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Towards Understanding Collaborative Learning in an Undergraduate Cybersecurity Course: A pilot study using the AAC&U Teamwork VALUE Rubric, with implications for teaching and learning in Cyberethics contexts

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Abstract

The primary aim of this study is to investigate the experiences of students in a third-year undergraduate Information Technology Ethics course with group work, comparing two populations: Cybersecurity Information Technology majors and non-Cybersecurity Information Technology majors.
The researcher is using the American Association of Colleges and Universities (AAC&U) Teamwork VALUE Rubric to qualitatively analyze student reflections from both groups. The study's objectives include: 1) Understanding challenges faced by Cybersecurity students with group work. 2) Identifying unique characteristics of Cybersecurity students that may impact their experiences with group work. 3) Informing the development of pedagogy for future courses.
Data analysis involves scoring and analyzing student reflections using the AAC&U Teamwork VALUE Rubric. The study's hypothesis is that Cybersecurity students will display both common and unique characteristics in their experiences with group work. These insights could help inform pedagogical approaches tailored specifically to the needs of Cybersecurity students, enhancing student learning outcomes.
This research has significant implications for educators seeking to improve student success and engagement in Information Technology Ethics courses, particularly those related to Cybersecurity. By exploring these experiences, educators can develop targeted strategies to support Cybersecurity students' success in group work environments and foster a more inclusive and supportive community.

Keywords: Cybersecurity education, teamwork, collaboration, communication, cyberethics

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1. INTRODUCTION

Teamwork and collaboration are essential skills for both educational institutions and modern organizations. In today's interconnected world, individuals from diverse backgrounds and disciplines must work together to achieve common goals, think creatively, and innovate. However, implementing effective teamwork and collaboration strategies can be challenging, particularly in academic environments where instructors often encourage students to work independently.

Traditional educational systems often prioritize efficiency and productivity over deep learning, leading to an emphasis on assessment outcomes rather than the learning process itself. In contrast, the outcome of this study moves to rebalance the focus towards genuine student learning experiences, particularly in complex group work settings like Information Technology Ethics courses. By examining students' perspectives through a qualitative lens, educators can gain a more nuanced understanding of what works and what does not in fostering collaborative learning environments.

Using the American Association of Colleges and Universities (AAC&U) Teamwork VALUE Rubric as a framework, this study aims to provide an objective, yet contextualized, analysis of Information Technology student experiences with group work, highlighting opportunities for pedagogical improvement with Cybersecurity majors. By examining the challenges and triumphs of Cybersecurity students as they navigate complex group work in an Information Technology Ethics course, educators can gain a deeper understanding of the complexities that underpin successful collaboration and develop more effective pedagogical strategies to support student success in this field.

While existing research has explored group work dynamics in various fields, no study has directly compared Cybersecurity and non-Cybersecurity major students' experiences using the AAC&U Teamwork VALUE Rubric. By applying this framework to their data, unique patterns of behavior are identified by the researcher, based on the differing expectations and demands within each group. The framework itself may also be better informed and improved by the application to this unique area.

In replicating real-world ethical dilemmas within a controlled classroom setting, students challenge each other to think critically. This approach allows the capture of the discomfort of their collaboration processes through their reflection on the work - specifically on the response to conflict.

While it is possible to look at group work in many ways, the use of the AAC&U Teamwork VALUE rubric narrows the research study to a manageable level. Other AAC&U VALUE rubrics, such as the AAC&U Ethical Reasoning VALUE rubric, may also provide insights into future work. There are also many other peer evaluation and group dynamics evaluation methods that could cross validate the findings.

2. LITERATURE REVIEW

The complexity of group work has long been a subject of intense study, and it is most well defined by Tuckman’s 1965 model of Forming, Storming, Norming, and Performing, known as “Tuckman’s ladder”. Variations of this in the Information Technology space are still being understood in research, with some suggesting that cultural differences may have a role in building trust, especially during the ‘storming’ phase of the ladder (Karlson & Nazer, 2024).

Deardorff’s 2009 work on cultural competence is a finger pointing at the moon for future work in effective global teamwork, especially in virtual settings. But even more vital is an increased understanding of how Information Technology students approach ethical issues in an age where the knowledge gap between policymakers and the creators is widening, as the globe shrinks.

Unfortunately, there is not a perfect method to understand best practices in group work, both due to the difficulty in accurately measuring the behavior (such as the Hawthorne Effect, explored by Landsberger in 1957) as well as the tendency to bias the observation with any prompting in the absence of true immersion.

Excessive interaction between the researcher and the subjects can cause a skewing of results, instead of an observation of natural state or baseline, as intended. While research in other undergraduate and professional settings is informative, the cybersecurity space may also have unique challenges that have not been identified. With that said, there are still efforts to improve and define what good teamwork is, specifically using the AAC&U Teamwork VALUE Rubric.

AAC&U has several different VALUE Rubrics which define levels of competence for different educational goals (McConnell et al., 2019). By using this tool and defining a baseline, the researcher hopes that future improvements will be more clearly understood by research in their impact to student outcomes tied to pedagogical changes. These rubrics also are flexible enough to implement and analyze after the fact, meaning they have broad application compared to more invasive methods.

Pande, et al. have looked at group work in the military setting, using audio and video recording to create transformer-based models of effective behavior (2023). In the educational setting, there have been efforts to understand the behaviors of students as effective teams as part of broader efforts to improve pedagogy. Notably by Oakley et al. in 2004.

Bahrami et al. use reflections and surveys to elicit a response to an activity after the fact in the place of direct recording, which can be time consuming and expensive (2023). This is the method chosen for this research as it balances the invasive nature of the experiment while still returning reliable data.

Research Question

Is there a difference in group work challenges between classes as reported in self-reflection through the lens of the AAC&U Teamwork VALUE Rubric for Cybersecurity and non-Cybersecurity majors in a third-year Information Technology Ethics course?

3. DATA AND METHODS

The main variables being investigated are the independent variable of course major (either Cybersecurity or non-Cybersecurity) and the dependent variable - response to conflict, as measured by the "Responds to Conflict" row in the AAC&U Teamwork VALUE Rubric (shown in Appendix B and available from the website: aacu.org/value/rubrics).

The inclusion into either group was done by the researcher naturally as part of the enrollment in the course. Students were either grouped by research as cybersecurity students in the major or enrolled in the non-cybersecurity course. The researcher taught both classes with identical curriculum, deadlines, and evaluations.
The scoring of the Teamwork VALUE Rubric was done against a group reflection prompt taken in the last weeks of the courses. The students were not provided by the instructor with the AAC&U Teamwork VALUE Rubric related to the scored area of conflict. The prompt for this reflection is shown in Appendix A.

There were ninety-four total students in the Cybersecurity class and there were sixty-eight total students in the non-Cybersecurity class. The total number of groups in each class was Cybersecurity: eighteen, and non-Cybersecurity: thirteen. The average number of group members for both classes was five. The instructor allowed students to choose their groups, with any unassigned students added to complete groups, where necessary.

Operationalization of Variables

In responses to the prompt students were asked by the instructor to discuss challenges and how they were or were not overcome in the group. Based on these responses the researcher scored the individual as a number from 1-4, representing the level according to the rubric.

While there is not an explicit explanation of the term conflict in the prompt provided to the students, many students reported conflict as a natural part of group work. Both classes were given lectures by the researcher tied to productive conflict at the start of the semester. Conflict here is taken by the researcher as a broad definition reflection of any difficulty or challenge which was faced by the students during the group work in either class. Students also discussed how they overcame this group challenge, leading to scoring ranging as 1-Passive to 4-Continuous based on the rubric available in Appendix B.

The ability and willingness to engage with ideas related to Cyberethics, self-confidence, writing and group socialization skills such as time management and communication are all extraneous variables to the research. All students were at least Sophomores with 45 hours of coursework. Most of the students were Juniors or Seniors.

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The instructor did not inform students that their answers were being used in research; however, they were told to be honest in their answers and that the responses would assist future delivery of the course. The use of the data is consistent with the associated IRB and does not change the delivery of the course, meeting the learning objectives tied to collaboration.

Data Collection

Data was collected through quantitative peer evaluation scores completed by group members after the completion of the group assignments. There are five milestones which require students to assume responsibility both individually, and as a team, to achieve group outcomes. The individual reflections evaluate the effectiveness of the individual and the group from the perspective of the student.

The researcher collected data after the semester ended through download using the learning management software. The names of students were programmatically removed before analysis as well as any references for course information or other group members. The responses to paragraphs four and five were then extracted manually by the researcher from the submissions and collected to be scored based on the "Responds to Conflict" row in the AAC&U Teamwork VALUE Rubric.

Sample

The researcher compares self-reported behavior based on reflections of group work at a Midwestern University undergraduate course on professional ethics in Technology. Two populations are compared in analysis, one with a major in Cybersecurity and one in another related field.

Groups were formed through self-identification. Results are presented at the course, group, and individual level. If a response did not demonstrate the Rubric (a score of 0) they were removed from the analysis. Also removed were any selections that appeared AI-generated or were incomplete. Selections continued until a sample representing at least 20% of the class had been collected.

Analysis

The main evidence of group success is taken to be the response to conflict. Successful groups can divert or harness conflict into a productive opportunity to gain experience from mistakes and achieve the group milestones. Less successful groups report either being passive with conflict (i.e., "going with the flow" or being a "couch potato") or responding to challenges, such as a missed deadline, in an ad hoc fashion.

Individual scores were averaged for each member of a group to generate a group score. This group score was then averaged and reported as representative for the class, either cybersecurity or non-cybersecurity. Any variation in the responses to conflict are noted in specific examples and analysis tied to group behavior.

The individuals completed the reflections singularly, though the samples may refer to the same group in some cases. Where there are differences in scoring based on the same group, values will be averaged.

For example, if Student A and Student B are both in Group 1 and are selected for analysis, the scores will be averaged to represent an overall score for Group 1. So, if Student A received a score of 2 on their reflection and Student B received a score of 4, the Group 1 overall score used to compare the two classes would be three. There are not half scores assigned based on the AAC&U Teamwork VALUE Rubric.

4. RESULTS

The total number of individual reflections scored were Cybersecurity: 20 (21%) and non-Cybersecurity: 13 (20%). Of these individual reflections there were representatives of 12 Cybersecurity groups (67%) and seven non-Cybersecurity groups (54%).

The Average score based on the group rubric was two for the Cybersecurity students and three for the non-Cybersecurity students. The Cybersecurity students had more scores in the low range compared to the non-Cybersecurity students. Both groups had the least scores in level 3. Most scores for both groups were in the

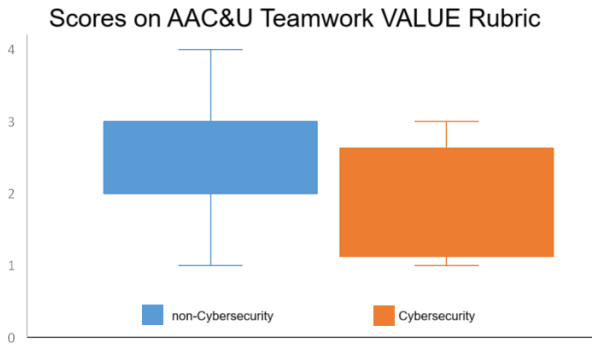

Figure 1. Scores on AAC&U Teamwork VALUE Rubric, *Responds to Conflict (AVG)*.

low range level 1 or 2. The non-Cybersecurity students had more scores at level 4.

Themes

Conflict is an inherent yet inevitable aspect of collaborative work, arising from diverse perspectives, values, and expectations. Despite its ubiquity, conflict management remains a critical yet often overlooked aspect of team dynamics. In the context of Information Technology Ethics courses, where students are tasked with navigating complex group work scenarios, effective conflict management is essential for fostering productive collaboration, achieving shared goals, and promoting overall team success. This thematic analysis aims to explore the ways in which conflicts emerge and evolve during collaborative learning experiences, highlighting key factors that influence conflict resolution, and examining the importance of initiative-taking strategies to mitigate conflicts and enhance teamwork outcomes.

Benchmark 1: *Passively accepts alternate viewpoints/ideas/opinions*, refers to the extent to which students are willing to consider and challenge diverse perspectives in their work. Simply agreeing with the majority or taking little responsibility is the defining characteristic of this rubric. Students remarked about the problem of passive group members and the strategy to resolve this behavior:

"Some of our other challenges were to hold each other accountable and to provide the same amount of work so there was no one free riding on some of the work required."

Benchmark 2: *Redirecting focus toward common ground, toward task at hand (away from conflict),* refers to a student's ability to refocus discussions and interactions on shared goals and objectives, while practicing active listening. When conflicts occurred, groups found a benefit to directly addressing the conflict in an ad hoc manner:

"I think taking time to explain each perspective can help each group member better understand how to learn from one another and develop new critical thinking skills related to other perspectives."

"We handled the issue of leaving assignments until the last minute by having a group meeting to only discuss this issue and how can we fix it."

The main difference between Benchmark 2 and 3 is the continuous engagement with conflict. Instead of an ad hoc approach, Benchmark 3: *Identifies and acknowledges conflict and stays engaged with it.* Students expressed this most often with regards to communication issues:

"We implemented an online collaboration platform to facilitate asynchronous communication…during our project discussions there were varying opinions on the project's requirements that created tension that needed to be addressed through open communication."

"Reflecting on this experience, we acknowledge the pivotal role of consistent communication and equal participation in group dynamics. In future collaborations, prioritizing early intervention in communication breakdowns and absenteeism will be imperative.

Benchmark 4: *Addresses destructive conflict directly and constructively, helping to manage/resolve it in a way that strengthens overall team cohesiveness and future effectiveness*. When students address destructive conflicts directly and constructively, they can help to build trust, foster a sense of collaboration, and create a more cohesive team environment that is better equipped to tackle challenges and achieve shared goals. It was the least observed for the Cybersecurity student cohort, not including a value of 0, which was not found and would represent no conflict. The main signal of continuous conflict management is an appeal to the group contract all students designed themselves as part of the first group deliverable. As one student claimed when a group member was repeatedly late or absent from work:

"We also decided that we would act in accordance with our team contract. The contract specified that if someone did not contribute towards the assignment then their names would be taken off the submission. By acting in accordance with the team contract no one could claim that they were not aware of the consequences of not participating in the group activities."

5. DISCUSSION

While the findings do not show a drastic difference between the two groups, it is of note that there seems to be a lesser acknowledgement of conflict as an ongoing and systemic issue in teamwork with Cybersecurity students. Many Cybersecurity students reported statements such as "group work is always like this" or "we still met our deadline even though it was the last minute."

In contrast, the non-Cybersecurity students analyzed were more likely to refer to the group

contract that each group was required to create at the beginning of the course. They also were more likely to point to ongoing behavioral changes, such as appointing a "taskmaster" to ensure deadlines were met and team members were kept on schedule.

This lack of long-term planning may represent a blind spot, both in the Information Technology curriculum, and more prominently in fields requiring a larger proportion of technical skills, such as Cybersecurity. While both classes reported "divide and conquer" mentality and there were not any drastic failures noted, some students seem more equipped to directly confront the challenges of teams than others. It could be that the information necessary to understand this complex social and cultural landscape is not being prioritized by existing pedagogy.

One solution may be to demonstrate conflict in a safe manner, such as during review of group milestones or as part of the group formation process. By ensuring that all members of the team are aware that the productive conflict is meant to realign the team with the goal of a stronger final product, it is possible that some of the missed opportunities with the Cybersecurity majors could be avoided.

Future Work

For the purposes of this study, only one semester of data was used. In developing frameworks and future studies that elaborate on these findings it may be fruitful to include a broader toolset for diagnostic and more data in general.

While it was not possible to measure the other aspects of the AAC&U Teamwork VALUE Rubric, the prompts shown in Appendix A could be modified to ask the questions more directly. Of particular interest in this study were the challenges and conflicts faced by groups; however, a more complete picture of these issues may be found by incorporating issues such as individual contributions or time management skills.

6. CONCLUSION

In conclusion, this study provides insight into the complexities of collaborative learning in Information Technology Ethics courses. By examining the challenges and triumphs of Cybersecurity students navigating complex group work, we shed light on the importance of effective pedagogical strategies to support student success. Our findings suggest that rebalancing the focus towards genuine student learning experiences can lead to increased efficiency, productivity, and overall student satisfaction. The use of the American Association of Colleges and Universities (AAC&U) Teamwork VALUE Rubric provided a nuanced framework for analyzing student reflections, highlighting unique characteristics of Cybersecurity students that may impact their group work experiences.

The implications of this study are significant, particularly in higher education institutions where Information Technology Ethics courses are increasingly becoming a core component of undergraduate curricula. Our research highlights the need for educators to adopt more inclusive and supportive approaches to teaching collaborative learning, one that acknowledges the diverse backgrounds and expertise of students from Cybersecurity majors. By integrating targeted strategies to foster teamwork, communication, and critical thinking skills, educators can create more effective learning environments that cater to the unique needs of their students. Our study contributes to a growing body of research on collaborative learning in academic settings, offering practical insights for educators seeking to enhance student outcomes and promote success in Information Technology Ethics courses.

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APPENDIX A

Reflection on Group Work Assignment Prompt.

Here are the steps you need to follow for a reflection on a group work essay. The essay structure below takes the funnel approach to essay writing: it starts broad and general, then zooms in on your specific group's situation.

1. Introduction
2. Explore the benefits of group work
3. Explore the challenges of group work
4. Give examples of the benefits and challenges your group faced
5. Discuss how your group handled your challenges
6. Conclusion (Discuss what you will do differently next time)
7. Edit!

This is a 6-step essay (the 7th-step is editing!).

Here's a general rule for how much depth to go into depending on your word count:
1200-word essay ~ one paragraph for each step (1-6)

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APPENDIX B

AAC&U Teamwork VALUE Rubric.

	Capstone 4	**Milestones** 3	 2	**Benchmark** 1
Responds to Conflict	Addresses destructive conflict directly and constructively, helping to manage/resolve it in a way that strengthens overall team cohesiveness and future effectiveness.	Identifies and acknowledges conflict and stays engaged with it.	Redirecting focus toward common ground, toward task at hand (away from conflict).	Passively accepts alternate viewpoints/ideas/ opinions.