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GIFTS: Building Conflict Resolution Skills among First Year STEM Undergraduates

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GIFTS: Building Conflict Resolution Skills among First Year STEM Undergraduates

Motivation

Teaching STEM students how to resolve team conflicts is critical to their academic and professional development [1]. Recent industry data underscores this urgency - while 98% of employers rate teamwork as a critical career readiness competency, 73% report difficulty finding graduates with essential soft skills like teamwork and conflict resolution [2], [3]. This gap is particularly concerning as only 77% of recent STEM graduates rate themselves as proficient in teamwork, suggesting a disconnect between workplace demands and graduate preparedness [2]. The problem is further exacerbated by the fact that 60% of STEM employees never receive basic conflict resolution training [4], highlighting the crucial need to address these skills during academic preparation.

Engineers, scientists, and technologists often work in interdisciplinary teams to solve complex problems, requiring collaboration across diverse perspectives and expertise [5]. However, such collaboration inevitably brings challenges, including conflicting ideas, differing communication styles, and cultural misunderstandings [6], [7]. Without proper conflict resolution skills, these challenges can hinder productivity, strain relationships, and impede project outcomes [8].

Conflict resolution equips STEM students with the tools to address disagreements constructively [9]. It fosters active listening, empathy, and the ability to mediate discussions, ensuring that all voices are heard [10]. These skills are essential in creating a collaborative environment where innovative solutions can emerge [11]. Moreover, learning to manage conflicts early prepares students to handle real-world scenarios, such as negotiating project priorities or mediating disagreements among colleagues, with professionalism and confidence [10], [12]. Teaching conflict resolution also promotes diversity and inclusion, as STEM teams often include individuals from various cultural, academic, and personal backgrounds [13]. Effective conflict resolution training helps students navigate these differences respectfully, creating equitable and inclusive spaces that leverage diverse perspectives for innovation [14], [15]. This is particularly important given the growing emphasis on soft skills in STEM curricula, where employers increasingly value interpersonal competencies alongside technical expertise [16].

Overall, integrating conflict resolution into STEM education addresses a critical skills gap in the workforce while fostering collaborative, inclusive, and productive team dynamics [17]. By addressing conflict constructively during their academic journey, STEM students can develop the essential interpersonal skills needed for professional success, turning potential obstacles into opportunities for growth and innovation.

Context

This introductory cybersecurity course, offered during the Fall 2022 semester at a large Midwestern university, enrolled over 120 first-year students pursuing a major in Cybersecurity. The course provided a comprehensive foundation in key cybersecurity concepts, covering topics

such as the confidentiality-integrity-availability (CIA) triad, risk management, information systems development, Unified Modeling Language (UML), and database design. These topics are designed to equip students with the theoretical knowledge and technical skills essential for addressing modern cybersecurity challenges. The course was conducted in a large lecture hall and followed a project-based learning approach [18], encouraging students to apply their disciplinary knowledge to solve practical challenges. The course structure is included in Table 1:

Table 1: Course Structure

Course Component	Details
Weekly Lecture Sessions	Two 50-minute sessions focusing on cybersecurity concepts and theoretical frameworks.
Weekly Lab Sessions	One 1-hour-and-50-minute session emphasizing teamwork and hands-on application of course topics.

Semester-Long Project: Students collaborated in randomly assigned teams of 4–6 members within their lab sections throughout the semester. The semester-long project required teams to integrate concepts from lectures and lab activities to achieve several key objectives: identifying system requirements, developing UML models for a given case study, creating security and organizational planning documents, and implementing a database that met the identified requirements. This collaborative approach emphasized the application of theoretical knowledge to practical challenges, fostering both technical and teamwork skills. Given the team-based nature of the course, training students on the principles of teamwork and conflict management was a key component.

To support this, students completed a module on teamwork and productive conflict as part of the course. The module provided strategies for managing conflicts, fostering trust, and enhancing psychological safety within diverse teams. Additionally, the course instructor and graduate TAs participated in a 60-minute training led by an expert in intercultural competence and STEM. This training equipped them with the knowledge and skills to facilitate team collaboration and address any conflicts that arose during the project. The instructor and TAs used this training to guide students in resolving conflicts constructively, ensuring a supportive and productive learning environment for all team members. By combining technical and interpersonal learning objectives, the course aimed to prepare students to navigate the multifaceted challenges of both academic and professional settings in cybersecurity.

Portable Intercultural Module: Productive Conflict

As part of the lab sessions, students completed an online portable intercultural training module (PIM) on "productive conflict". The PIM is an asynchronous 90-minute module housed in the learning management system. This module on productive conflict introduces students to the foundational concepts of conflict styles, trust, and psychological safety, while also providing practical strategies for bridging differences and managing emotions. The module culminates in a capstone reflection where students synthesize their learning and apply it to a realistic conflict scenario.

Learning Objectives

1. Understand different conflict styles and their impact on team dynamics.
2. Reflect on personal conflict styles and how they influence interactions.
3. Explore the concepts of trust, including types of trust and their role in building psychological safety.
4. Develop strategies to bridge differences, shift frames, and manage emotions during conflicts.
5. Apply theoretical knowledge to practical scenarios through a capstone reflection.

Module Components

Table 2 presents the description for each section within the PIM module.

Table 2: Productive conflict module outline

Module Section	Description
Introduction to Conflict Styles	Introduces common conflict styles such as avoiding, accommodating, competing, compromising, and collaborating. Through interactive activities, students reflect on their preferred conflict style, considering how it influences their interactions and decision-making in team settings.
Types of Trust and Psychological Safety	Explores the role of trust in teamwork, distinguishing between cognitive trust (competence-based) and affective trust (emotion-based). Students learn about psychological safety, emphasizing the importance of creating an environment where team members feel secure to express ideas, take risks, and admit mistakes without fear of judgment.
Strategies to Bridge Differences	Teaches practical strategies for conflict management, including: • *Shifting Frames:* Reframing conflicts to find common ground. • *Managing Emotions:* Using techniques like deep breathing, mindfulness, and active listening to de-escalate tensions • *Building Empathy:* Understanding and appreciating diverse worldviews and experiences
Capstone Reflection	Students completed a capstone reflection at the end of the module

Capstone Reflection

Students apply their learning to a fictional conflict scenario. The scenario describes a senior design project team struggling with interpersonal conflicts and miscommunication during a peer assessment session, which led to unresolved tensions and stalled progress on their website redesign project for a local non-profit. The case highlights challenges in team dynamics, including feedback mismanagement and differing conflict styles. After reading the case students were required to write a 300–500-word essay, to analyze the conflict, identify the styles and dynamics involved, and propose strategies for resolution. The goal of the reflection is to assess the students in terms of their understanding of the module's concepts and their practical application in resolving conflicts. Students answer the following reflection questions:

• Why are things going wrong on this team?

- If you were a team member, how would you go about getting the team to work through the conflict and get things back on track?
- How might a different member approach this challenge?

Assessment Methods

Each reflection essay, ranging from 300 to 500 words, was analyzed using a rubric (given in Appendix) adapted from the categories proposed by Thite et al [19]. The original rubric was modified to better suit the goals of this course by adding descriptive details, introducing a construct for empathy, and expanding the scoring structure to include three levels: Basic, Proficient, and Advanced. These adaptations ensured a comprehensive evaluation of the students' reflections on their teamwork and conflict resolution experiences. The rubric covered six key categories, mentioned in Table 3:

Table 3: Rubrics category and definition

Category	Definition
Dispute Resolution (Conflict Management)	Assessed the students' ability to identify core issues in team conflicts and propose solutions.
Feedback	Evaluated how students received and implemented feedback constructively to promote a positive team culture.
Information Sharing (Communication)	Examined the clarity, consistency, and inclusivity of team communication, as well as the students' listening skills.
Versatile Leadership	Assessed the students' ability to recognize and build on team members' contributions, foster participation, and motivate team members effectively.
Empathy	Measured the students' capacity to acknowledge and understand team members' emotions and perceptions and use this understanding in resolving conflicts.
Ethical Behavior (Accountability and Trust)	Evaluated trust-building actions, accountability, and the ability to promote a culture of reliability and mutual respect within the team.

Benefits of using Rubrics for Assessment

Rubrics offer several key benefits when assessing reflections. First, rubrics provide a structured and objective framework to evaluate diverse aspects of student learning, ensuring consistency across assessments [20]. By breaking down reflections into specific categories such as dispute resolution, feedback, and empathy, rubrics help identify strengths and areas for improvement in students' teamwork and conflict resolution skills. They also offer clear expectations, guiding students to focus on critical elements of their reflection and enhancing the quality of their responses [21]. Additionally, rubrics facilitate actionable feedback, empowering students to develop essential interpersonal and intrapersonal competencies that are critical for academic and professional success.

Appendix: Rubrics used for analysis

Category	Level 1: Basic	Level 2: Proficient	Level 3: Advanced
Dispute Resolution (Conflict Management)	The reflection shows limited recognition of core issues and suggests solutions that fail to address the root causes. The reflection suggests minimal efforts to maintain team cohesiveness.	The reflection shows recognition of major issues and some understanding of underlying causes. The reflection suggests solutions that maintain team cohesiveness occasionally.	The reflection accurately identifies core issues and underlying causes, suggesting solutions that consistently maintain strong team cohesiveness and adapt effectively to changing demands.
Feedback	The reflection demonstrates a negative attitude towards feedback or a tendency to ignore it. Rarely suggests implementing feedback constructively.	The reflection demonstrates a generally positive attitude towards feedback, with occasional suggestions for constructive implementation.	The reflection demonstrates a positive, non-defensive attitude towards feedback and consistently suggests ways to implement feedback constructively and promote a culture of constructive feedback.
Information Sharing (Communication)	The reflection shows inconsistent communication, with a tendency to monopolize the discourse in only one team member and rarely clarify views. Demonstrates inconsistent listening.	The reflection shows generally clear communication, where most of the people can express themselves, occasional interruptions but generally good listening and clarification of views.	The reflection consistently demonstrates respectful, polite, and constructive communication, with restated views for clarity and attentive listening without interruptions.
Versatile Leadership	The reflection rarely articulates the merits of ideas, builds on others' contributions, or brings inactive members into discussions. Suggests minimal assistance and motivation.	The reflection occasionally articulates the merits of ideas and builds on others' contributions. Sometimes suggests bringing inactive members into discussions and providing assistance and motivation.	The reflection consistently articulates the merits of ideas, constructively builds on others' contributions, regularly suggests bringing inactive members into discussions, and provides motivation and assistance to team members.
Empathy	The reflection does not show interest in understanding team member's feelings or perceptions; it ignores	The reflection shows interest in understanding team member's feelings, but does not use it to build	The reflection encourages the acknowledgment of team member's feeling and perceptions, and build

	or actively leaves out their emotions.	a resolution based on understanding each other.	from the communal understanding.
Ethical Behavior (Accountability and Trust)	The reflection shows a tendency to ignore trust-building actions.	The reflection generally shows actions that earn the trust of team members through timely and quality contributions.	The reflection consistently shows actions that earn the trust of team members by completing tasks on time and contributing high-quality work, promoting a culture of accountability and trust.

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