used densely enough but without meaning and variety.	*Good*	4
	Symbols are used appropriately.	*Very good*	5
Originality	There is no mind map structure.	*Not Good*	1
	The mind map is similar to other examples and does not contain any original elements.	*Can be improved*	2
	The mind map contains very few original elements.	*Middle*	3
	The mind map contains some original elements.	*Good*	4
	The mind map contains original elements.	*Very good*	5

However, while the set of criteria employed is suitable for primary and secondary education, it is currently being further developed to be more detailed for higher education based on the results of a needs analysis. Refinement is being undertaken within the context of the main criteria presented in Table 4.

Table 4. *How to Create a Mind Map? Developed Course Criteria*

Criteria	*Score*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Scientifics	0-8									
Contents	0-6								x	x
Focus Idea	0-6								x	x
Main Category	0-5							x	x	x
Sub Category	0-5							x	x	x
Key Word	0-5							x	x	x
Visuality	0-7									x
Connection	0-5							x	x	x
Design	0-8									
Colour	0-6								x	x
Creativity	0-5							x	x	x
Aesthetic	0-8									
Openness	0-8									
Simplicity	0-8									
Care	0-5							x	x	x
Naming	0-5							x	x	x
Total	0-100									

CONCLUSION

Mind-mapping as a learning tool should be introduced to individuals at an early age as much as possible. This technique is highly beneficial both in reinforcing self-directed learning processes and in ensuring the retention of acquired knowledge. Nevertheless, it is also feasible for adults to effectively utilize this technique within their professional development processes. In 2024, curricula developed by Ministry of Education (MoNE), integrated mind maps into the curricula of 5th and 9th grade students. As of 2025, its use is expected to increase across all educational curricula. While Mind Mapping will not resolve all educational challenges, it will significantly enhance learning efficiency and effectiveness compared to traditional methods. It is recommended that this developed course design be offered as an elective course in other higher education institutions. Instructors are encouraged to develop their customized designs based on this model.

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The Mediating Role of Resilience in the Relationship Between Mindfulness and Creative Teaching Self-efficacy among Special Needs Teachers in Inclusive Classrooms

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Abstract

This study aims to explore The mediating role of Resilience in the relationship between mindfulness and creative teaching self-efficacy among special needs teachers in inclusive classrooms. A correlational design was employed. The relationships between the research variables were analyzed in the form of examining the paths of a structural equation model. The study population included teachers of Special Education and Integration. 200 teachers were selected using the convenience sampling method. The results of structural equation modeling showed that mindfulness directly and positively predicts creative self-efficacy in teachers in inclusive classrooms. The results of structural equation modeling also showed that mindfulness directly and positively predicted resilience in teachers in inclusive classrooms. Another finding showed that resilience directly and positively predicted creative self-efficacy in special needs teachers in inclusive classrooms.

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INTRODUCTION

Education is regarded as a fruitful and at the same time difficult matter in which teachers, as the starting point of any educational and upbringing transformation, play the greatest and most important role (Siegel et al., 2025). This issue is especially relevant in the education of exceptional children because exceptional teachers have more difficult tasks and consequently more vulnerability due to the specific educational situation in which they operate (Levinson et al., 2024). The first step towards achieving a successful teaching staff is to understand the factors that affect the quality of teachers' activities; because teachers in exceptional schools, due to the type of special educational environment, are more susceptible to job burnout compared to other teachers (Benigno et al., 2024). According to Martinez et al. (2024), a teacher's beliefs about the nature of knowledge and knowing play an important role in his or her behaviors and subsequently the beliefs and learning of students. In the field of education, this concept was considered by researchers with an emphasis on teachers' self-efficacy. Teacher self-efficacy is defined as teachers' beliefs about their abilities and capabilities in the context of teaching (Emiru & Gedifew, 2024).

Individuals' beliefs enable them to successfully perform creative behavior in a specific context and create a context of creative self-efficacy in them (Yang & Du, 2024); therefore, creative self-efficacy is used to describe an individual's belief in their ability to produce creative results and outcomes (Alhadihaq et al., 2024). By referring to the theory of creative self-efficacy and modern and new cognition, creativity was conceptualized as a behavior that produces useful and new ideas, products, and performance (Shaw et al., 2021). In addition to defining creative self-efficacy as a construct that increases individuals' ability and produces creative ideas, this construct can be viewed as a physiological process that affects the level of self-confidence of the individual (Dampérat et al.,2016).

Therefore, people who have creative self-efficacy are motivated and persistent towards their goals with confidence, and they face problems creatively and try to eliminate them (Abulela,2024). People who have high creative self-efficacy will have higher expectations of themselves for creative behavior compared to those who have low creative self-efficacy (Alhadihaq et al., 2024). Therefore, examining the factors and contexts It seems necessary to influence the creative self-efficacy of teachers. In this regard, the results of the study by Wang et al. (2024) showed that there is a relationship between the level of self-efficacy beliefs and resilience of teachers, and teachers with high self-efficacy beliefs also have high resilience; therefore, according to previous studies, one of the important characteristics that every person in their job, especially the job of a special education teacher, should have in the education process is resilience. Resilience can be considered the ability to cope with problems (Üstündağ & Akar, 2022) in a way that helps the individual deal with and adapt to difficult and stressful life situations and protects individuals from pathological disorders and life difficulties (Fathalla,2018).

It is obvious that being resilient in relation to students' challenges and job performance plays an important role in the career decision-making of teachers of special education students. This resilience, in turn, gives them the ability to continue working (Elkady, 2019). Mohammed and Mostafa (2015) consider resilience to be the application of specific strategies that working people experience in adverse conditions. A resilient teacher has a positive attitude and realistic expectations of themselves and others during difficult times, focuses on learning and self-improvement, is committed to students, and has self-confidence and self-belief because they believe that life is more meaningful than giving up in the face of problems (Dinç & İlgar, 2022).

Resilience is important in education for three reasons: first, it affects the teacher's expectations of students, because the teacher himself is a model for showing resilient behavior. Second, teaching is a difficult and complex profession and requires that the teacher deal correctly and logically with the ambiguities, difficulties, and difficulties encountered in the classroom, and this requires a

resilient behavior style (Üstündağ & Akar, 2022). On the one hand, the teacher must manage his stress and on the other hand, he must perform his professional duties correctly in order to maintain his motivation and commitment to the teaching profession over time. Third, resilience is defined as the ability to solve problems, quickly retrieve possible solutions, and act boldly in the face of various problems in an efficient manner, and is precisely related to a sense of commitment to work, self-management, and motivation in teaching for the comprehensive achievement of students (Üstündağ & Akar, 2022). This shows the importance of paying attention to professional resilience in teachers, especially teachers in special schools. However, the findings of Almohammadi (2025) indicated that high mindfulness can promote resilience among teachers. Mindfulness is a technique that, combined with meditation and specific mental orientations towards an experience, encourages awareness of the present moment in a non-judgmental way by minimizing involvement in thoughts and feelings (Aydın & Ünlü Kaynakçı, 2022).

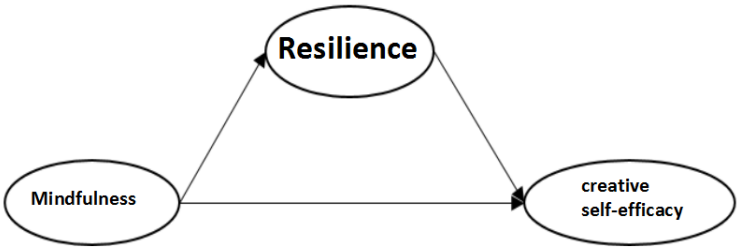
Different definitions of mindfulness reflect three basic characteristics: a) Attention and awareness focused on the present moment b) Intention or purposefulness that adds a motivational component to a person's attention and behavior c) Attitude that indicates how a person pays attention, or the state that a person is in when paying attention, such as interest, curiosity, non-judgment, acceptance, and responsiveness (Şakiroğlu et al., 2017). The most important part of mindfulness practices is being aware, that is, committing to the presence of mind (Ghomi et al., 2015). Also, several studies have been conducted on research variables, including the research of Fan and Cui (2024, who showed in a study that there is a positive and significant relationship between mindfulness and self-efficacy. The results also showed that mindfulness and self-efficacy have a negative and significant relationship with the level of stress.

AIMS AND RESEARCH GAP

Teachers face numerous challenges, including low salaries and wages, heavy workload, long working hours, student misconduct, student decline, and lack of support from the principal, all of which lead to feelings of inadequacy, reduced self-esteem and self-efficacy, job dissatisfaction, and burnout. Given these challenges, teachers must have the ability to make the right decisions in the face of adversity and hardship. The findings of the study by Wu and Qin (2025) indicated that high mindfulness can promote resilience among teachers. However, despite extensive research on resilience, mindfulness, and creative self-efficacy, the researcher did not find a comprehensive study that examined the prediction of creative self-efficacy based on mindfulness with regard to the mediating role of psychological resilience; therefore, he attempted to investigate this issue.

Therefore, the present study aims to answer the question of whether the mediating role of psychological resilience is related to mindfulness and creative self-efficacy of teachers in special schools. According to the aforementioned research background, the conceptual model of this study is shown in Figure 1.

Figure 1. *Conceptual research model*



METHOD

A correlational design was employed. The relationships between the research variables were analyzed in the form of examining the paths of a structural equation model.

PARTICIPANTS

The study population included teachers of Special Education and Integration. 200 teachers were selected using the convenience sampling method. The questionnaires were administered virtually. In the present study, 140 female teachers (70%) and 60 male teachers (30%) participated. The average age of the participating teachers was 29.6, and they ranged in age from 21 to 33 years. They were from schools for inclusion. They were at least one year experience. The inclusion criteria for the study were: 1- Individual consent to participate 2- All teachers were exceptional school teachers. The exclusion criteria for the study were: 1- Individual non-cooperation 2- Physical illness that prevented participation.

ETHICAL APPROVAL

Participants are informed about the purpose of the study, and they provided their written consent

DATA COLLECTION TOOLS

Connor and Davidson Resilience Questionnaire (RISC-CD): The original scale was developed by Connor and Davidson (2003) who viewed resilience as a measurable ability to cope with stress. The scale consists of 25 items, which are self-rated on a five-point scale (0-4): never (0), rarely (1), sometimes (2), often (3), and almost always (4). The assessment is based on how the subjects felt in the past month, with a total score of 0-100, with higher scores representing higher resilience. When Connor and Davidson (2003) developed the scale, the research subjects included community samples, primary care outpatients, private psychiatric outpatients, generalized anxiety disorder (GAD) research subjects, and post-traumatic stress disorder (PTSD) clinical trial subjects. The internal consistency Cronbach's α of the scale was .89, and the test-retest reliability was .87. The data from the general population sample were analyzed and confirmed to have a five-factor structure. Factor 1: "Personal competence, high standards and resilience"; Factor 2: "Trust in personal instincts, tolerance Factor 3: "positive acceptance of change and safe interpersonal relationships"; Factor 4: "control"; and Factor 5: "spiritual influence". The reliability of this tool in this study was 0.86, which indicates that the reliability is desirable.

Langer Mindfulness Questionnaire: The Mindfulness Questionnaire was designed and developed by Langer (2004) to measure mindfulness in teachers. This questionnaire has 14 questions and four subscales: 1) *Awareness* of the environment (14, 12, 9, 4), 2) novelty seeking (14, 12, 9, 4), 3) Flexibility (1, 2, 3), and 4) novelty creation (10, 11, 12). The reliability of this tool in this study was 0.79, which indicates that the reliability is desirable.

Creative Self-Efficacy Questionnaire (Karwowski et al., 2018): This 11-item scale was developed and used by Karwowski et al. (2018). This scale is single-factor and has five items. The items of this scale are scored based on a five-point Likert scale from one (I completely disagree) to five (I completely agree). Karwowski et al.(2018) used the test-retest method with an eight-month interval to examine the validity and reported a coefficient of 0.48. The validity of this scale was examined by calculating the correlation of the score of each item with the total score of the scale. In the present study, by calculating Cronbach's alpha, a coefficient of 0.82 was obtained, which indicates the desirable validity of this scale. Confirmatory factor analysis was used to examine validity. Factor analysis was performed using the principal components analysis method on the scale items. The KMO index was 0.82 and the Bartlett chi-square test of sphericity was significant. The total variables were able to explain 58.80 percent of the total variance of the structure.

DATA ANALYSIS

Data analysis was performed using the correlation method based on the structural equation modeling approach using AMOS version 24 software. The desired data were collected through the following three questionnaires.

RESULTS

DESCRIPTIVE STATISTICS ANALYSIS

The results of Pearson's correlation (Table 1) showed that there are significant relationships between the research variables; therefore, the research model can be examined. It should be noted that the proposed model of the present study was examined in two parts: a) Measurement model: to determine whether the measurement model developed for the constructs has the minimum defined scientific criteria or not. The results of the measurement model showed that in the resilience questionnaire, all factors have a factor loading of more than 0.3. It should be noted that the measurement model had a good fit. b) Structural model.

Table 1. *Descriptive Statistics of Each Variable and Correlation Matrix*

Variable	*M*	*SD*	*1*	*2*	*3*
1. Mindfulness	44.30	1.44	-		
2. Resilience	60.33	1.65	0.53**	-	
3. Creative self-efficacy	32.17	1.82	0.58**	0.60**	-

Note: n = 200. p < .01.

Based on the standardized coefficients (beta) in table 2, it is observed that the paths of the structural model of the present study are significant. The beta values of these correlations along with their significance level can be seen in table 2. To determine the significance of the indirect paths, the output of the bootstrap command in the AMOS software is reported in table 3.

Table 2. *Standard And Unstandardized Coefficients Of Direct Paths İn The Structural Model Of The Research*

Path			*Non-standard coefficients (B)*	*Standard coefficients (β)*	*Standard Error (S.E.)*	*Critical Ratio (C.R.)*	*p*
Mindfulness	→	Resilience	0.50	0.61	0.07	6.22	.000
Resilience	→	Creative self-efficacy	1.22	0.55	0.15	5.77	.000
Mindfulness	→	Creative self-efficacy	0.51	0.43	0.1	4.88	.000

As the results of the bootstrap test show (Table 3), resilience has established a mediating role between mindfulness and creative self-efficacy. As shown in table 4, the structural model of the research has an acceptable fit.

Table 3. *Results Of The Bootstrap Test For The İndirect Path Coefficients Of The Structural Model*

Predictor variable	*Mediator*	*independent variable*	*Indirect effect*	*Lower limit*	*Upper limit*	*p*
Mindfulness	Resilience	Creative self-efficacy	0.40	0.25	0.56	.002

As can be seen in table 4, the structural model of the research has an acceptable fit.

Table 4. *Fit İndices Of The Research Structural Model*

Measurement model	*Index*
3.7	χ2/df (Standardized Chi-Square Index)
0.92	CFI (Comparative Fit Index)
0.93	TLI (Tucker Lewis Index)
0.04	RMSEA (Root Mean Square Error of Approach)
0.93	GFI (Goodness-of-Fit Index)
0.94	AGFI (Adjusted Goodness of Fit)

DISCUSSION

The aim of the present study was to explain, within the framework of a model, the role of mindfulness on creative self-efficacy of special needs teachers in inclusive classrooms through the mediation of psychological resilience. The results of structural equation modeling showed that mindfulness directly and positively predicts creative self-efficacy in teachers in inclusive classrooms. This finding is consistent with the results of the research of Wang (2024), Fan and Cui(2024), Yen et al.(2024),and Almohammadi(2025). In explaining this finding, it can be said that mindfulness means paying attention in a specific and purposeful way in the present. Mindful people perceive internal and external realities freely and without distortion and have a great ability to deal with a wide range of thoughts, emotions, and experiences, both pleasant and unpleasant. Mindfulness is the ability to self-regulate attention and direct it towards the task. Numerous studies, including Zhou et al.(2020), have shown that having mindfulness skills reduces symptoms of vulnerable mood, anxiety, worry, stress, and tension.

In other words, mindfulness is a specific way of cultivating attention to develop awareness. On the other hand, it should be noted that self-efficacy reflects a sense of control over life, mind, beliefs, and attitudes. At the same time, mindfulness also leads to the correction, control, and processing of negative thoughts. Mindfulness also includes being able to identify problematic aspects of a thought and establish a relationship with these thoughts with a different approach. In fact, mindfulness makes a person deal with mental content in different ways, which is a characteristic that indicates creative self-efficacy in the person (Fan and Cui, 2024). Mindfulness strengthens three important skills(Ding, 2024). First, mindfulness activates “omnipresent thinking” in humans, meaning that it opens the doors of the human mind to new ideas. Second, mindfulness exercises strengthen “attention” in humans, which means that it becomes easier for the person to understand and identify practical and creative ideas than before. Third, mindfulness exercises strengthen people’s courage and flexibility in facing obstacles and possible failures(Ding, 2024). This is of great importance because obstacles and failures have a direct relationship with the innovation process in humans; therefore, it can be concluded that mindfulness affects creative self-efficacy. The cognitive-behavioral perspective also believes that mindfulness can lead to sustained exposure to feelings, thoughts, and emotions, desensitizing conditioned responses, and reducing avoidance behaviors. As a result, this awareness of thoughts and feelings provides the individual with the ability to deal with different situations, and as a result, the individual will feel more effective.

The results of structural equation modeling also showed that mindfulness directly and positively predicts resilience in teachers in inclusive classrooms. In explaining this finding, as Almanasef and Almaghaslah (2024) state, higher levels of mindfulness may help individuals overcome difficult situations and achieve higher levels of resilience. Mindful people are better able to respond to difficult situations without engaging in involuntary and maladaptive behaviors. They are open to new perceptions, tend to be more creative, and are better able to deal with difficult situations, painful thoughts, and feelings without weakness or discomfort. Some research has shown that mindfulness can reduce the use of avoidant coping styles in response to stress and increase resilience (Almanasef & Almaghaslah, 2024).

Another finding showed that resilience directly and positively predicts creative self-efficacy in special needs teachers in inclusive classrooms. In explaining this finding, it can be said that people who have higher resilience skills have the ability to successfully adapt to threatening situations and are better able to tolerate and overcome difficulties (Radhamani & Kalaivani, 2021). As a result, despite difficult and difficult conditions, they have confidence in their abilities to deal with problems and have the necessary flexibility to face various

situations. In fact, resilient people have the flexibility needed to face life's challenges and believe that they can overcome the problems that arise and that negative life events do not prevent them from achieving their goals. On the other hand, low resilience causes the person to lack the ability and capacity to deal with problems and avoid problems instead of coping effectively and constructively; therefore, it can be concluded that resilience and creative self-efficacy have a meaningful relationship with each other (Radhamani & Kalaivani, 2021).

It seems that the resilience of teachers in special needs in inclusive classrooms makes them more resistant to problems in the workplace, especially problems related to teaching exceptional children, and less stressed and distressed. As a result, it seems that such teachers, with high patience and tolerance, believe in their abilities to perform their duties and try to provide the best conditions for themselves and their students with their creativity when dealing with exceptional children.

The results of structural equation modeling showed that mindfulness, mediated by resilience, positively predicts creative self-efficacy in special needs teachers in inclusive classrooms. In other words, the more mindfulness teachers have, the higher their resilience will be, and the more resilience they have, the greater their creative self-efficacy will be.

CONCLUSION

To sum up, the results of structural equation modeling also showed that mindfulness directly and positively predicted resilience in teachers in inclusive classrooms. Another finding showed that resilience directly and positively predicted creative self-efficacy in special needs teachers in inclusive classrooms. People who are mindful are aware of their thoughts, behaviors, emotions, and motivations and try to manage and regulate them in the best possible way. Mindfulness makes a person more aware of themselves and their surroundings, and as a result, when faced with problems, due to their awareness of matters, they avoid taking any sudden, emotional, or incorrect actions and instead find a logical solution to them by comprehensively examining the problems; therefore, mindfulness increases the resilience of the individual. On the other hand, the direct effect of the components of stress coping skills in controlling unpleasant and crisis-causing life situations leads to the provision of effective solutions when accidents, problems, and traumatic psychological pressures occur, and will increase the individual's performance in social environments. Mastery and resilience of individuals not only make them stronger and more flexible in the face of problems, but also empower them to acquire skills such as controlling behavior and searching for new solutions. As a result, a resilient person believes that he can control the situation using his abilities and find appropriate and new solutions to problems and issues; therefore, it can be concluded that mindfulness affects creative self-efficacy through resilience.

LIMITATIONS AND RECOMMENDATIONS

Since mindfulness is one of the variables that is effective in improving resilience and is a skill that has the ability to be taught, it is suggested that future research be conducted focused on experimental designs related to teaching this skill. It is also suggested that similar research be conducted among other teachers (public, non-profit, gifted schools) to provide a more appropriate perspective on the relationship between the research variables and their relationship with each other. Convenience sampling introduces an increased risk of bias into the research process. Future research could include longitudinal designs and mixed-method approaches for a deeper understanding of causal mechanisms. Considering the results of the research, it is recommended that policy makers and educators pay attention to improving the level of mindfulness and resilience of teachers of teachers in special needs in inclusive classrooms and plan to increase the mindfulness and resilience of teachers, especially teachers in special needs in inclusive classrooms.

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Review Article

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Pre-Service Teachers' Understanding and Perceptions Toward Assessment Literacy: A Systematic Review

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Abstract

The study determined pre-service teachers' understanding and perceptions toward assessment literacy. The study utilized a systematic review and synthesis of peer-reviewed empirical research publications from journals. Twenty-one peer-reviewed journal articles were acquired using a search utilizing the keywords: assessment literacy and pre-service teachers with teaching experience, sourced from EBSCO and Advanced Google Search. Seventeen of the twenty-one identified journal articles were then evaluated. The findings from these articles indicated that preservice teachers are deficient in understanding assessments and have perceptions toward assessments. Knowledge in assessment is very crucial for teachers in general to enhance their teaching practices in the classroom, which in turn improves upon students' learning outcomes. In view of this, stakeholders of teacher training institutions should factor more in assessment literacy, both theory and practice into the curriculum to equip their pre-service teachers with more skills in assessment.

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INTRODUCTION

Assessment plays a crucial part in education (Ainscow, Beresford, Hopkins, Southworth & West, 2012) and therefore influences the instructional methods of teachers and the learning outcomes of students at both the classroom and institutional levels (Baird, 2013). Assessment is recognized as a fundamental principle in curricula throughout numerous global educational systems and is also a critical component of teacher professionalism (Cochrane-Smith, Piazza, & Power, 2013; O'Neill & Adams, 2014). The increasing interest in this subject is attributed not only to accountability demands and the recognition of assessment as a catalyst for educational reform (Heitink, Van der Kleij, Veldkamp, Schildkamp, & Kippers, 2016), but also to the necessity for educators to enhance student learning by devising and executing effective assessments in their classrooms (DeLuca, Chavez, Bellara, & Cao, 2013; DeLuca, Klinger, Pyper, & Woods, 2015; Hill, Cowie, Gilmore, & Smith, 2010; Lam, 2015; Popham, 2011). Significant efforts have been undertaken to assist both rookie and experienced educators in comprehending the facets of assessment practice, including development, administration, scoring, and the communication of assessment results to students (DeLuca & Bellara, 2013). Assessment literacy is defined as "an individual's understanding of the fundamental assessment concepts and procedures" (Popham, 2011, p. 267). Educational research (DeLuca, Chavez, & Cao, 2013; Stiggins, 2010) and various policies and standards (JCSEE, 2000; 2003; NBTS, 2003; NCATE, 2006 in the US; Australian Professional Standards for Teachers, 2012 and ACACA, 1995 in Australia; JAC, 1993 in Canada) have sought to inform teacher practice and promote the assessment literacy deemed essential for proficient teachers.

The acknowledgment of the essential function of teacher assessment literacy as a proficient and effective means (Popham, 2018) to address accountability requirements and enhance student learning in the classroom (DeLuca & Bellara, 2013; McMillan, 2017; Scheerens, 2016) is manifest in policy documents and standards in the United States and beyond (DeLuca, LaPointe-McEvan, & Luhanga, 2016). Therefore, the capacity of teachers to conduct classroom assessments and apply assessment data is essential to effective assessment practices (Pastore & Andrade, 2019). Teachers typically govern classroom assessment environments by establishing the evaluation methods for students, the frequency of these assessments, and the approach to providing feedback, as noted by Koloi-Keaikitse (2017). Teachers bear substantial responsibility for evaluating student learning, making their assessment skills and techniques of paramount importance (Pastore & Andrade, 2019). In classroom assessment, instructors' perceived assessment skills are vital as they affect their actual assessment practices, prompting them to frequently participate in activities they consider themselves adept at (Acar-Erdol & Yıldızlı, 2018; Brown, Gebril & Michaelides, 2019). The perceived assessment skills refer to educators' beliefs of their proficiency in data collection, analysis, and evaluation to monitor student learning outcomes and guide educational practices (Brown et al., 2019; Pastore and Andrade, 2019). The method by which educators assess their students is crucial, as it is intimately connected to both instruction and student learning outcomes (Crichton & McDaid, 2016). These procedures encompass assessment design, administration, scoring and interpretation, grading, as well as the utilization and evaluation of assessment data (Koloi-Keaikitse, 2017).

Also, Scarino (2013) emphasizes the significance of assessment literacy in teacher education and suggests that teachers' educational background and training may significantly impact their assessment literacy, hence affecting the quality of assessment practices. Likewise, Paiva et al. (2022) conducted an extensive analysis of automated assessment in computer science education. The results demonstrated that educators with higher academic qualifications are more adept at effectively employing and executing advanced assessment technology. Palau et al. (2015) conducted a study on educational assessment, demonstrating that teachers with advanced degrees exhibit greater proficiency in utilizing diverse assessment methodologies to effectively measure student development. It is well observed that as teachers attain higher qualifications, their evaluative skills and

perspectives develop, thereby affecting their assessment techniques (Brown et al., 2019; Yan & Brown, 2021).

Also, the impact of teachers' pedagogical experience on their assessment competencies and methodologies has received significant scholarly attention. Shepard et al. (2018) emphasized the need of integrating formative assessment, grading procedures, and large-scale evaluation, suggesting that teachers' expertise in utilizing these assessment methods is influenced by their teaching experience. Deeley et al. (2017) found that faculty members with less than six years of teaching experience had lower assessments of teaching efficacy in course and assessment design than those with more than six years of experience. This study demonstrates that the evaluation skills and methodologies of experienced educators are effectively amalgamated. Gamage et al. (2020) did research on the online application of pedagogical approaches and discovered that teaching experience substantially impacts the efficacy of assessment procedures. Research indicates that seasoned educators have profound understanding of assessment principles and possess a cohesive ability to apply both formative and summative assessment procedures. This underscores the vital significance of teaching experience in enhancing teachers' evaluative abilities and methodologies.

Research by Black and Wiliam (2018) highlighted the connection between classroom assessment and pedagogy, demonstrating that experienced instructors have a deeper comprehension of assessment techniques and are more skilled at aligning assessments with instructional goals. Moreover, it is underscored that teaching experience is vital in the evaluation activities of educators, as it enables them to learn from their mistakes and formulate ways to adjust to the dynamic character of the learning process (Barnes et al., 2017; Coombs et al., 2018).

Previous studies have assessed the correlation between teaching experience of teachers and assessment practices and have shown significant influence on each other. Therefore, it become necessary to know the assessment literacy level of student-teachers (pre-service teachers) who are going to the field to teach since they are required to yield positive results in their students. In this regard, the present study determined pre-service teachers' understanding and perceptions toward assessment literacy. Specifically, the study sought to determine the understanding and perceptions of K-12 pre-service teachers in Assessment literacy. Therefore, it addressed the question; how do K-12 pre-service teachers perceive the knowledge of assessment literacy in education? The study focused on enhancing the productivity of K-12 pre-service teachers in the classroom and students' success. The ability of teachers to exhibit high levels of assessment literacy in turn affects their professionalism and their students' learning outcome.

ASSESSMENT LITERACY

According to Erwin (1991, as referenced by NCF (Government of Pakistan, 2018b), assessment encompasses the processes of identifying, selecting, developing, gathering, evaluating, analyzing, and utilizing information to perpetually enhance students' learning and development. It is the systematic collection, review, and use of information about educational programs to improve student learning; therefore, the ability for preservice teachers to understand assessment principles and practices and to use assessment data effectively to support students learning is known as assessment literacy. This parameter is a crucial aspect that teacher educators must address in the training of student teachers during their preparation, since it will influence their productivity. Preservice teachers' assessment literacy will significantly impact their knowledge in assessments, ability to interpret and use assessment data, their teaching confidence, and enhance the integration of technology in assessment.

PRESERVICE TEACHERS' KNOWLEDGE AND PERCEPTIONS

Preservice teachers' knowledge is the understanding and skills that preservice teachers possess on assessment practices and how to apply them to meet students learning in the classroom. These skills include the types of assessments, the principles underlying each type, and the purpose of

the types of assessments. Hence, perceiving the knowledge of preservice teachers on assessment literacy will enable stakeholders to know preservice teachers' needs in assessment principles underlying the types of assessments and then cater it into their training.

Preservice teachers' ability to understand the process of implementing assessment, collecting data from the assessment, and using the data to support student learning will be one of the parameters that will be enhanced with assessment literacy. Knowing this ability of the preservice teachers and how they will apply the data from assessment to support students learning outcomes will provide stakeholders with the need to ensure high assessment literacy in pre-service teachers.

METHODOLOGY

This study included a systematic review and synthesis of peer-reviewed empirical journal articles. The primary objective of this design was to mitigate bias and enhance transparency throughout the review process by employing explicit, systematic methods to minimize bias in the selection and inclusion of studies, evaluate the quality of the included studies, and summarize them objectively (Liberati et al., 2009). Also, the purpose was to identify existing literature on assessment literacy among preservice teachers, their understanding and perceptions toward assessments. The outcome of the search yielded twenty-one peer-reviewed journal articles. The methodology described by Khan et al. (2003) for the selection of journal articles was employed. According to Khan et al. (2003), to arrive at a quality results and synthesis of articles, these stages should be employed for the review; selection of relevant research using databases and search keywords, assessment of study quality, synthesis of evidence, and interpretation of findings. After the review stages, 17 articles were considered out of the 21 articles. The procedures for the selection of these articles have being explained further below.

SELECTION OF RELEVANT WORK

The researcher initiated the search for journal articles via EBSCO and Advanced Google Search. Journal papers were selected because, as noted by Reeves and Crippen (2021), they typically offer a more comprehensive description and analysis of data compared to conference proceedings, which may only present initial phases or preliminary versions. The search strategy utilized the following keywords: assessment literacy, pre-service teachers, and years of teaching experience.

INCLUSION- EXCLUSION CRITERIA

The inclusion criteria used in the selection of the articles were firstly, articles from the year 2014 to 2024. Secondly, articles on pre-service teachers and their perception on knowledge of assessment literacy. However, the exclusion criteria were articles beyond the specified years and articles on only one type of assessment. Also, articles on assessment literacy applied in non-education disciplines were excluded.

ASSESSING THE QUALITY OF STUDIES

The articles were subsequently evaluated by analyzing the titles and abstracts. The constructs, literature review, methodology, findings, comments, and conclusions of the numerous journal papers were also examined.

SUMMARIZING THE EVIDENCE

Krippendorff (2012) contends that the preliminary stage of content analysis involved a coding procedure for study attributes based on research questions, wherein certain narrative or representational components of each manuscript were identified as evidence. The elements of the manuscripts that pertained to the research issue were identified and designated a term (construct) that signifies a characteristic.

INTERPRETING THE FINDINGS

17 out of the 21 identified journal articles were on assessment literacy among pre-service teachers whilst the remaining 4 were on assessment types. For the excluded articles, one was on formative assessment, two were on summative assessment and the remaining one was on diagnostic assessment and these were excluded from the review. The findings of the 17 journal articles were presented in table 1.

Table 1. *Articles selected and their overview*

Authors	*Constructs*	*Findings*
1. Sheikh and Manap (2024)	classroom assessment, Secondary education	Many teachers employed quiz methodologies, interrogatives, instructional strategies, open-ended inquiries, and closed questions. Certain educators were implementing the incentive system and cultivating a sense of accountability among students.
2. Wolde, Agago, and Zinabu (2024)	assessment skills and assessment practices, Predictors of teachers	The academic qualifications of teachers, their teaching experience, and the assessment training they have undergone predict their perceived assessment competencies and practices.
3. Zou, Yuan, Mo, and Mustakim (2024)	assessment Strategies	Enhancements in curriculum assessment methodologies by the adoption of practical, strategy-oriented evaluations can significantly improve teaching quality and student learning results.
4. Yang, Huang, Wu and Xiong (2024)	assessment of preservice physics teachers' knowledge	The preservice teachers' knowledge, skills, and understanding of force and motion were only moderately advanced, and their topic knowledge showed no correlation with their KSU. A four-tier progression system for KSU was also established.
5. Stăncescu and Drăghicescu (2016)	importance of assessment, science teachers' perspective	Science teachers believe they should prioritize the assessment process and incorporate contemporary assessment strategies, such as formative assessment, and alternative methods, like portfolios, alongside traditional strategies and techniques.
6. Beziat and Coleman (2015)	classroom assessment literacy, pre-service teachers'	Pre-service teachers exhibit a deficiency in assessment literacy, notwithstanding their completion of training in classroom assessment.
7. Zin Oo, Alonzo and Asih (2022)	teacher assessment literacy, pre-service teachers	Four fundamental content designs in assessment programs were identified from the twelve articles: audience-oriented, theory-driven, policy-driven, and classroom practice-driven.
8. Atjonen, Pöntinen, Kontkanen and Ruotsalainen (2022)	Assessment Literacy of Preservice Teachers: Emphasis on Knowledge Base, Assessment Conceptions, and Teacher Development	The students' understanding of assessment knowledge and concepts was notably diverse and demonstrated a profound awareness of the comprehensive nature of assessment. Furthermore, assessment is a challenging subject for student instructors to engage in discussions with their classmates.
9. Zin Oo, Alonzo and Davison (2020).	Pre-service teachers' Decision-Making and Classroom Evaluation Methods	The decision-making of preservice teachers (PSTs) in the classroom was significantly shaped by their ideas and values regarding assessment procedures, however it was notably restricted by their supervising teachers. The PSTs who comprehended the ideas of assessment for learning (AfL) and sought to apply continuous evaluation encountered conflict with supervising professors who want to maintain stringent control over the practicum. Consequently, most PSTs were unable to employ assessment methodologies effectively to guide their judgments regarding learning and teaching activities.
10. Mellati and Khademi (2018)	Teachers' Assessment Literacy, Students' Writing Proficiencies, and Consequences for teacher Development	The assessment literacy of teachers significantly influences students' writing performance, while teachers' understanding of assessment fosters effective and motivated assessment design in educational settings.

11. Ogan-Bekiroglu and Suzuk (2014)	The assessment literacy of pre-service teachers and its practical application	The research uncovered discrepancies between theoretical and practical evaluation literacy. This study advocates for teacher education programs to emphasize assessment theories and evaluation types, underscore the validity and reliability of assessments, facilitate student engagement in both traditional and performance-based assessment methods, and offer opportunities for reflection, practice, and revision of these methods.
12. Lian and Yew (2016)	A Framework for Analyzing the Assessment Literacy of Preservice teachers	Researchers posited that preservice teachers might demonstrate three tiers of assessment literacy according to the cognitive development model. The three tiers consist of unistructural, multi-structural, and relational.
13. Kitty, Liesbeth, Marjan and Elly de Bruijn (2023)	Teachers' perceptions of assessment literacy	Seven interconnected dimensions of assessment literacy were identified: 'ongoing enhancement of assessment literacy', 'meticulous decision-making', 'alignment', 'collaboration', 'discussion', 'advancement and innovation', and 'managing conflicts.' This depiction of assessment literacy, grounded in teachers' perceptions, may inform the enhancement of their assessment literacy in practice.
14. Güngör and Güngör (2023)	Enhancing Pre-service Teachers' Assessment Literacy during the Practicum	Pre-service teachers recognized the disparity between the EFL curriculum and actual classroom assessment procedures, enhanced their self-confidence through participation with action research for assessment preparation, and cultivated a tacit grasp of assessment literacy through experiential learning in real contexts.
15. Delosa, Pagara and Manla (2021)	Assessment Literacy of Madrasah Teachers	The assessment literacy of Madrasah teachers need improvement, indicating that the majority lack the knowledge and abilities in employing efficient assessment tools. Enhanced learning can be attained through the implementation of efficient classroom assessment methods and strategies.
16. Larsari (2021)	Teacher Assessment Literacy (TAL) regarding Learners' Writing Progressions	The influence of teacher assessment literacy (TAL) significantly impacts writing development. Teacher assessment literacy (TAL) significantly influences the improvement of learners' writing skills.
17. Nayagi and Rajendran (2019)	Approaches to Classroom Assessment by Pre-Service Teachers	Pre-service teachers demonstrated a superior comprehension of three out of five topics, namely assessment purpose, measurement theory, and confidence in evaluating the assessment. Nonetheless, the study revealed that individuals possess a deficient comprehension of assessment design and techniques.

Table 1 shows the studies done on pre-service teachers' perceptions and understandings in assessment literacy from 2014 to 2024. It was revealed that majority of preservice teachers lack the knowledge and abilities in employing efficient assessment tools. Also, individuals preservice teachers possess a deficient comprehension of assessment design and techniques. It was further revelaed that most preservice teachers (PSTs) were unable to employ assessment methodologies effectively to guide their judgments regarding learning and teaching activities. Assessment plays a major role in promoting learners performance. As revealed by the table, the influence of teacher assessment literacy (TAL) significantly impacts writing development. Teacher assessment literacy (TAL) significantly influences the improvement of learners' writing skills. Also, The assessment literacy of teachers significantly influences students' writing performance, while teachers' understanding of assessment fosters effective and motivated assessment design in educational settings.

Also, preservice teachers' ability to make vital decisions on students' performance depends on their skills of using the appropriate assessment strategies in the classroom, and their ability to cultivate a sense of accountability among students. The preservice teachers' understanding of assessment knowledge and concepts was notably diverse and demonstrated a profound awareness of the comprehensive nature of assessment. In addition, it was seen that their decision-making in the classroom was significantly shaped by their ideas and values regarding assessment procedures, however it was restricted by their supervising teachers. Therefore, it was revelaed that teacher

education programs should emphasize on assessment theories and evaluation types to underscore the validity and reliability of assessments, facilitate student engagement in both traditional and performance-based assessment methods, and offer opportunities for reflection, practice, and revision of these methods.

UNDERSTANDING AND PERCEPTIONS OF PRE-SERVICE TEACHERS ON ASSESSMENT LITERACY

The review indicated that pre-service teachers exhibit a deficiency in assessment literacy, notwithstanding their completion of training in classroom assessment (Beziat & Coleman, 2015). Consequently, students must attain greater proficiency in assessment literacy. Furthermore, pre-service instructors demonstrated a superior comprehension of three out of five topics, namely assessment goal, measurement theory, and confidence in evaluating the assessment. Nonetheless, they possess a deficient comprehension of assessment design and assessment methodologies (Nayagi & Rajendran, 2019). Consequently, Ogan-Bekiroglu and Suzuk (2014) assert that teacher education programs must emphasize assessment theories and evaluation kinds. This suggests that emphasizing these curriculum features will augment the comprehension and implementation of effective assessment procedures in the classroom, hence enhancing students' academic achievement.

Wolde, Agago, and Zinabu (2024) assert that the educational qualifications of instructors, their teaching experience, and the assessment training they have had are predictors of their perceived assessment competencies and practices. According to Zin Oo, Alonzo, and Davison (2020), preservice teachers' (PSTs) decision-making in the classroom is significantly shaped by their views and values regarding assessment strategies, although it is notably restricted by their supervising teachers. The PSTs who comprehended the ideas of assessment for learning (AfL) and sought to apply continuous evaluation encountered conflict with supervising instructors who want to maintain stringent control over the practicum. Consequently, most PSTs were unable to employ assessment methodologies effectively to guide their judgments regarding learning and teaching activities (Zin Oo, Alonzo & Davison 2020). This indicates that pre-service teachers' perceptions of assessment literacy are contingent upon their attitudes, values, educational attainment, and assessment training.

DISCUSSION

The concept of assessment literacy is crucial for teacher programs in training of preservice teachers. The knowledge in assessment is needed by these teachers to ensure learning among students. For instance, in the US, the recent revision of the InTASC Model Core Teaching Standards and Learning Progressions for Teachers 1.0 (CCSSO, 2017) introduces the notion of assessment literacy, acknowledging that teachers must possess enhanced knowledge and skills in developing diverse assessments, appropriately balancing formative and summative assessments, and utilizing assessment data to comprehend each learner's progress, plan and modify instruction as necessary, provide feedback to learners, and document learner advancement relative to standards. From a socio-cultural standpoint, assessment literacy is regarded as socially distributed, contextually reliant, and intertwined with cultural artifacts, objects, and individuals (e.g., professional standards, school organization, students, and colleagues), as observed by Pastore (2023). Recent research has consistently emphasized the assessment illiteracy of both pre-service and in-service teachers, arguing for improvements in teacher preparation about assessment techniques. The recent redefinition of assessment literacy, instead of following a basic checklist aligned with professional standards, highlights the dynamic interaction between the vertical and horizontal aspects of assessment literacy and investigates how to analyze these elements and their impact on improving teacher assessment proficiency (Pastore, 2023).

The results of the present study revealed that preservice teachers understanding in assessments is deficient and thus their perceptions toward assessments need to be improved. These findings corroborate numerous investigations regarding the efficacy of the assessment course, indicating that pre-service teachers' understanding of assessment practices has not sufficiently

advanced to fulfill the current demands of assessment in standard teaching (Abbott, 2016; Beziat & Coleman, 2015; Deneen & Brown, 2016; Izci & Caliskan, 2017). This was corroborated by Alkharusi et al. (2011); Davidheiser (2013); Gotch & French (2013); King (2010); Mertler (2003). These authors indicate that multiple studies have investigated teachers' understanding of assessment and their perceptions of assessment competence. The findings suggest that teachers may not be adequately prepared to evaluate student learning and possess limited knowledge necessary for implementing high-quality assessments. Specifically, pre-service teachers exhibited constrained assessment competencies (Coombs, 2018; Cowan, 2009; DeLuca & Klinger, 2010; MacLellan, 2004; Volante & Fazio, 2007).

CONCLUSION

The study assessed the understanding and perceptions of pre-service teachers ' assessment literacy. The findings indicated that preservice teachers' understanding of assessment is deficient and their perceptions toward assessment need to be improved. Knowledge in assessment is very crucial for teachers in general to enhance their teaching practices in the classroom, which in turn improves upon students' learning outcomes. In view of this, stakeholders of teacher training institutions should factor more assessment literacy, both theory and practice, into the curriculum to equip their pre-service teachers with more skills in assessment.

LIMITATION OF THE STUDY

Due to time constraint, secondary data were gathered from specific number of peer reviewed journal articles on preservice teachers and thus the findings cannot be generalized.Also, articles published within the time frame of 2014 to 2024 were considered in the review.

SIGNIFICANCE OF THE RESEARCH

Firstly, the research will help to improve K-12 pre-service teachers' percptions toward assessment, and improve their classroom efficiency and student achievement, as they will be more professional, and their learners will be more capable of learning because of increased assessment literacy. Moreover, most of the literature focused on assessment literacy of in-service teachers and not so much on pre-service teachers, so this study seeks to address the assessment literacy of pre-service teachers. The study will give stakeholders and teacher educators knowledge on the assessment literacy of their preservice teachers and suggest remediation before their practical teaching experience.

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