Fostering Critical Thinking Skills in Textile Technology Students: Challenges, Strategies, and Case Studies

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ABSTRACT

This study investigates the essential function of critical thinking in the instruction of textile technology, considering the increasing worldwide challenges of digitalization, sustainability, and industrial innovation. Traditional teaching techniques often hinder the development of higher-order cognitive abilities, restricting students' capacity to address real-world challenges. This study emphasizes effective ways for fostering analytical thinking, such as problem-based learning, Socratic questioning, and capstone projects, by reviewing the research, instructional practices, and three case examples. Research demonstrates that integrating critical thinking into the curriculum cultivates students' leadership abilities and equips them for job needs. The paper proposes a transformative educational model that prepares aspiring textile technologists with the essential skills necessary for problem-solving and decision-making. It addresses issues related to assessment reforms, instructional gaps, and motivational barriers.

Keywords: Critical Thinking Skills, Textile Technology Education, Problem-Based Learning, Socratic Questioning, Curriculum Innovation

INTRODUCTION

Textile technology is a field that continually evolves, drawing on ideas from engineering, materials science, design, and sustainability. As the textile industry undergoes digital transformation and faces global challenges such as sustainability, supply chain resilience, and automation, it requires graduates who can think critically, solve problems, and make informed decisions. Critical thinking, characterized as the capacity to evaluate information impartially and derive logical conclusions, is not only a desirable competency but also an essential prerequisite for achieving success in this dynamic environment (Burke & Sinclair, 2014; Glogar et al., 2025). To foster critical thinking among textile students, it is essential to re-evaluate the curriculum, pedagogical approaches, and assessment systems. The textile industry need a workforce capable of understanding and adapting to advanced technologies, underscoring the significance of critical thinking abilities (Flores et al., 2010; Kirstein, 2013).

Traditional teaching methods and systemic problems hinder the development of critical thinking skills in engineering and technical education, particularly in developing countries. Textile technology education is at a critical juncture in its development, and it must evolve to keep pace with the rapid changes in the world. The textile industry is facing numerous new challenges, including "new concept," "new structure," "new mode," "new quality," and "new system," all of which pose significant problems (Zhang, 2021). The incorporation of critical thinking skills into the curriculum is not only advantageous but imperative for equipping students to manage the complexities and advancements in the field (Kettley, 2011). Graduates from higher education programs must be able to think critically (Swart, 2017). These skills are more than just memorizing facts and following rules; they empower students to think critically, solve problems, and make informed choices in

situations that are constantly changing and unclear (LeHew & Meyer, 2005). This study analyzes the challenges of fostering critical thinking in textile technology students, proposes targeted techniques for skill development, and presents case examples that demonstrate the actual use of these strategies.

LITERATURE REVIEW

Critical Thinking in Textile Technology

Recent research validates the importance of critical thinking in several domains, highlighting its role in enhancing problem-solving abilities, fostering creativity, and supporting lifelong learning (Perdanasari et al., 2021). Critical thinking encompasses several mental processes, including discernment, analysis, and evaluation, that collectively enable individuals to understand things logically and make informed decisions (Saadé et al., 2012). Critical thinking is essential in textile technology for developing long-lasting solutions, creating new materials, and enhancing supply chain management. Textile technology students with strong critical thinking skills can examine complex problems, weigh their options, and make informed decisions that help the industry address pressing issues such as environmental impact, resource efficiency, and global distribution networks. Some people, on the other hand, argue that the technical nature of textile technology education can make it more challenging to develop critical thinking skills. This is because it often focuses on mastering specific procedures and ideas instead of developing broader analytical skills. Conventional pedagogical approaches in textile technology education often fail to adequately cultivate critical thinking skills despite the growing industry demand for these competencies. The focus on rote memorization and technical skills often overlooks the development of higher-order cognitive skills, including analysis, evaluation, and problem-solving, which are crucial for navigating the complexities of the contemporary textile industry. This gap between what schools teach and what businesses need is a significant problem that needs to be addressed so that textile technology graduates are prepared for the demands of their field.

Textile technology students must learn to think critically in order to keep pace with the evolving needs of the modern workplace (Anwar & Mutiah, 2022). The textile industry is facing numerous challenges, including environmental sustainability, ethical sourcing, and the adoption of new technologies. To solve these problems, the industry needs workers who excel in critical thinking. Students who excel in critical thinking are better equipped to navigate the evolving textile industry and devise innovative solutions to its most pressing challenges. Insufficient critical thinking skills among college graduates may hinder their development into competent leaders (Flores et al., 2010). The absence of critical thinking skills, including analytical reasoning, problem-solving, and decision-making, can hinder their ability to manage intricate challenges and lead their organizations effectively (Flores et al., 2010). Nevertheless, it is essential to acknowledge that critical thinking skills can be cultivated and enhanced through specific educational approaches and opportunities for practical Implementation (Flores et al., 2010). With the right help and advice, college graduates can develop the cognitive skills they need to be effective and successful leaders.

Students need to learn how to think critically in order to fully benefit from modern learning methods (Saputri et al., 2022). To succeed in the rapidly evolving world of education, students need to develop these skills. Innovative teaching methods that promote deep thinking and logical problem-solving can help students improve their critical thinking skills (Kurnia & Caswita, 2020). Technology-enhanced learning environments are one good way to help students think critically. These environments provide students with access to a wealth of information and offer opportunities for collaboration and participation. Students need to learn how to excel in their future careers and develop critical thinking skills to prepare them for success in life. Consequently, educators need to prioritize instructional strategies that foster critical thinking. Critical thinking skills are enhanced through engagement with proofs, concepts, methodologies, criteria, or contextual factors that inform critical-thinking indicators, leading to decisions in self-regulation or assessments that culminate in inference, evaluation, analysis, and interpretation (Muntaha et al., 2021). Critical thinking entails the utilization of defined standards and criteria to cultivate a rational and substantive mindset. Students can develop critical thinking skills that help them address complex problems by employing a structured approach that considers relevant evidence, logical reasoning, and diverse perspectives.

Challenges to the Growth of Critical Thinking

A significant barrier to cultivating critical thinking skills in textile technology students is the traditional curriculum's predominant focus on rote memorization and technical proficiency, frequently to the detriment of higher-order thinking skills (Akhdinirwanto et al., 2020). Many programs place more emphasis on teaching facts and established procedures than on allowing students to ask questions, analyze, and evaluate concepts. This method of teaching may not be sufficient to help students develop the critical thinking skills they need to succeed in the modern textile industry. Students' ability to deal with the challenges they will face in their careers can be significantly impacted by not having to engage in critical thinking and real-world problem-solving tasks. Some people, on the other hand, argue that textile technology students also require a solid foundation in technical knowledge and procedural skills. This is because it provides them with the basic understanding they need to engage in more advanced critical thinking and problem-solving. Students can gain a deeper understanding of the industry's complexities and be better prepared to find, analyze, and solve real-world problems by mastering fundamental concepts and skills.

Another significant issue is that textile technology students lack opportunities to work on real-world problems and case studies that require them to think critically and solve problems. Many textile technology programs do not provide students with opportunities to work on challenging, ill-defined problems that are similar to those they will encounter in their future jobs. This lack of exposure can significantly hinder students' ability to apply their critical thinking skills in real-world situations, thereby reducing their readiness for the industry's demands. To help students develop the critical thinking skills they need to do well in the modern textile industry, they need more chances to work on real, open-ended problems. Moreover, the absence of thorough faculty training and support in critical thinking pedagogy can considerably impede the effective cultivation of critical thinking skills among textile technology students (Flores et al., 2010). A significant problem with teaching students these important skills is that teachers often lack opportunities to learn and apply effective critical thinking strategies in their work. Providing faculty with the essential resources, training, and incentives to prioritize critical thinking instruction is crucial for guaranteeing that textile technology graduates possess the cognitive skills necessary to navigate the complexities of the contemporary industry. It is essential to provide teachers with the necessary tools to effectively implement critical thinking pedagogy in their classrooms, thereby helping students develop these important skills. (Munawi et al., 2020). Providing teachers with the right support and incentives to incorporate critical thinking into their lessons will help textile technology graduates prepare for the challenges and uncertainties they will encounter in their careers.

The third major problem is that students are not interested in or motivated to engage in activities that require them to think critically. Some students find these kinds of tasks challenging or unpleasant because they do not believe in their abilities or think they are not relevant to their personal interests and career goals. This lack of motivation among students can significantly hinder their ability to learn how to think critically, as they may not be willing to put in the necessary effort to tackle challenging problems and consider information from diverse perspectives. To solve this problem, teachers need to employ methods that engage students and make critical thinking activities more relevant and valuable for students studying textile technology. Teachers can enhance students' motivation and commitment to developing critical thinking skills by designing lessons that align with their interests, career goals, and preferred learning styles. This could involve using real-world case studies, projects relevant to the industry, or hands-on learning activities that demonstrate the importance of critical thinking in the field of textile technology. Providing students with opportunities to apply their critical thinking skills to solve real-world problems can also help them understand the importance of these skills in their future careers.

Another problem is the way that students in textile technology classes are tested. Multiple-choice tests and other traditional tests often test how well students remember things instead of how well they can critically use the knowledge. These assessment methods can lead students to focus on memorization rather than engaging in more in-depth analysis and evaluation. Tests that focus on memory do not help people think critically or analyze things more deeply. Teachers should use more real-world assessments, such as case studies, projects, and presentations, that require students to apply their knowledge, think critically about complex problems, and formulate logical solutions. Additionally, a lack of resources and support can make it more challenging to develop critical thinking skills.

A significant problem is that students lack motivation and interest in activities that require them to think critically. Some students find these tasks challenging or unappealing by nature, especially if they lack confidence or believe the tasks are unrelated to their interests or career goals. Due to this lack of motivation, students may be less inclined to engage with challenging problems or consider information from diverse perspectives, which can hinder their development of critical thinking skills. To address this, teachers should employ methods that engage students more actively and make critical thinking exercises more relevant and valuable for textile technology students. This may entail aligning instructional methodologies with students' interests, career objectives, and learning styles while integrating real-world case studies, industry-specific projects, or interactive learning experiences to demonstrate the practical significance of critical thinking within the discipline. Furthermore, offering students the opportunity to apply their critical thinking skills to solve real-world problems can help them understand the importance of these skills in their future careers. Students who think critically tend to do so less when they perceive things as too difficult or not useful. Teachers should ensure that activities are relevant to students' interests, incorporate real-world examples, and provide students with opportunities to solve real-world problems.

Methodology for Cultivating Critical Thinking Skills

One effective way to help textile technology students to develop their critical thinking skills is to use problem-based learning (Benedicto & Andrade, 2022). Problem-based learning is a teaching method that focuses on using real-world, complex problems as the primary means of learning (López et al., 2023). This teaching method differs from traditional lecture-based ones because it places students in real-life situations that require them to think critically, devise creative solutions, and collaborate. Teachers can help students develop important critical thinking skills, such as analysis, evaluation, and synthesis, by giving them vague, open-ended problems that are similar to the ones they will encounter in the textile industry. Students must clearly define the problem, gather relevant information, formulate potential solutions, and evaluate the advantages of each alternative before reaching a well-informed conclusion. Problem-based learning not only fosters critical thinking skills but also improves students' capacity for effective collaboration, persuasive communication of ideas, and ownership of their educational process (Xu et al., 2023). The use of multimedia in problem-based learning settings can help students develop critical thinking skills (Fajari et al., 2020). Students learn more about the subject and how to use it in the real world by working on real-world problems. This makes the learning experience more meaningful and interesting (Yulianti, 2021). By presenting students with real-world problems to solve, teachers can help them develop the critical thinking skills necessary to succeed in the ever-evolving textile industry.

Another very effective way to help textile technology students develop their critical thinking skills is to use case studies. Case studies provide students with real-life situations, problems, or challenges that professionals in the textile industry encounter. Students must then analyze the situation, identify the most important issues, weigh their options, and develop well-thought-out suggestions. Many aspects of textile technology can serve as case studies, including product development, supply chain management, environmental sustainability, and innovation. These case studies are useful for developing critical thinking skills because they require students to apply their knowledge and reasoning to solve complex problems relevant to the industry. Through the examination of case studies, students develop the skills to discern implicit assumptions, assess evidence, consider various viewpoints, and make informed decisions (Kardoyo et al., 2020). Additionally, case studies facilitate collaborative learning as students collectively analyze the scenario, generate potential solutions, and substantiate their recommendations. Case studies help students learn how to think critically by requiring them to apply their knowledge to solve real-world problems. Students learn more about the problems and opportunities in the textile industry by working on case studies, which also helps them improve their critical thinking skills and prepare for future jobs (Popil, 2010).

Encouraging group projects can help students think critically because they must work together to solve challenging problems or complete tasks (Browne et al., 2009). Collaborative projects emulate the team-oriented environment prevalent in many textile industry workplaces, necessitating proficient communication, negotiation, and compromise (Rohmah et al., 2020). Teachers can set up group projects that encourage critical thinking by assigning students different roles that require them to view things from various perspectives, instructing them to question each other's assumptions, and ensuring there are clear standards for evaluating the

quality of the work (Nor & Sihes, 2021). Students learn to value different points of view, consider alternative options, and make informed decisions as a group by collaborating on projects. Working together is similar to how the textile industry operates in teams, which encourages communication, negotiation, and diverse perspectives. Collaborative projects also help students improve their social skills, such as listening actively, providing constructive feedback, and resolving conflicts, all of which are essential for success in group settings. Students learn how to utilize the group's collective intelligence to achieve shared goals while also enhancing their critical thinking skills through group projects.

Socratic questioning is an effective way to encourage textile technology students to think critically. It uses probing, open-ended questions to get them to think critically, analyze things more deeply, and question their assumptions. Instead of giving students direct answers, teachers who employ the Socratic method ask questions that prompt them to think critically about their ideas, identify flaws in them, and construct strong arguments (Ho et al., 2023). This method requires students to actively engage with the content, critically evaluate diverse viewpoints, and deepen their understanding. Asking questions encourages people to think more critically by prompting them to examine things more closely and challenge their assumptions (Riwayatiningsih, 2019; Swart, 2017). Socratic questioning can be effectively utilized in various educational contexts, including lectures, discussions, and collaborative activities. Students enhance their comprehension of subject matter and fortify their critical thinking abilities through reflective dialogue and introspection (Nelson, 1980).

Case Studies

The following section presents three case studies that explore different methods used to cultivate critical thinking skills in textile technology students.

Case Study 1:

A university's textile engineering program used a problem-based learning method in its first course (Cortázar et al., 2021). The textile industry presented real-world problems to the students, such as developing environmentally friendly textile products or enhancing manufacturing processes. Students collaborated in small groups to examine the issue, develop potential solutions, and present their findings to the entire class. The instructor acted as a facilitator, assisting the pupils in resolving the problem and offering comments to promote critical thinking. The results showed that students who participated in the problem-based learning activities made significant improvements in their ability to think critically about complex problems, weigh different options, and clearly articulate their ideas. This method fosters collaborative problem-solving, improves analytical skills, and cultivates effective communication abilities, all of which are essential for success in the textile sector (Cortázar et al., 2021).

Case Study 2:

There is much emphasis on using case studies and Socratic dialogue. The Fashion Design Department requires students to examine case studies, participate in Socratic dialogues, and answer open-ended questions to enhance their higher-order thinking skills (Bates et al., 2024). It is well established that these teaching methods, which include case studies and Socratic dialogues, facilitate students' critical thinking skills (Bates et al., 2024). Case studies help students think critically about complex problems, identify key stakeholders, and generate innovative ideas (Bates et al., 2024). Socratic discussion, emphasizing inquiry that stimulates critical thinking, aids students in deepening their thought processes, challenging their preconceptions, and analyzing situations from many viewpoints (Bates et al., 2024). The case examples illustrate the significance of incorporating practical experiences into education. While some may contend that traditional lecture-based education is enough, students said that these experiences facilitated their ability to assess design decisions, comprehend the societal implications of design, and cultivate their creative concepts. Additionally, by discussing case studies, students may have learned how to break down complex problems, identify key players, and devise innovative solutions to meet the needs of both the business and the customer. The Socratic technique, via probing questions, facilitated deeper contemplation among students, prompting them to interrogate their preconceptions and examine issues from other viewpoints.

Case Study 3:

Putting a Capstone Design Project into action. A community college's textile technology program included a capstone design project as part of its curriculum. Students had to collaborate to develop a new textile product or process that addressed a specific industry need. This hands-on experience provided students with the opportunity to apply what they had learned and practiced in a real-world setting, which helped them think critically and solve problems. The capstone project helped students gain a deeper understanding of the challenges and complexities of the textile industry while also enhancing their creativity and ability to generate new ideas. Capstone projects also help students learn how to work together to reach common goals, share ideas, and settle disagreements. Students develop important interpersonal skills, such as communication, negotiation, and leadership, through this group project. Employers in the textile industry value these skills. Students had to apply what they knew and could do to solve challenging problems, make informed choices, and clearly articulate their ideas throughout the entire project. Additionally, having teachers from the computing and engineering departments on site helped generate new ideas that focus on technology and user needs, fostering collaboration among people from different fields (Baniya). As a result of this collaborative approach, new textile products and processes were developed that addressed real-world problems and needs. A group of industry experts evaluated the students' projects, assessing their creativity, critical thinking, and technical skills.

According to the case studies mentioned above, students who work in groups can use conversations to identify complex problems that they can then use as the basis for their design-thinking process (Paudyal et al., 2021). Any business that wants to utilize design thinking must be able to collaborate effectively (Paudyal et al., 2021). By incorporating these strategies into the textile technology curriculum, teachers can equip students with the critical thinking skills necessary to succeed in a rapidly changing world. In the end, these practices will benefit not only the students but also the textile industry, as they will produce workers who can generate new ideas, solve problems, and lead.

CONCLUSIONS

Textile industry is dynamic and ever-changing, so students need to learn to think critically if they want to be successful there. Sustainability, automation, and global competitiveness are just a few of the challenges that students will face. But traditional textile education tends to focus more on memorization and mechanical skills, which makes it harder for students to develop these important cognitive skills. These challenges make it hard for students to learn practical skills, especially when combined with low student engagement, inadequate evaluation practices, a lack of staff training in critical thinking pedagogy, and a lack of practical application. To overcome these challenges, instructors can employ active learning strategies including case studies, group projects, Socratic questioning, problem-based learning, and technology-driven assessments. These instructional methods give students real-world experience that will help them in their future jobs. Students will then start to develop the creative and critical thinking abilities they need to do well in the textile business. More research should be done on how to make the new critical thinking module in textile education system more scalable to help students develop their analytical skills. Also, a systematic strategy must be taken to connect the effects of leadership skills with the already existing critical thinking module

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