



EXAMINATION OF PRE-SERVICE SCIENCE TEACHERS' SCIENCE FICTION SELF-EFFICACY IN THE CONTEXT OF THE AI AND STEM RELATIONSHIP

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Abstract: Science fiction, a synthesis of scientific knowledge and literary creativity, stands out as a resource that supports learning through imagination. This enables the development of higher-order thinking skills in STEM education. Furthermore, it is thought that science fiction, which presents a utopian or dystopian vision beyond current technological developments, influences how artificial intelligence, whose use is becoming increasingly widespread today, is perceived by individuals. Within this scope, the study aims to examine pre-service science teachers' science fiction self-efficacy in the context of the artificial intelligence and STEM relationship. The study group of the research, which utilized a correlational survey design, consists of 191 pre-service science teachers. The Science Fiction Self-Efficacy Scale, Artificial Intelligence Anxiety Scale, and STEM Awareness Scale were used as data collection tools. SPSS 27 software and Pearson's correlation coefficient were used in the analysis of the data. The results of the study indicated that higher levels of pre-service science teachers' science fiction self-efficacy were associated with lower anxiety regarding learning and AI configuration, as well as higher levels of STEM awareness. It is recommended that qualitative studies capable of examining the relationships identified in the research in depth and experimental studies capable of revealing cause-and-effect relationships be conducted.

Key words: Science fiction, STEM education, artificial intelligence, anxiety, science education.

1. Introduction

Is the function of science fiction works, where time passes quickly, merely to entertain? Or is it to enable the reader to evaluate their own time by stimulating their imagination with the question, 'What if?' When viewed critically, it can be said that science fiction works are learning resources that shed light on the future and encourage their audience to think about science, technology, and society. Science fiction is defined as a literary genre that addresses people's reactions to developments and changes in science and technology, examines perceptions of change through technology, encourages the reader to think critically about their own world, and demonstrates that different worlds are possible (Asimov, 1986; Baccolini, 2004). A day imagined in the future, aliens from outer space, humanoids, robots, technological wonders, superpowers, extraordinary travels in time and space can be shown as examples of the elements rendered in science fiction works (Abdel Radi, 2020). Although the elements are extraordinary, the subjects are handled in a way that the recipient can relate to their own self and life, their reactions to social and technological changes, and their thoughts about the future. Therefore, it can be said that science fiction has a sociological, technological, and psychological context that is well relevant to human life.

Science fiction, in short, is the combination of the problems of the real world or the future with imagination and technology in a scenario to produce observable solutions. It inspires the recipient to think differently, to question, and to solve problems. Tang (2014) stated that looking at scientific concepts in science fiction content with a questioning approach and discussing them in the classroom environment can build an interesting bridge between students and the subject. Asimov (1986) stated that using science fiction works that are interesting in terms of their characteristics, even if they

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contain scientifically incorrect information, as an educational tool can arouse students' curiosity and desire to learn. Based on the same idea, Ekem (1992) stated that if the scientific content is correct, learning can take place with visual and auditory support, and if it is incorrect, the ability to question events and facts and to think critically and analyze can be developed. Similarly, Goldsmith and Mattei (2014) have noted that even poor science fiction can inspire students to engage in research and serve as a source of inspiration for new ideas. Barnett et al. (2006) have stated that science fiction increases students' ability to access and relate to science, and that it has a significant impact on their scientific and conceptual understanding. It has been stated that it can be used in science education to provide visual concretization, can be used in the teaching of socio-scientific topics, can develop media literacy, and can reduce the likelihood of falling for pseudoscientific claims (Arroio, 2010; Lin et al., 2013). Ultimately, science fiction is a genre with a wide sphere of influence that cannot be confined to the entertainment sector alone, and it stands out as an imagination-based learning material that enables learning through enjoyment. From this perspective, science teachers and teacher candidates are expected to have a certain level of science fiction self-efficacy.

Previously featured in science fiction works and now increasingly popular in today's world, artificial intelligence remains a subject of debate, yet it possesses an ever-expanding influence in the field of education. Jeff Crume, who stated that artificial intelligence has the goal of surpassing or becoming equivalent to human abilities, that is, imitating intelligence, stated that from a cognitive point of view, it has the skills of discovering information, making inferences, analyzing and synthesizing, reasoning; from a psychomotor point of view, it can also perform concrete movements with the field of robotics (IBM Technology, 2023). Although it has certain limitations from an effective point of view, it continues to impress the masses with its imitation skills in the current situation.

The benefits of using artificial intelligence in education have been highlighted in numerous studies, indicating that it improves learning outcomes through personalized and adaptive learning experiences, increases student engagement and motivation, and makes education more interactive and exciting for both teachers and students (Aaron et al., 2024; Ateş, 2025; Karsenti, 2019; Marr, 2021). In addition, gamified content enables learning through enjoyment and encourages learners to achieve success (Baba et al., 2024; Marr, 2024). Artificial intelligence, which primary school teachers stated they mostly used in science lessons, saves time in instructional design, classroom applications, and assessment stages, thereby lightening teachers' workload (Shin & Shin, 2020). Teachers who choose to utilize artificial intelligence to alleviate their workload can use the time saved for their own development and to spend more time with their students. In addition to all these benefits, the fact that students or institutions with sufficient financial resources can benefit from the latest versions of AI-integrated smart learning systems, which offer more personalised and faster support, are ad-free, and provide additional storage space and specialised services, highlights the risk that AI may exacerbate economic inequalities (Aaron et al., 2024; Baba et al., 2024; Chiu & Li, 2023; Shin & Shin, 2020). These risk factors bring with them anxiety towards artificial intelligence and cause individuals to develop an excessive fear of changes caused by artificial intelligence (Kaya et al., 2024).

The STEM educational approach is a process and skill-focused problem-based learning method that integrates science, technology, engineering, and mathematics disciplines into education to provide a holistic understanding of solving real-world problems (Akarsu et al., 2020; Campbell & Jobling, 2014; Huang & Qiao, 2024). Zollman (2012) states that, in addition to the necessity for qualified teachers in STEM education to have a high level of STEM awareness, they must also consider students' identity development for self-regulation and self-actualization behaviors beyond lesson objectives. In short, it can be said that STEM education teaches students the art of existing not as individuals who cause problems in society, but as unique individuals who produce solutions to problems.

STEM education enables students to experience teaching in school and relate it to daily life, to share their ideas with other students in different ways through collaboration, and to develop 21st-century skills such as problem solving, systematic and critical thinking, as well as professional skills (Abdel Radi, 2020; Lyons & Quinn, 2014; Zollman, 2012). It stands out as an effective approach, particularly in science lessons, for enabling learning by doing and experiencing. The relationship between science fiction self-efficacy and anxiety towards artificial intelligence and STEM awareness can be examined under the roof of imagination and technology, as shown in Figure 1.

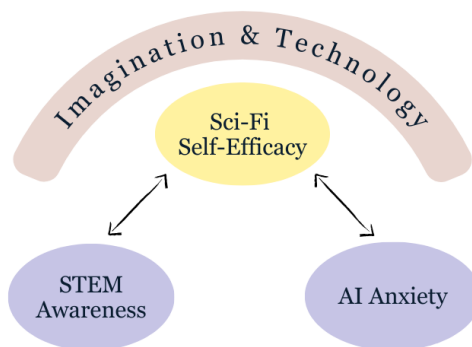


Figure 1. *The context of imagination and technology*

Anxiety towards artificial intelligence; learning artificial intelligence, losing reasoning skills over time, and replacing artificial intelligence technologies with people at workplaces, possible failures and abuse, structuring in the human image, and becoming out of control and independent over time can occur (Wang & Wang, 2019). It is closely related to individuals' resistance to change (Modliński et al., 2024). Therefore, for individuals to embrace artificial intelligence, a climate of trust is required where they can foresee its background. For example, in a study conducted by Ates and Polat (2025) on the use of structured artificial intelligence in educational settings, it was noted that science teachers and teacher candidates' likelihood of adopting the use of humanoid robots in educational settings increased in relation to the perceived and observed benefits of this technology, ease of use, and the level of institutional support. Therefore, individuals' perception of artificial intelligence as a beneficial, user-friendly, and supported technology provides motivation for its adoption. Science fiction encourages individuals to think creatively and innovatively beyond their current knowledge and skills (Marozzo et al., 2024). Rather than resisting change, it is a deliberate process that is attempted to be understood. However, science fiction plays a significant role in shaping perceptions of artificial intelligence through its predictions about the future and its depiction of artificial intelligence. Indeed, Baqoyeva and Shaxinabonu (2024) note that Asimov, a writer who shaped science fiction literature, foresaw intelligent learning systems in his works and drew attention to artificial intelligence's potential to transform education. Osawa et al. (2022) noted that science fiction stories about robots generally focus on the theme of these entities breaking free from human control and becoming independent, and that the common thread in these stories is that unforeseen events cause anxiety in society. Furthermore, they have argued that in the technical sense of configuring artificial intelligence, human-like images should be avoided. Similarly, Hudson et al. (2023) emphasized that the science fiction works they examined predominantly portray artificial intelligence in ways that lead to negative outcomes and that these works are related to human-equivalent, or general, artificial intelligence. Thus, in a society that has so far only encountered narrow artificial intelligence, science fiction writing through which people can form ideas about the future of AI may likely cause individuals to experience anxiety regarding artificial intelligence.

It is well known that in STEM applications where students are active learners, it is of great importance to produce something different from previous ones, to do something that has not been done before, to think originally, and therefore to use imagination and creativity. Lyons and Quinn (2014), who argue that science fiction is an inspiring tool for developing students' creative thinking skills, state that students can experience intellectual discoveries in STEM activities integrated with science fiction. This situation highlights the idea of utilizing the visual and auditory media power of science fiction in STEM education to determine the solutions to a problem and design a unique product for the most suitable solution. Flying cars, interstellar travel, time machines, nanotechnology, and similar elements are frequently encountered in science fiction works, where another striking feature is undoubtedly the futuristic and technological designs that spark the reader's imagination. De Lepe et al. (2015), who define a learning activity in which a story is written to explore how these designs and potential science fiction elements of the future may affect future individuals socially and economically as science fiction prototyping, stated that science fiction is a good way to enhance motivation toward STEM

subjects. Brucker-Kley et al. (2024) have described science fiction prototyping as a creative way of identifying requirements for future technologies. Nicholes (2018) stated that through science fiction prototyping activities, students' curiosity and interest in scientific and technological developments can be enhanced, allowing the integration of art into STEM education and thus making the STEAM movement more functional. Science fiction, which enables the exploration of scientific, technological, cultural, social, and environmental connections in terms of its place in science education, offers students an interdisciplinary learning opportunity (Vrasidas et al., 2015). In this sense, it can be said that the integration of science, technology, engineering, and mathematics disciplines with art can be achieved through science fiction works with non-standard and extraordinary content.

Existing studies have examined science fiction, STEM or artificial intelligence variables separately. However, there are very few studies that address science fiction self-efficacy, artificial intelligence anxiety and STEM awareness together within the same model. It has been noted that most studies in the literature focus on the educational value of science fiction, but there are only a limited number of studies that address the role of science fiction in developing core competencies in the context of higher education (Yang et al., 2025). In this respect, determining the relationship between pre-service science teachers' science fiction self-efficacy and their anxiety towards artificial intelligence is important in terms of revealing the effect of science fiction on the perception of artificial intelligence. Similarly, revealing the relationship between pre-service science teachers' science fiction self-efficacy and their perspectives on STEM awareness in a relational context is critical for integrating science fiction with STEM in science education and for it to gain meaning as a learning approach. This study aimed to examine the science fiction self-efficacy of pre-service science teachers in the context of the artificial intelligence and STEM relationship. The research questions have been determined as follows:

1. Is there a relationship between pre-service science teachers' science fiction self-efficacy and anxiety towards artificial intelligence?
2. Is there a relationship between pre-service science teachers' science fiction self-efficacy and STEM awareness?

2. Method

2.1. Research Model

In the study, a correlational relational survey design was utilized, as the aim was to determine whether there is a correlational relationship between pre-service science teachers' science fiction self-efficacy, their anxiety toward artificial intelligence, and their STEM awareness, and if such a relationship exists, to identify its direction, degree, and correlation coefficient (Karasar, 2017; Fraenkel et al., 2012).

2.2. Study Group

The study group consists of 191 pre-service science teachers enrolled in the Science Teaching Undergraduate Program at a state university in Turkey during the 2023–2024 academic year. In cases where the generalizability of a study's findings can be ensured through the replication of related research, participants are described as the study group (Karasar, 2017). Convenience and the accessibility of useful information were prioritized in the selection of the study group for this research (Creswell, 2020; Fraenkel et al., 2012). The characteristics of the participating pre-service science teachers are presented in Table 1. Accordingly, it can be stated that the majority of the pre-service science teachers have a moderate level of technological proficiency.

Table 1. *Characteristics of Participants*

Variables		N	%
Gender	Female	147	77.0
	Male	44	23.0

Class Level	1st Year	46	24.1
	2nd Year	52	27.2
	3rd Year	46	24.1
	4th Year	47	24.6
Technological Proficiency Level	Low	8	4.2
	Moderate	155	81.2
	High	28	14.7

2.3. Data Collection Tools

The Science Fiction Self-Efficacy Scale for Pre-Service Science Teachers (SFSES), developed by Aksoy and Balbağ (2024), is a unidimensional, 14-item, five-point Likert-type scale. The Cronbach's Alpha reliability coefficient was reported as .880 by the developers of the scale. The Cronbach's Alpha value for this study is presented in Table 2.

The Artificial Intelligence Anxiety Scale (AIAS), developed by Wang and Wang (2019) and adapted into Turkish by Akkaya, Özkan, and Özkan (2021), is a 16-item, five-point Likert-type scale. It consists of four sub-dimensions: learning, job replacement, sociotechnical blindness, and AI configuration. The learning sub-dimension refers to individuals' anxiety about understanding and learning to use the specific functions of AI technologies and applications; job replacement refers to concerns that individuals may lose independent thinking skills as a result of using AI technologies and that AI may increase unemployment by replacing humans in workplaces; sociotechnical blindness refers to anxiety arising from the lack of transparency and accountability in AI technologies, fears of misuse, various malfunctions, and loss of human control; and AI configuration refers to concerns about presenting AI to society in a human-like manner. The Cronbach's Alpha reliability coefficients were reported by the adaptors as ranging from .875 to .950 for the sub-dimensions and .937 for the overall scale. The Cronbach's Alpha values for this study are presented in Table 2.

The STEM Awareness Scale (SAS), developed by Buyruk and Korkmaz (2016), is a 17-item, five-point Likert-type scale consisting of two sub-dimensions: positive outlook and negative outlook. The Cronbach's Alpha reliability coefficients reported by the developers were .929 for the positive outlook sub-dimension, .806 for the negative outlook sub-dimension, and .927 for the overall scale. The Cronbach's Alpha values for this study are presented in Table 2.

2.4. Data Collection Process

Research and ethics committee approval, which is essential for administering the scales to pre-service science teachers selected based on suitability for the research objective and accessibility, was obtained from the relevant university. Data was collected via Google Forms to prevent data loss, save paper, and ensure environmental sustainability. The form consisted of a total of four sections: demographic information, SFSES, AIAS, and SAS. The form was presented to the students in a face-to-face classroom setting, and the link was shared after providing the necessary information about the purpose and scope of the research and the principle of voluntariness. The data collection process ended when a sufficient number of responses were reached.

2.5. Data Analysis

At this stage, the data collected via Google Forms was first saved to an Excel file and then transferred from the Excel file to the SPSS 27 program for analysis. Initially, the form responses obtained from 199 individuals were examined. Through reverse items, it was determined that some pre-service teachers had filled out the form carelessly. These individuals, along with outliers, were excluded from the data set, and the analysis continued with 191 individuals.

Skewness and kurtosis values were considered in the normality analysis. Since the skewness and kurtosis values of the total and sub-dimension scores of the scales were within the ± 1 range, parametric tests were employed in accordance with the assumption of normal distribution (Büyüköztürk, 2024). The skewness, kurtosis, and reliability values of the scales are presented in Table 2.

Table 2. Normality and Reliability Values of Scales

Scales	Skewness	Kurtosis	Cronbach's Alpha
SFSES	-.324	.385	.845
AIAS	-.199	-.275	.918
Learning	.613	.199	.924
Job Replacement	-.365	-.433	.848
Sociotechnical Blindness	-.454	-.060	.851
AI Configuration	-.302	-.574	.946
SAS	-.061	-.254	.932
Positive Outlook	.116	.222	.938
Negative Outlook	-.887	.679	.900

Meaningful relationship analyses utilized the Pearson correlation coefficient. A correlation coefficient with an absolute value between 0.00 and 0.30 is interpreted as a low level of correlation; between 0.30 and 0.70 as a moderate level; and between 0.70 and 1.00 as a high level (Büyüköztürk, 2024).

3. Results

The results of Pearson correlation analysis for the problem “*Is there a relationship between pre-service science teachers' science fiction self-efficacy and anxiety towards artificial intelligence?*” are presented in Table 3 in terms of the total and sub-dimension scores of the scales.

Table 3. Results of Pearson Correlation Analysis on the Relationship Between SFSES and AIAS

		AIAS	Learning	Job Replacement	Sociotechnical Blindness	AI Configuration
SFSES	r	-.133	-.149	-.002	-.092	-.174
	p	.066	.039*	.975	.204	.016*
	N	191	191	191	191	191

* $p < .05$ (2-tailed)

According to Table 3, there was no significant relationship between pre-service science teachers' science fiction self-efficacy and their anxiety towards artificial intelligence in terms of total scale scores ($r = -.133$; $p > .05$). However, there were significant relationships in terms of sub-dimensions. A low-level and negative relationship ($r = -.149$; $p < .05$) was found between learning and SFSES, and a low-level and negative relationship ($r = -.174$; $p < .05$) was found between AI configuration and SFSES. In other words, higher science fiction self-efficacy is associated with lower levels of anxiety toward AI learning and configuration among pre-service science teachers.

The results of Pearson correlation analysis for the problem “*Is there a relationship between pre-service science teachers' science fiction self-efficacy and STEM awareness?*” are presented in Table 4 in terms of the total and sub-dimension scores of the scales.

Table 4. *Results of Pearson Correlation Analysis on the Relationship Between SFSES and SAS*

		SAS	Positive Outlook	Negative Outlook
SFSES	r	.163	.138	.152
	p	.024*	.057	.035*
	N	191	191	191

*p<.05 (2-tailed)

Table 4 shows that there is a low-level, positively significant relationship between pre-service science teachers' science fiction self-efficacy and their STEM awareness in terms of total scale scores ($r=.163$; $p<.05$). Higher science fiction self-efficacy is associated with higher levels of STEM awareness. In terms of sub-dimensions, no significant relationship was found between positive outlook and SFSES ($r=.138$; $p>.05$), while a low-level and positively significant relationship was found between negative outlook and SFSES ($r=.152$; $p<.05$).

4. Conclusion

In conclusion, the findings suggest that higher science fiction self-efficacy is associated with lower levels of anxiety regarding learning about artificial intelligence and its implementation. This association may be understood in terms of the potential role of science fiction in providing individuals with prior exposure to scientific and technological concepts, thereby facilitating familiarity with emerging technologies such as artificial intelligence. Indeed, Kırallı Gider (2024) stated in her study that students who have prior knowledge about artificial intelligence exhibit lower levels of anxiety toward AI compared to those without such knowledge. Hudson et al. (2023) stated that the difficulty individuals experience in interacting with artificial intelligence stems from the inability to fully define AI's capacity to alter and transform, that is, its agency, and its boundaries. In other words, as pre-service science teachers' science fiction self-efficacy increases, their preparedness regarding the transformative and altering capacities of scientific and technological developments also rises, playing a mitigating role on anxiety toward learning, which is a preliminary step in interacting with AI. Moreover, in a study examining the impact of science fiction films on pre-service science teachers' views on science, technology, and society, Önen Öztürk (2017) reported that after watching ten science fiction films over a five-week period, the participants' perspectives were positively influenced. In this context, it can be stated that science fiction works hold significant value in broadening perspectives on the relationship between science, technology, and society through science fiction-based thinking skills.

Abdel Radi (2020) stated that the purposes of science fiction works that address scientific and technological developments include developing problem-solving, creative, scientific, and critical thinking skills, as well as stimulating students' minds and imagination through the ability to predict future scientific discoveries and inventions. Therefore, it is thought that pre-service science teachers with high science fiction self-efficacy may possess a controlled, critical perspective and a research-oriented motivation regarding the potential risks of artificial intelligence, the precautions to be taken against these risks, its benefits and drawbacks in the field of education, and the requirements for using AI in education. In this way, it can be stated that their anxiety toward learning artificial intelligence also decreases.

A negative relationship was observed between pre-service science teachers' science fiction self-efficacy and their anxiety toward AI configuration, which may be interpreted in relation to emotional interactions, love, compassion, and instinctive attachments depicted between humanoid robots and human main characters in science fiction narratives following certain plot developments. In this regard, Büyükdeniz (2020) stated that AI presented to viewers in a humanoid form in science fiction scenarios leads to an emotional change in human attitudes and that the difference between a household robot used in daily life and humanoid robots in science fiction stems from a bond, such as a sense of emotional responsibility. When assessed from a psychosocial perspective, it can be argued that individuals may develop stronger emotional responses to technologies to which they attribute human-like characteristics. Within this framework, the emotional attachment that audiences develop towards

artificial intelligence characters in films such as "I, Robot: Sonny" (Proyas, 2004), "Real Steel: Atom" (Levy, 2011), and "The Wild Robot: Roz" (Sanders, 2024) can be explained by this psychosocial mechanism. Ajeesh and Rukmini (2023) stated that humanoids in science fiction works serve as a valuable resource for observing society's perception of the other. Appel et al. (2016) indicated that individuals relate to humanoid robots in science fiction films, and this association enhances the acceptance of structured artificial intelligence technologies. In short, it can be argued that science fiction not only facilitates a clearer understanding of future technologies but also helps individuals make sense of the relationship between people, technology, and society.

In a study by Mara and Appel (2015) observing participants in an experimental group interacting with a humanoid robot, it was found that an emotional science fiction narrative reduced the fearfulness toward humanoid robots. Brucker-Kley et al. (2024), who examined young people's thoughts on forming friendships with humanoid emotional AI in the future, reported that most of the youth who experienced this process in virtual reality environments responded positively to the idea of befriending a humanoid emotional AI. Therefore, it can be stated that AI integrated with emotional intelligence generally instills confidence or reduces anxiety in pre-service science teachers rather than causing concern. Furthermore, Modliński et al. (2024) indicated that individuals' anxiety toward AI and attitudes toward robots are related to their level of interaction with technology. In this context, the fact that the majority of pre-service science teachers in the study group reported a moderate level of technological proficiency may have inversely affected their anxiety regarding structured AI and humanoid robots, which are commonly depicted in science fiction works.

It was concluded that higher science fiction self-efficacy among pre-service science teachers is associated with higher STEM awareness. This can be interpreted as a motivating indicator for the integration of science fiction into STEM education. In this regard, Marozzo et al. (2024) found that individuals with a STEM background and high awareness in this field produced more creative outcomes when watching science fiction films compared to those without a STEM background, indicating that science fiction can have a motivating effect on individuals' existing STEM knowledge and skills. Similarly, Lyons and Quinn (2014), De Lepe et al. (2015), and Lin et al. (2013) reported that science fiction enhances technological creativity, imagination, and product design skills, as well as increasing interest in STEM. Nicholes (2018), emphasizing that integrating science fiction into STEM education activates STEAM education with the addition of art, highlighted the positive interaction between science fiction and STEM. In this context, it can be stated that science fiction can make STEM education functional in terms of imagination and technology.

In summary, the results of the study revealed that science fiction self-efficacy is negatively related to anxiety toward learning and configuring artificial intelligence, and positively related to STEM awareness. This highlights the positive effect of science fiction on learning the specific functions of AI and on integrating structured AI into the education of the future. Furthermore, considering the reflection of science fiction on STEM education, it can be stated that it plays a supportive role in developing higher-order thinking skills. Indeed, Marozzo et al. (2024) and Yang et al. (2025) indicated that incorporating science fiction-related topics into educational programs can be an effective method for enhancing students' understanding of technology and creative thinking skills. In this context, using science fiction as an imagination-based learning material in courses and subsequently integrating it into educational programs is important for meeting the requirements of future education.

5. Limitations and Recommendations

This study has certain limitations. Firstly, as the study was conducted using a correlational and cross-sectional design, the relationships between variables could be identified, but no causal inferences could be drawn. Secondly, as the data were collected using self-report scales, participants' tendencies towards social desirability or their subjective assessments may have influenced the results. Thirdly, as the study's sample consisted of science teacher trainees studying at a single state university, the generalisability of the findings to different universities, departments, or cultural contexts is limited. Furthermore, the study did not control for variables such as gender, experience of using technology, and level of knowledge regarding artificial intelligence. Finally, whilst the relationships identified

were statistically significant, they were found to be of a low magnitude. This suggests that STEM awareness and anxiety regarding artificial intelligence cannot be explained solely by science fiction self-efficacy, and that other individual, educational, and environmental factors may also play a role.

Based on the findings of the research, the recommendations are as follows:

1. Considering the relationship between science fiction self-efficacy, and artificial intelligence anxiety, and STEM awareness, it is recommended that activities aimed at increasing science fiction self-efficacy be carried out in faculties regarding how pre-service teachers can integrate science fiction into their lessons as a teaching material.
2. For researchers, it is recommended that qualitative studies be conducted to examine the relationships identified in this study in depth, and that experimental studies be carried out to reveal cause-and-effect relationships. Furthermore, studies utilising advanced statistical methods, such as structural equation modelling, could be conducted to examine the relationships between variables in greater depth. It is believed that research involving participants from different universities and cultural contexts will contribute to the generalisability of the findings.

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