

PAPER

Students' Motivation in the Artificial Intelligence Environment: A Systematic Review

Wajeeh Daher(✉),
Ejteyad Abu Thabet

Graduate Studies Faculty,
An-Najah National University,
Nablus, Palestine

wajeehdaher@najah.edu

ABSTRACT

Students' motivation affects several educational variables related to students' learning, including the learning outcomes. Artificial intelligence tools are flourishing in educational contexts. Research related to artificial intelligence contexts needs to address the various aspects of students' motivation in these contexts. The present research intended to perform a systematic review of research papers that addressed students' motivation in the artificial intelligence context. Specifically, it intended to examine the types of such motivation in terms of four aspects: description, factors influencing the motivation type, factors influenced by the motivation type, and the type as a mediator between other educational variables. To look for appropriate papers, we used the terms 'artificial intelligence' and 'students' motivation' as keys used to search appropriate papers in Scopus, Web of Science and 'Scholar; and afterward's we added terms as 'influence' or 'impact' and 'mediator; The results of the review showed that not all four aspects were realized in the literature arrived at as a result of the collecting data process. The four aspects were found for some of the motivation types, such as intrinsic motivation, while other types did not have the four aspects, such as extrinsic motivation. We recommend that educational researchers address each one of the four aspects of the different motivation types in the artificial intelligence context. This approach would give educators means for understanding how to encourage students' motivation to learn and thus their learning outcomes in the new educational context.

KEYWORDS

artificial intelligence, students' motivation, review

1 INTRODUCTION

Students' motivation plays an important role in implementing educational curricula since it significantly influences teaching and learning practices. The success of learners to learn is related to their motivation to engage in learning. Motivation leads the learner to achieve his or her learning goals. Students' motivation is also fundamental to effective teaching. In particular, student motivation for learning is

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fundamental because being in the classroom does not guarantee students' desire to learn. Consequently, motivated students tend to learn efficiently and enjoy their learning, while unmotivated students may learn little and make learning challenging and unenjoyable. Understanding and influencing learner motivation is important for ensuring the achievement of curriculum goals and objectives [1]. Thus, research is needed to lead to this understanding.

Research indicates one factor that influences students' motivation to learn when using artificial intelligence (AI) tools, which is their perceptions of the AI technology, especially their perceptions of affect, interaction, and efficacy related to learning with AI tools [2]. The present article explores the intricate relationship between AI and student motivation, examining the relationships reported in the literature between AI learning environments and students' motivation to learn.

The present research intends to perform a systematic review of the literature on students' motivation to learn in AI environments. These environments are flourishing as educational ones, where various studies addressed the issue of students' motivation in the AI environments, which implies the need for a review that could assist instructors and principals in their decision-making regarding the utilization of these environments in the schools and the classrooms. We will first address motivation-in-general of students learning in the AI environments and then address each type of the motivation addressed by studies whose topic was students' motivation in the AI environments.

By investigating the motivational factors that drive students to embrace AI in their learning journeys, we can better understand how to create effective educational environments that harness the full potential of AI. Indeed, incorporating intrinsic motivation (at the expense of "organizational efficiency") can lead to creativity and invention. Therefore, understanding motivation sources for both human and machine intelligent systems is a powerful tool for designing better systems and enhancing human-machine collaboration. This understanding can be enriched and deepened by reviewing the literature regarding students' motivation to learn in AI environments.

In addition to the above, systematic review research of studies that addressed students' motivation to learn in AI environments is needed, as research that addresses this issue is on the rise. The present research attempts to do that, focusing on different issues of the relationship between motivation and other educational variables. Following are the research questions that address these relationships.

1. How do studies interested in students' motivation in AI learning environments describe the different types of motivation?
2. What impact does motivation have on educational outcomes in AI learning environments, according to research studies?
3. What impact do educational variables have on motivation in AI learning environments, according to research studies?
4. What is the role of motivation as a mediating variable between educational variables in AI-driven learning environments, according to research studies?

2 METHODOLOGY

The goal of the present study is to perform a systematic review of the literature on students' motivation to study in an AI environment. Following, we describe the search strategy adopted in the present study.

2.1 Search strategy

Identifying studies was accomplished by utilizing Scopus, Web of Science and Scholar. At the beginning, we searched studies by using the terms ‘students’ motivation’ AND ‘AI; We also added or substituted the term ‘AI’ with ‘Chatbot’ or even ‘bot.’ Afterwards, we added terms as ‘influence’ or ‘impact’ and ‘mediator’;

2.2 Eligibility: Inclusion/exclusion criteria

A structured search for articles related to motivation in AI environments was carried out, and analysis was applied to the studies that met the criteria. The eligibility criteria included: (1) the journal is an education journal, (2) the journal is peer-reviewed, (3) the article is about students’ learning, and (4) the article studies students’ motivation in AI-based environments. Forty-two papers were found that answer the four conditions.

2.3 Data saturation

We determined that our analysis had reached saturation after examining 43 studies. This saturation was twofold: no new categories emerged, and the properties of existing categories remained unchanged. To further solidify our findings, we analyzed an additional 15 studies from educational technology journals. This additional analysis confirmed the saturation point we had previously identified.

In addition, a sample size of 42 papers is considered appropriate for qualitative synthesis. This number exceeds the average of 14 studies and prevents the analysis from becoming overly saturated, which could dilute insights [3]. Previous research, such as Hennink and Kaiser [4] and Lin et al. [5], has utilized similar sample sizes for their respective systematic reviews and studies of interactive designs. Hennink and Kaiser [4] conducted a systematic review of 23 studies to investigate the sample size required for saturation. Lin et al. [5] examined 22 empirical studies to explore interactive designs for oral tasks, analyzing teaching methods, task types, the role of robots and facilitators, and their impact on oral language proficiency.

2.4 Reliability of the analysis

Two reviewers independently screened all retrieved records and reports. Doing that, they addressed the type of motivation described in the research, the role of the motivation type as an educational variable, whether it is a factor affecting other educational variables or the opposite, and whether the study is a mediation study. The agreement between coders turned out to be 0.915, an acceptable one. In addition, the screening tried to verify that the reviewed studies did not include any type of bias.

2.5 PRISMA 2020 checklist

We tried to satisfy the conditions listed in the PRISMA 2020 Checklist. These conditions varied from describing the goals of research (as ‘Identify the report as a systematic review’ or ‘Provide an explicit statement of the objective(s) or question(s)

the review addresses'), describing conditions of selecting the papers (as 'Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses' or 'Present the full search strategies for all databases, registers and websites, including any filters and limits used.').', describing the reviewed papers (as 'Cite each included study and present its characteristics') and discussing the limitations of the review process (as 'Discuss any limitations of the evidence included in the review' or 'Discuss any limitations of the review processes used').

Moreover, to address the risk of bias in the included studies, we studied all papers published on students' motivation to learn in the AI environment until the end of the year 2024 that emerged in Scopus, Web of Science and Scholar. We assumed that taking all such papers will lessen the overall bias that could exist in the papers.

3 RESULTS

3.1 Motivation in the context of artificial intelligence (AI)

As AI continues to revolutionize various sectors, its impact on education is becoming increasingly profound. The integration of AI tools in students' learning offers unprecedented opportunities to enhance student engagement and motivation, ex. [6, 7, 8]. In this context, motivation refers to the psychological factors that drive students to engage with AI-driven educational tools and resources, influencing their learning experiences and outcomes. Understanding these motivational dynamics helps educators to integrate AI effectively in the classroom.

AI works through algorithms and is designed to simulate humans. At its core, machine learning (ML) algorithms are divided into three categories: supervised, unsupervised, and reinforcement learning. Specifically, supervised learning is a means for computers to learn by being told the correct answer, while unsupervised learning is a way to predict the future by clustering similar data. Unlike supervised learning, reinforcement learning is unclassifiable, where there is no fixed answer and no reward for the actions [9].

Artificial intelligence has many capabilities, and it can help students by offering them personalized learning experiences that match their personal needs and interests. Through algorithms, AI systems can adjust content, activities, and feedback for each student. AI's role in improving student motivation is becoming acknowledged in education. Studies show that AI affects student motivation through personalized learning, feedback, and game-like activities that encourage social interaction. When students use AI-based learning environments, they can learn at their own pace and in ways that suit their interests. These environments can identify what students do well and where they need help, then provide suitable learning materials. This helps students become more involved in their learning and work independently to improve themselves. AI systems also give helpful feedback by looking at how students are doing and offering suggestions that fit each student's needs [10].

Lee et al. [11] found that using AI chatbots in health courses could improve students' performance and motivation. Chiu et al. (2023) pointed out that as AI learning tools became more advanced, understanding students' motivation to learn with these tools was needed. In particular, students' motivation to learn using digital media is significantly correlated with their individual-level perception of AI. Moreover, students' self-efficacy plays a crucial role in their motivation, with female students showing lower self-efficacy for learning using digital media compared to male students. Notably, teachers' motivation to integrate digital media in teaching at a classroom level was significantly positively correlated with student motivation [12].

Regarding AI's role in enhancing personal learning, personal learning networks, and environments, Tsai et al. [13] aimed to develop and use an AI-assisted programming module to compare differences among multi-ethnic college students regarding their learning expectations, motivation, and effectiveness. Their motivation was examined using the cognitive learning theory. The findings indicated that students had different performances in terms of their motivation to learn programming. Moreover, the Chinese students' learning motivation was driven by their perception of programming's value. In a related study, Qawaqneh et al. [14] showed that using AI-based virtual laboratories (VLabs) affected students' motivation toward learning mathematics, with students using AI-based VLabs demonstrating higher motivation compared to those using traditional methods.

From another perspective, Jin et al. [15] demonstrated that AI applications help support cognitive and behavioral regulation in many social learning domains but not for motivation regulation. Moreover, Li [16] showed that university students' attitudes toward AI-based systems had minimal impact on their learning motivation to achieve goals and self-standards. Further research by Beketov et al. [17] found that using an intelligent learning support system led to a statistically significant increase in medical students' motivation. Similarly, Jia and Tu [18] revealed that AI capabilities could indirectly enhance students' critical thinking awareness through improved self-efficacy and learning motivation. Supporting these findings, Chen and Liu [19] demonstrated that learning through intelligent robot image recognition technology instruction was more effective than textbook learning in enhancing students' understanding of "cell division" concepts and promoting science learning motivation.

Building on recent developments, Almulla [20] found that ChatGPT positively influences learning motivation and enhances student engagement. Complementing these findings, Tiwari et al. [21] demonstrated that students respond positively to ChatGPT's educational applications. Tiwari et al. attributed these results to the tool's utility, social presence, legitimacy, and motivation.

Below, we describe studies that addressed a specific type of motivation in the AI environments. These types of motivation are intrinsic motivation, extrinsic motivation, academic motivation, and second language motivation. We chose these types of motivation as the data-collecting process resulted in studies that addressed more than one aspect of them in educational AI environments. These aspects are a description of the type of motivation, the impact of the type on other variables, the influence of other variables on the type, and the type of motivation as a mediating variable. We will address each type of motivation by addressing these aspects of it.

3.2 Intrinsic motivation

Moybeka et al. [22] described intrinsic motivation as a need to do something because it feels satisfying and comes from enjoying learning. Chiu et al. [23] used self-determination theory to study intrinsic motivation. They found that students become more motivated when their basic needs are met, such as feeling independent, capable, and connected to others. These needs help students stay engaged and keep trying when learning gets challenging. Alhur et al. [24] also used self-determination theory and showed that students need the freedom to explore AI topics. Students should understand the material well and see how it connects to real situations. The study showed that intrinsic motivation, practical learning, and working together are important in AI education. Lin et al. [5] found that people have intrinsic motivation when they like what they are learning and feel good about it. When students

are motivated this way, they set better goals, participate in learning activities, and achieve their goals. Chiu et al. [23] found that motivation affects how students learn, how much they participate, and how long they keep trying to reach their goals. It also changes how they think and learn. When looking at AI, Alhur et al. [24] showed that intrinsic motivation is very important for doing well in school, especially in challenging subjects such as AI. Moybeka et al. [22] found that intrinsic motivation helps students learn language better in AI settings over time. However, they also found that if AI controls too much of the learning, students might lose their intrinsic motivation because they have to follow set paths. Their study showed that AI can help increase intrinsic motivation when appropriately used. Alhur et al. [24] also found that intrinsic motivation, learning by doing, and working together help students learn AI better. Martín-Núñez et al. [25] discovered that intrinsic motivation is connected to how students think about computing and how they learn AI. Chiu et al. [23] found that students are more motivated to use and learn from AI when these tools work well in real classroom settings. Their study examined how teacher help affects student experiences with AI and how this changes their motivation to learn. Their analysis revealed that using chatbot programs, intrinsic motivation and competence for learning depend on teacher support and student experience (i.e., self-regulated learning and digital literacy). Supporting these findings, Moybeka et al. [22] clarified that AI enhances intrinsic motivation, boosts self-efficacy, and facilitates personalized language learning experiences.

Attempts were made to enhance students' intrinsic motivation in the AI environment. Klissarov et al. [26] developed the Motif system (intrinsic motivation from AI feedback) to enhance intrinsic motivation through AI feedback. Of particular note, a system such as Motif can directly convert progress in large models into decision-making progress: advanced deep learning or motivation techniques could easily mean increased control efficiency, and better multimedia deep learning systems might eliminate the need for explanatory labels. Subsequently, Motif was evaluated in the complex and open NetHack learning environment, and it showed an excellent performance in the presence and absence of external environmental rewards.

In addition to the above, Alasgarova and Rzayev [27] investigated AI integration in secondary education and its effects on students' motivation and learning through the Self-determination theory framework. Their research found that AI tools such as ChatGPT-4 can affect the academic process. The study indicated that AI could offer many benefits, and its integration requires careful consideration of ethical use, digital literacy, and enhancement of intrinsic motivation.

Some studies examined intrinsic motivation as a mediating variable. Martín-Núñez et al. [25] found that intrinsic motivation mediates the relationship between perceived AI learning and computational thinking. Wang et al. [28] added that attitude mediates the effect of AI knowledge and self-standards on motivation to use artificial intelligence.

3.3 Extrinsic motivation

Boguslawski et al. [29] suggest that extrinsic motivation, driven by external factors like deadlines, assessments, or job prospects, is distinct from intrinsic motivation, which stems from internal factors such as interest and personal satisfaction. While extrinsic motivation can be effective in certain contexts, it is widely acknowledged that intrinsic motivation often leads to greater engagement and performance. Lan [30] argues that extrinsic motivators, like rewards or punishments, can influence

learning behaviors. Extrinsic motivation involves engaging in an activity with the primary goal of achieving external rewards or avoiding negative consequences, rather than the inherent enjoyment or satisfaction derived from the activity itself [28]. According to Self-Determination Theory, extrinsic motivation is driven by external factors, such as rewards or pressures, which compel individuals to engage in activities [31]. There are numerous theoretical models of motivation, with the most common distinction being between intrinsic and extrinsic motivation. Intrinsic motivation stems from internal factors like interest and enjoyment, while extrinsic motivation is driven by external rewards or punishments. For instance, a student's personal interest in a subject is intrinsically motivating, whereas grades serve as an extrinsic motivator. The interplay between intrinsic and extrinsic motivation is complex, as they can influence each other in various ways. Combining moderate extrinsic motivation with high intrinsic motivation may lead to optimal outcomes, such as higher grades and reduced test anxiety [32].

Lan [30] explored the interplay between TPI (Teacher Professional Identity) tensions and motivations in AI-enhanced teacher training. This interplay indicates how TPI tension-based motivations affect teachers' adoption and use of AI. Chavez and Palaoag [33] reported that students' motivation and preferences for AI-powered mobile applications enhance students' reading comprehension.

Wang et al. [34] found that AI learning anxiety negatively impacts learning motivation, while AI job replacement anxiety positively influences extrinsic motivation. Additionally, learning self-efficacy and both intrinsic and extrinsic motivation positively affect learning intention. Interestingly, learning self-efficacy has a positive moderating effect on the relationship between intrinsic motivation and learning intention, but a negative moderating effect on the relationship between extrinsic motivation and learning intention. These findings emphasize the significance of AI anxiety and can inform the design of AI courses to optimize learning outcomes. Fahmy [32] found that personalized and on-demand AI feedback can effectively meet students' needs for autonomy and competence, thus boosting motivation. Although this approach may slightly reduce physical class attendance, it significantly increases cognitive engagement in learning activities.

3.4 Academic motivation

Bora and Thokan [35] studied the relationship between the use of conversational AI and academic motivations among Indian students. They found that academic motivation predicted significantly students' use of chatbots. Hmoud et al. [36] investigated students' task motivation characteristics in the AI context, specifically regarding ChatGPT. Their study concluded that generative AI could be used in educational environments to enhance student learning motivation and consequently raise their academic motivation and achievement.

Motivation and engagement are essential for students to flourish in academic settings. With rising student-to-teacher ratios, some students seek more feedback than they receive from teachers. Fahmy [32] indicated that AI-based assessment could be used in this respect. The study revealed that personalized AI-based on-demand feedback could meet autonomy and competence needs to improve motivation, especially intrinsic motivation. Moreover, based on Activity Theory (AT), in clarifying relationships between difficulties in educational activity, certain relationships were identified between students-tools (student interaction with AI technology), tools-students (AI technology development), and tools-community (AI adaptation

within an educational community). This requires the necessity to refocus on intrinsic motivation, emphasizing cognitive needs, meaning, and choice [37].

Wang et al. [28] found that attitude mediates the effect of AI knowledge on academic motivation to use artificial intelligence.

3.5 Second language learning motivation

Wei [38] used the term L2 to denote the second language motivation. Wei [38] focused on the role of AI-supported education in enhancing second language motivation for EFL learners and self-regulated learning. Specifically, the study described how AI language learning tools affect learners' language learning performance and, at the same time, increase their motivation to learn.

Wei [38] reported that second language motivation can affect learners' engagement to achieve language proficiency in the AI environment. Self-regulated language learning could be utilized in the AI environment, leading to students' motivation to learn a second language and thus to their engagement in this learning.

From a contemporary perspective, Liu et al. [39] explained how motivation and enjoyment change and interact with learning contexts when participants engage in AI-IDLE (Informal Digital Language Learning of English mediated by generative AI). Ebadi and Amini [40] looked at how university students feel about using AI mobile apps to learn English. The students used a chatbot called CSIEC (Computer Simulation in Educational Communication) with 256 English language learners. The study focused on how the chatbot's human-like features and social interaction affected student motivation. They found that students were more motivated when the chatbot seemed more human-like and socially present. Students felt more motivated, excited, and confident about learning English when the chatbot acted like a real instructor.

Yang [41] showed that when AI was used in teaching English, it helped students learn better, manage their own learning, and achieve better results. Yang also found that AI works well for students learning English as a Foreign Language. Murakami et al. [42] focused on creating a lesson where students worked in groups to study how AI is used in job interviews. After this lesson, students became more interested in learning about AI for language learning. This showed that using AI makes students more eager to learn languages. Klissarov et al. [26] studied a system called Motif and found it works very well at increasing student motivation when using large language models (LLM). Motif is considered the first step in harnessing common sense and domain knowledge for LLMs in a general and intuitive way to create competent AI agents.

4 DISCUSSION

To discuss the results of the review regarding motivation in AI environments, we will first discuss the results regarding each motivation type and then address students' learning in the AI environments and teachers' instruction in these environments.

Intrinsic motivation is a critical factor in the learning process, particularly in AI-enhanced environments. It facilitates students' learning [22]. Specifically, intrinsic motivation positively influences academic performance and learning outcomes, specifically in the AI environment, as the case in language learning [22]. By understanding the dynamics of intrinsic motivation and leveraging AI effectively, educators can create more engaging and effective learning experiences. In addition, Klissarov et al. [26] found that the AI environment enhances intrinsic motivation.

Moreover, intrinsic motivation has been identified as a mediating variable between two educational variables, as between students' perceived AI learning and their computational thinking [25], indicating that intrinsic motivation can lead students to engage with AI tools in learning.

Extrinsic motivation influences learning behaviors in several significant ways. First, it encourages engagement and participation, where it can drive students to engage in learning activities in the learning, especially in learning with AI tools [33]. Extrinsic motivation can also encourage students' adoption of specific strategies to meet external expectations, where such strategies emerge as a result of the utilization of AI tools. In addition, extrinsic motivation in the AI environment can be influenced by other educational variables, such as AI learning anxiety, that could negatively impact this type of motivation. In addition, being concerned about career issues due to AI options can enhance extrinsic motivation, as students will feel the need to learn in order to ensure their future job possibilities [34]. In addition, Fahmy [32] reported that personalized feedback from AI can meet students' needs for autonomy and competence, thereby leading to their motivation to learn. This suggests that when extrinsic motivation meets students' intrinsic needs, their learning outcomes will be influenced positively.

The incorporation of AI in educational settings can enhance academic motivation through personalized learning environments, teaching strategies, and feedback that can support students' learning processes. Specifically, recent research indicates that AI tools can enhance academic motivation the previous educational means [36]. Moreover, the AI context can mediate between academic motivation in and learning outcomes, which supports students' learning processes and improves their learning outcomes. Effective teaching strategies play a crucial role in fostering academic motivation. This fostering is especially needed in the AI environment [2]. Thus, working with the students in the AI environment motivates them to learn.

Research indicates that second language motivation is significantly enhanced in AI environments. Wei [38] reported that this motivation is activated through using AI tools that provide personalized feedback, adaptive learning paths, and engaging content, which contribute to increased motivation. Increased motivation in second language learning is associated with higher levels of engagement [39].

4.1 The influence of student motivation on learning in AI environments

The present review showed that students' motivation to learn in AI environments significantly impacts students' learning outcomes. Lin et al. [5] reported that learning in AI environments tends to make students set higher goals, not withdraw from the face of challenges, and utilize efficient learning strategies, which leads to improved learning outcomes. Moreover, Lee et al. [11] found that personalized learning in AI contexts can enrich motivation, resulting in improved performance.

Moreover, AI environments tend to provide self-regulated learning, which motivates students to engage in their learning and monitor the processes of this learning. AI tools can support students by providing personalized feedback and resources [15].

4.2 Factors that influence a student's motivation to learn in an AI environment

Several factors were found to influence students' motivation to learn in an AI environment. **Personalization of learning is one such factor, where** AI tools can

match content to the individual student's learning styles and paces. This personalization makes learning more relevant to the individual student, which can increase his or her motivation [10]. **Autonomy influences** students' motivation to learn in an AI environment. AI can facilitate students' autonomy by offering various paths and resources, leading to the increase in intrinsic motivation [32]. **Interaction and collaboration** also influence students' motivation to learn in an AI environment, where this motivation to learn in an AI environment increases when these environments provide students with activities relevant to their **real-world experiences**. When students see how their learning connects to real-world situations, their motivation to learn is enriched [43].

Teachers who integrate AI tools into their teaching and provide support and encouragement can significantly enhance student motivation [12]. This is especially true when students are given activities that challenge them because of their difficulty. This teacher's support allows students to experience success and develop confidence [5].

5 CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

Artificial intelligence is flourishing in the scientific domain and in education [44–49]. The present study performed a systematic review of the literature in relation to the motivation of students to learn in AI environments. The literature addressed not only students' motivation to learn in such environments but also teachers' instruction that influences students' motivation to learn in AI environments.

The review showed that AI environments provide the students with different means that increase their motivation to learn. Real-time feedback provided by AI systems helps students understand their progress, leading to the enhancement of their motivation.

Teachers can interfere in the AI environment to provide additional resources and assistance to students and thus enhance their motivation and self-regulated learning. By using AI to help students set personal learning goals and assess their learning processes, autonomy and self-directed learning can be promoted, leading to increased motivation as students become aware and responsible for their learning processes.

In the context of enhancing students' motivation in AI contexts, teachers can orchestrate towards experiences that motivate students to learn. These experiences include personalized learning, interactive games and gamification, interaction, and self-regulated learning.

One limitation of the present study is the period of the publishing of the reviewed studies, where every day new studies appear that address students' motivation to learn in the AI environments.

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7 AUTHORS

Wajeeh Daher is a Full Professor in the Graduate Studies Faculty at An-Najah National University. A significant part of his research focuses on the different aspects of using technology in educational settings. One main issue focuses on the professional development of pre-service and in-service mathematics teachers in using digital tools to encourage school students' high order thinking, creative thinking, critical thinking and metacognitive thinking. Other issues are concerned with the affective and social aspects of learning with technology (E-mail: wajeehdaher@najah.edu).

Ejteyad Abu Thabet obtained BA in Mathematics Teaching Methods in 2010. She worked as a teacher in public schools for two years. She obtained a master's degree in mathematics education in 2013, a master's degree in applied statistics in 2017, and a doctorate in measurement and evaluation from Yarmouk University in 2020. She published research in international journals in mathematics education, measurement and evaluation, and curriculum evaluation. She is an Assistant Professor at An-Najah National University and Birzeit University.