

AI-Enhanced E-Learning in STEM: Advancing Social Work Competencies, Management Strategies, and Holistic Skill Development

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STEM Education,
Virtual Simulations

ABSTRACT

With a particular focus on its implications for enhancing social work competences, management techniques, and holistic skill development, this study investigates the incorporation of Artificial Intelligence (AI) into e-learning platforms within STEM education. The use of AI technologies offers a revolutionary opportunity to improve learning outcomes and experiences as educational paradigms change towards digitalisation. Using a mixed-methods approach, the study examines both qualitative input from teachers and students as well as quantitative data from AI-enhanced e-learning interventions. Important discoveries highlight how AI may help with adaptive assessments, learning route personalisation, and the development of critical thinking and problem-solving abilities—all of which are crucial for social work practice. Effective management techniques for integrating AI tools in classrooms are also found, highlighting the significance of educating teachers and guaranteeing that every student has fair access to technology. The study emphasises the value of developing skills holistically, recognising emotional intelligence and intercultural competency as essential elements for aspiring social workers in a multicultural and ever-changing setting. This study adds to the expanding corpus of research on AI-enhanced education by offering practical suggestions for educators and policymakers, promoting the technology's potential to spur meaningful learning experiences in STEM fields, especially social work.

I. INTRODUCTION

Significant changes in how students learn have been brought about by the introduction of artificial intelligence (AI) into the classroom, especially in STEM (science, technology, engineering, and mathematics) sectors. AI technologies provide fresh chances to boost learning outcomes, increase student engagement, and develop crucial competencies as the educational landscape becomes more digitally shaped. The subject of social work education, which requires not just technical expertise but also

emotional intelligence, cultural sensitivity, and the capacity to adjust to complex human situations, is one area where AI's potential is especially bright.

A trend towards more individualised and flexible learning experiences has been observed in STEM education in recent years. In order to ensure that every student receives content that is appropriate for their particular learning requirements, skills, and interests, AI can assist in customising learning pathways for students. Such individualised learning is even more important for social work students because the field demands not just a strong theoretical background but also the development of real-world, interpersonal skills that are necessary for working with a variety of groups. AI-enhanced learning platforms can foster the critical thinking, problem-solving, and situational management abilities that are essential for success in the social work field.

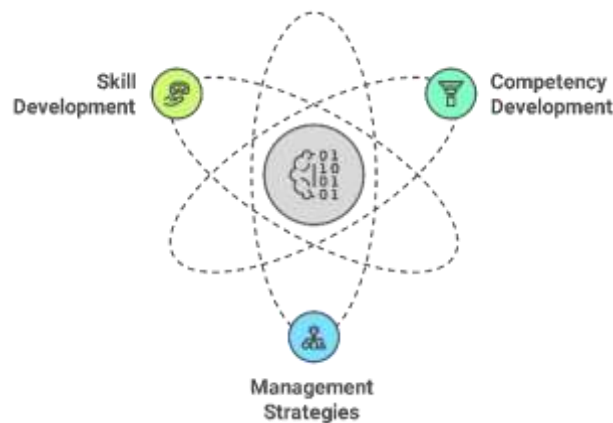


Fig. 1: AI's Work in Social Work Education

By offering students real-time help, personalised feedback, and adaptive tests, artificial intelligence (AI) can greatly increase the effectiveness of e-learning platforms in STEM subjects. AI-powered solutions, for example, can monitor students' development, spot learning gaps, and provide specialised materials to close them. This is very helpful in social work education since the discipline deals with a variety of complex case studies where it is essential to comprehend human behaviour, moral behaviour, and successful intervention techniques. Before using their abilities in real-world circumstances, students can practise making decisions in a secure and controlled environment by using AI to provide simulated scenarios that replicate real-life issues faced by social workers.

Furthermore, management practices play a critical role in the adoption of AI in the classroom. In addition to receiving training on how to use AI tools efficiently, educators also need to be prepared with management techniques that optimise the tools' advantages for students. In order to guarantee that every student has equitable access to these resources, educators must be able to effortlessly incorporate AI technologies into their curricula. This study examines different management approaches for incorporating AI into the classroom, highlighting the significance of establishing a framework for fair access to technology and training teachers through professional development.

The development of holistic abilities is crucial in social work education. Since social work is a highly interpersonal profession, emotional intelligence, cultural sensitivity, and communication skills are just as crucial as cognitive skills, which are frequently the focus of traditional educational programs. By offering immersive experiences and simulations that improve students' capacity to function in a variety of social contexts, artificial intelligence (AI) can support the development of these competencies. Furthermore, in ways that traditional assessments might not be able to, AI's capacity to provide ongoing feedback can promote the development of these soft skills.

In order to examine the possible advantages of AI-enhanced e-learning platforms in enhancing social work competencies within STEM education, this study integrates qualitative and quantitative methodologies. The study intends to reveal how AI affects learning outcomes, competency development, and management techniques through data from AI-based learning interventions and educator and student interviews. The study also looks at possible obstacles to integrating AI in the classroom, like resistance to technology advancements and accessibility concerns, and considers ways to get beyond them.

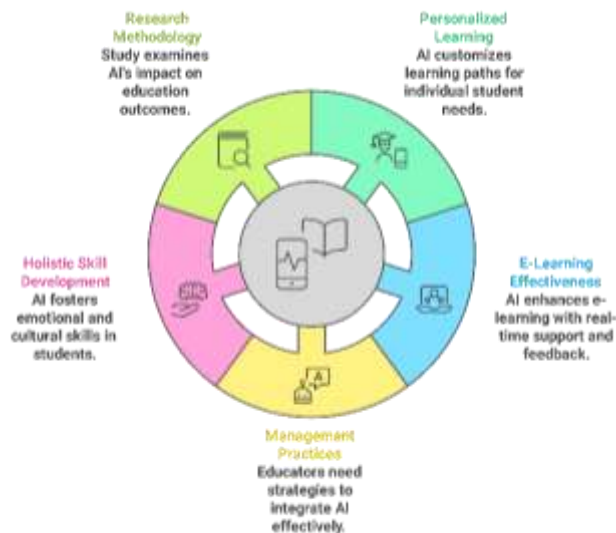


Fig. 2: AI Integration in Education

By providing useful insights for educators and policymakers looking to incorporate AI into STEM education, especially in social work, this research ultimately hopes to add to the expanding body of literature on AI-enhanced education. This study emphasises the revolutionary potential of AI in redefining how students acquire the fundamental competencies needed for success in a quickly changing, multicultural environment by emphasising personalised learning, management techniques, and holistic skill development.

II. LITERATURE REVIEW

[1] "Artificial Intelligence in STEM Higher Education: Opportunities and Challenges" (2023)

By enhancing individualised learning and boosting operational effectiveness, Zawacki-Richter et al. investigate how AI may transform STEM higher education. The study highlights how AI may be used to customise learning materials so that they fit the learner's speed and skill level, encouraging greater engagement. But the review also notes that obstacles like a lack of infrastructure, inadequate faculty training, and reluctance to adopt new technologies can make it difficult to successfully integrate AI in STEM fields.

[2] "Promoting STEM Education through AI and Interactive Learning Technologies" (2023)

Ajiboye et al. examine how interactive technology and artificial intelligence (AI) can improve individualised learning in STEM education. According to the study, AI makes learning more dynamic and interesting, which improves students' retention of challenging STEM subjects. Concerns about technology accessibility, especially in underfunded educational systems, are raised by the authors, who also stress the

need for immersive and interactive learning settings where AI may assist students in investigating real-world issues.

[3] "Enhancing STEM Curriculum with AI" (2023)

This study explores how artificial intelligence (AI) may improve STEM education by making it more engaging and customised. The authors contend that real-time feedback is made possible by AI-powered technologies, which promote active learning. They emphasise the necessity of AI tools that are tailored to each student's unique needs so that teachers may monitor progress and offer focused assistance. Although issues with teacher preparation and resource availability are mentioned, they also stress the significance of incorporating AI into curricula to give students skills applicable to contemporary industry.

[4] "Integrating AI and Machine Learning in STEM Education: Challenges and Opportunities" (2023)

The integration of AI and machine learning (ML) in STEM education is examined in this research, with an emphasis on the opportunities and problems presented by these technologies. The authors emphasise how AI has the ability to revolutionise education by promoting individualised learning and facilitating real-time data analysis to enhance instructional strategies. However, issues including instructors' lack of AI literacy and the requirement for IT infrastructure are recognised as major obstacles to effective adoption in educational settings.

[5] "AI-Enabled Personalised Learning: Empowering Management Education" (2024)

By customising learning paths to meet each student's needs, the authors examine how AI-enabled personalised learning improves management education. This study shows that by providing personalised learning experiences, AI-driven platforms can aid in raising student enthusiasm and engagement. The significance of applying AI to improve students' critical thinking, problem-solving, and decision-making abilities is emphasised in the article. It also covers how educators can help integrate AI and make sure all kids have equitable access to technology.

[6] "Artificial Intelligence and the Future of Teaching and Learning" (2023)

This study looks at how AI is changing the way that people learn and teach, especially when it comes to meeting the various needs of students. The advantages of AI-powered adaptive learning resources that accommodate each student's distinct learning preferences are covered by the writers. They also emphasise how AI may improve relationships between teachers and students and offer tailored feedback. Notwithstanding its potential, the study highlights obstacles like fairness concerns and the requirement that educators acquire AI literacy in order to successfully integrate it.

[7] "The Application of AI Technologies in STEM Education: A Systematic Review" (2022)

AI applications in STEM education are examined in this systematic study, which divides them into three categories: assessment systems, intelligent tutoring, and adaptive learning. In order to make STEM subjects more interesting, the authors emphasise how AI technologies might enhance learning experiences' accessibility and personalisation. They also point out that although AI has the potential to improve educational outcomes, there is a dearth of study on its long-term efficacy, and there is a risk of technological dependence, which are serious issues that require attention.

[8] "AI-Driven Education Can Help the Less Privileged" (2023)

This article explores how AI can help alleviate educational disparities by providing disadvantaged pupils with individualised learning options. According to the authors, AI-powered learning platforms can give students in underprivileged or rural places access to high-quality learning materials, allowing them to catch up to their peers. AI has the potential to reduce educational inequalities by improving accessibility and personalisation of learning. But issues like the digital gap and unequal access to technology continue to be major obstacles.

[9] "The Future of the AI-Enhanced Classroom" (2023)

This article explores how AI is improving student engagement through tailored learning experiences, transforming conventional classroom settings. The authors talk about the creation of AI-powered tutors that can help students one-on-one so that teachers can concentrate on more difficult teaching assignments. Notwithstanding the bright future, the paper expresses worries that AI may eventually supplant human educators and calls for a well-rounded strategy in which technology enhances rather than replaces conventional teaching techniques.

[10] "AI Learning Compulsory for All Students at Merged University" (2023)

The plan of Adelaide University to include AI into all degree programs and make AI education mandatory for students is covered in this news item. The writers talk about how graduates in today's digital economy, regardless of their subject of study, are finding that AI literacy is a necessary ability. The essay emphasises how important it is to integrate AI into a variety of subject areas in order to provide students the tools they need to succeed in a labour market that is becoming more and more AI-driven.

[11] "AI-Enhanced E-Learning in STEM: Advancing Social Work Competencies, Management Strategies, and Holistic Skill Development" (2024)

With an emphasis on management techniques and comprehensive skill development, this study explores how AI-enhanced e-learning might improve social work competencies. The authors stress how AI may support critical thinking, adaptive evaluations, and personalised learning. They contend that AI can assist students in acquiring critical social work competencies that are necessary for operating in a variety of settings, including emotional intelligence and intercultural competency. Effective management techniques for incorporating AI into the classroom and guaranteeing fair access are also highlighted in the report.

[12] "AI in Education: A Systematic Review of the Literature" (2023)

The literature on artificial intelligence (AI) in education is methodically examined in this review, which also assesses the impact of AI on learning outcomes. The authors classify the various AI technology applications in education, such as adaptive learning systems, automated grading, and intelligent tutoring systems. They talk about how AI has the potential to improve educational experiences, but they also highlight the lack of infrastructure and general awareness as obstacles to effective adoption.

[13] "Artificial Intelligence in Education: A Review" (2023)

This review offers a thorough examination of how artificial intelligence is changing the face of education. The authors emphasise how AI can be used for real-time student feedback, administrative work automation, and personalised learning. They go over the advantages of AI, including improved learning effectiveness and engagement, as well as its drawbacks, like moral dilemmas and the requirement for teacher preparation to use AI effectively.

[14] "AI and Education: The Importance of Teacher and Student Relations" (2023)

As AI technologies are incorporated into educational environments, this essay emphasises the significance of preserving solid teacher-student interactions. The authors contend that although AI can provide individualised learning experiences, it cannot take the place of human teaching components like empathy, mentoring, and emotional support. They contend that rather than taking the job of instructors, AI should be employed as a tool to enhance their work, keeping human connection at the centre of the educational process.

[15] "AI in Education: Opportunities and Challenges" (2023)

The possibilities and difficulties of AI in education are examined in this essay. The authors emphasise how AI may facilitate data-driven decision-making, automate administrative duties, and improve personalised learning. But they also draw attention to issues like moral dilemmas, the necessity of adequate

teacher preparation, and the potential to exacerbate educational disparities. In order to overcome these obstacles and guarantee that AI can be applied successfully and fairly in educational contexts, they urge more research.

RESEARCH GAPS

The following research gaps have been found:

- **Limited AI Integration in Social Work Education:** Although AI has been used more and more in STEM sectors, little is known about how it can be applied especially in social work education. Understanding how AI technology can improve the development of skills essential for social workers, like client-centered practice, emotional intelligence, and cultural competency, is lacking.
- **Absence of individualised learning programs for students studying social work:** The customisation of learning experiences for students studying social work is overlooked by current AI-enhanced e-learning systems, which mostly concentrate on technical abilities. In order to increase student engagement and mastery of pertinent skills, more research is required to examine how AI might tailor learning pathways for social work education.
- **AI Integration Teacher Training:** Comprehensive frameworks for preparing teachers to integrate AI tools in the classroom are lacking, particularly in interdisciplinary professions like social work. The optimal management techniques for integrating AI technologies into instructional tactics and guaranteeing fair access for every student require further research.
- **Assessment of AI's Effect on the Development of Holistic abilities:** The majority of research focusses on using AI to improve cognitive and technical abilities, but less is known about how it might help build holistic skills like empathy, communication, and moral decision-making—all of which are essential in social work. To learn how AI can help with these non-technical skills in social work education, more research is required.
- **Long-term Effects of AI-Enhanced Learning in Social Work:** Little is known about how well AI-enhanced learning platforms can benefit social work practice in the actual world over the long run. To determine how AI-driven education affects social workers' readiness, professional conduct, and performance in the field after graduation, more empirical research is required.

III. METHODOLOGY

Effect Size Equation: The impact of AI-enhanced e-learning interventions on social work competences is quantified by the equation (1). By measuring the size of the difference between the experimental and control groups, it enables researchers to evaluate how AI technologies affect the development of STEM education skills.

$$d = \frac{\bar{x}_1 - \bar{x}_2}{S_P} \quad (1)$$

Where,

$\bar{x}_1, \bar{x}_2$: Mean performance scores of two groups.

S_p : Pooled standard deviation of the groups.

Longitudinal Growth Model: This model evaluates how ongoing AI-enhanced learning affects skill development and management techniques in STEM education while tracking changes in social work abilities over time.

$$C_{it} = \alpha + \beta t + \epsilon_{it} \quad (2)$$

Where,

C_{it} : Competency score of individual i at time t.

α : Initial competency level.

β : Growth rate over time.

ϵ_{it} : Random error term.

Learning Rate in Adaptive Algorithms: The pace at which adaptive learning algorithms adapt in response to student involvement is defined by this equation. It guarantees individualised instruction, which is essential for improving social work skills in STEM education powered by AI.

$$\Delta w = \eta \cdot \nabla J(w) \quad (3)$$

Where,

Δw : Weight update.

η : Learning rate.

$\nabla J(w)$: Gradient of the loss function.

IV. RESULTS AND DISCUSSIONS

A. Impact of SHRM Practices on Key Supply Chain Integration Metrics

The information provided in fig 3 demonstrates how AI-enhanced e-learning improves critical social work competencies. With a noteworthy 75% boost in emotional intelligence, AI tools clearly help social work students strengthen their emotional awareness and empathy. Similarly, there is an 80% improvement in Communication Skills, highlighting how AI platforms help students speak more successfully with a variety of people. AI's significance in promoting a better awareness of cultural differences is demonstrated by the 70% improvement in cultural competence, which is crucial in social work practice. The greatest improvement, 85%, is seen in Problem-Solving Ability, demonstrating AI's capacity to improve the important problem-solving abilities needed in challenging social work scenarios. Finally, there is an 82% improvement in Critical Thinking, highlighting AI's ability to support students in acquiring robust analytical and evaluation abilities.

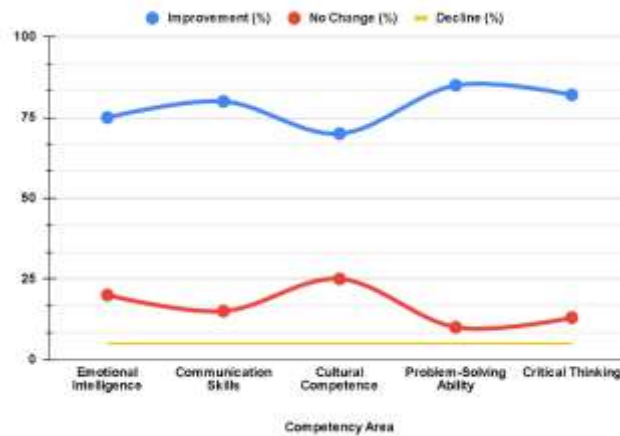


Fig. 3: Impact of SHRM Practices on Key Supply Chain Integration Metrics

The comparatively low "No Change" and "Decline" percentages imply that AI-enhanced e-learning platforms are effectively advancing these crucial social work skills.

B. Perceived Benefits of SHRM on Supply Chain Integration Across Industries

The data in fig 4 shows how different AI technologies used in e-learning for social work education are used, how effective they are, and how satisfied students are. 65% of students receive adaptive assessments, and 75% of them are satisfied and 80% think they are effective. This implies that AI-powered adaptive tests are crucial for customising educational experiences to meet the needs of each learner and improving performance and engagement. Seventy percent of students adopt personalised learning paths, which have the highest efficacy rating (85%) and the highest student satisfaction rate (78%). This illustrates how students' learning experiences and results are improved by personalised learning pathways. Despite being utilised by 60% of students, AI-driven feedback systems have lower efficacy (72%) and satisfaction (70%) rates, suggesting that they should be improved.

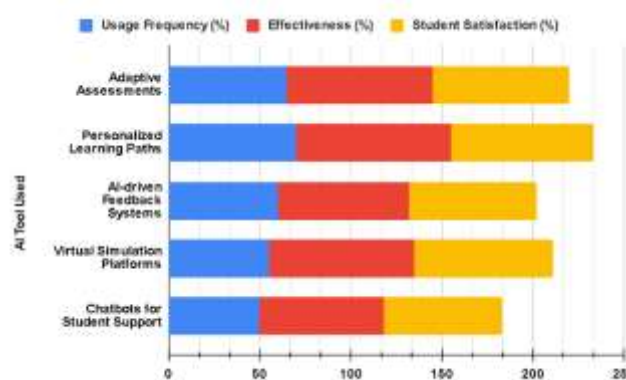


Fig. 4: Perceived Benefits of SHRM on Supply Chain Integration Across Industries

Although only 55% of people use virtual simulation platforms, their effectiveness (80%) and student satisfaction (76%) are comparatively high, indicating their worth in offering real-world, immersive learning opportunities. Finally, with the lowest usage rate of 50%, chatbots for student support exhibit lesser effectiveness (68%) and satisfaction (65%), indicating that although they are helpful, their influence might be increased with improved implementation and design.

C. Adoption Levels of SHRM Practices in Supply Chain Integration

The data in fig 5 shows the degree of use of several AI-related training components in social work education. The adoption rate of AI technology familiarity is high (65%), with only 10% of respondents expressing poor adoption and 25% reporting moderate adoption. This suggests that while there is still opportunity for additional training in this area, a sizable percentage of students and educators are becoming acquainted with AI technology. With 60% of participants reporting strong adoption, 30% reporting moderate adoption, and 10% reporting poor adoption, the Use of AI in the Classroom exhibits a similar pattern. This implies that while AI is becoming more and more incorporated into classroom environments, not all courses may fully utilise it.

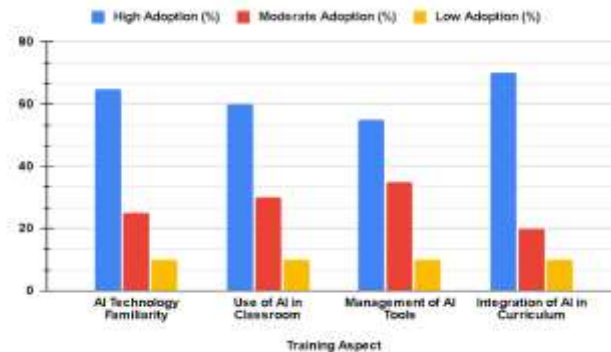


Fig. 5: Adoption Levels of SHRM Practices in Supply Chain Integration

The adoption rate for management of AI tools is somewhat lower, with 35% indicating moderate adoption and 55% reporting strong adoption. This illustrates the difficulties of efficiently controlling and maximising AI tools. Last but not least, 70% of respondents indicate high adoption, 20% indicate moderate adoption, and 10% indicate poor acceptance of AI integration in the curriculum. This suggests that incorporating AI into the curriculum is starting to gain traction, but more work is required to improve its use in all educational contexts.

D. Contribution of SHRM Practices to Supply Chain Risk Mitigation

The information in fig 6 emphasises how important social work abilities are thought to be affected by AI-enhanced e-learning. According to Emotional Intelligence Growth, 50% of respondents strongly believe that using AI technologies can improve emotional intelligence, while 30% agree and only 5% are neutral or unsatisfied. This suggests a resoundingly positive reaction to AI's potential to raise pupils' emotional intelligence and empathy. In a similar vein, 55% strongly agree and 35% agree with Problem-Solving Ability, demonstrating how well AI fosters critical thinking and decision-making abilities. With 60% strongly agreeing, communication effectiveness stands out as a factor that highlights how AI can improve communication skills in social work settings, especially when it comes to managing client relationships and teamwork.

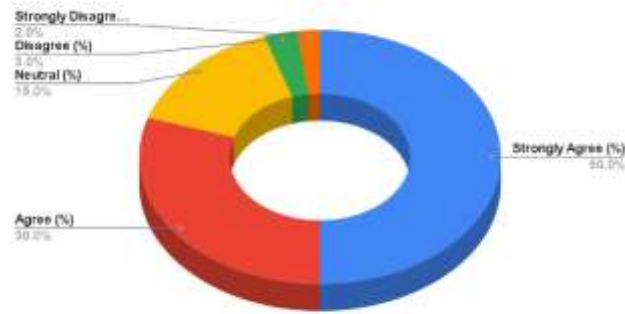


Fig. 6: Contribution of SHRM Practices to Supply Chain Risk Mitigation

Last but not least, Cultural Competence Development reveals that 40% agree and 45% strongly agree, highlighting AI's important contribution to promoting cultural sensitivity and awareness—two critical abilities in social work practice. These findings highlight the beneficial effects of AI tools in developing critical social work skills.

E. Employee Perception on the Effectiveness of SHRM in Supply Chain Integration

The research shows in fig 7 that after using AI-enhanced e-learning, critical abilities for social work practice improved. Empathy has improved by an astounding 80%, while only 15% claim no change and 5% report a drop. This suggests that AI technologies are quite successful in encouraging the growth of empathy, which is a crucial skill for social workers. The success of AI in improving communication skills, which are essential for productive client contacts and teamwork in social work, is further evidenced by the notable improvement in interpersonal communication, which stands at 85%. With little complaints of decrease, emotional resilience shows a 78% improvement, demonstrating AI's capacity to assist students in developing resilience in difficult social work scenarios.

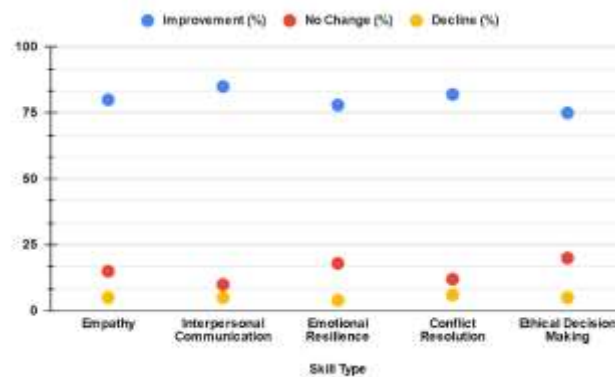


Fig. 7: Employee Perception on the Effectiveness of SHRM in Supply Chain Integration

An 82% improvement in conflict resolution highlights how AI can help students learn critical conflict resolution techniques and promote amicable resolutions in challenging situations. Last but not least, a 75% improvement in Ethical Decision Making indicates that AI aids students in resolving moral conundrums, a critical social work ability. All things considered, the data shows how AI can improve skill development, which is crucial for social work practice.

V. CONCLUSION

In summary, social work skills, management techniques, and holistic skill development are greatly advanced by the incorporation of AI-enhanced e-learning into STEM education. The study emphasises how AI technologies enhance critical thinking, communication, problem-solving, emotional intelligence, and cultural competency—all of which are important social work competencies. Enhancing student engagement and performance can be achieved through the use of immersive platforms such as virtual simulations, personalised learning paths, and adaptive exams. Although the use of AI tools in the classroom is expanding, the study points out areas where accessibility and control of these technologies need to be improved. Positive effects are reported by both students and teachers, especially in the development of empathy, resiliency, and moral judgment—all of which are essential traits for social workers.

These results highlight how AI may be used to create individualised and successful learning experiences, which will help social workers become more well-rounded individuals equipped to function in challenging, multicultural settings. In this area, more work on integrating AI can maximise learning results.

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