

Team Dynamics And Conflict Resolution: Integrating Generative AI in Project-Based Learning to Support Student Performance

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1. Introduction

Project-based learning (PBL) coupled with design thinking has emerged as a transformative approach in education, particularly in disciplines like engineering and product design. This pedagogical model encourages multidisciplinary collaboration among engineers and product designers, fostering creativity, innovation, and real-world problem-solving skills. However, the effectiveness of such collaborations hinges greatly on team dynamics and conflict resolution strategies.

The integration of Generative Artificial Intelligence (Gen AI) into project-based learning environments presents a promising avenue for improving both the efficiency and effectiveness of team collaboration. By leveraging its capabilities, teams can receive personalized recommendations and insights tailored to their specific project needs. Moreover, Gen AI's ability to analyze team dynamics and anticipate potential conflicts equips educators and students with invaluable resources for fostering a harmonious working environment conducive to creativity and productivity.

Central to this paper is the development of the Team Dynamics and Conflict Resolution (TDCR) module, which provides students with the needed knowledge and hands-on skills to form project teams, promote team dynamics, and successfully resolve conflicts.

This paper provided a detailed plan to integrate the TDCR module in any given course plan. While the TDCR module is a standalone module, the author proposes the deployment of a specialized GPT (Generative Pre-trained Transformer) tailored to the specific needs of multidisciplinary teams. A framework for Gen AI literacy and deployment and an evaluation rubric to quantify and assess the efficacy of human-Gen AI collaboration are proposed. Figure 1 shows the flow of the work presented in this paper. The following sections of this paper are organized as follows: Literature Review, TDCR Module, Gen AI Literacy Framework, Project Pal GPT, Human-AI Collaboration Evaluation Tool, and Conclusion

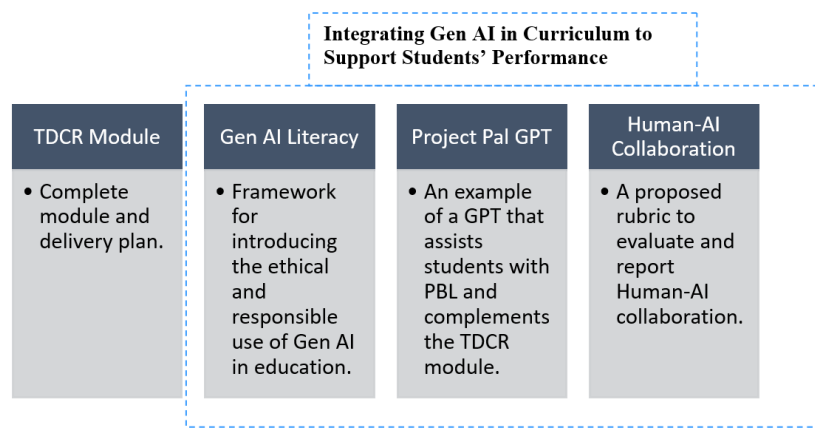


Figure 1: Flow of TDCR module and Gen AI integration in curriculum

2. Literature review

2.1. Project-based learning (PBL)

Project-based learning (PBL) has been shown to be effective in increasing students' motivation, problem-solving skills, and creative thinking [1], [2]. PBL provides students the opportunity to apply their knowledge to solve a real-world challenging problem [3]. PBL is usually achieved when students work in teams. The capacity to work effectively in teams is one of the highly demanded skills in the workforce [4]. This need has been recognized by both the academics and program accreditation entities like ABET which listed the ability to function in multidisciplinary team as an outcome that engineering graduates must have practiced and a skill that they have acquired by the time they graduate [4]. While academics try to educate students on the essentials of team dynamics and promote a collaborative environment, challenges and conflicts are inevitable [4]. Assessment in PBL is conducted through several metrics including the final deliverable which can be achieved in several milestones, the instructor's evaluation of both the team performance and the individual performance throughout the process, and via peer evaluation [3].

As industrial design educators explore options and ideas to develop project themes and experiences for their students, they usually consider several aspects of the educational process. Among these aspects are learning outcomes [5], appropriateness for student level [6], and representative of the challenges to solve complex problems as experienced in the real world [7], [8], [9]. To promote creativity, problem-solving skills, and real-world skills, project based learning (PBL) has been incorporated into design and engineering educations as well as in other disciplines like business and management studies [8], [10].

Design Thinking (DT) has become a prominent methodology in many industrial design and engineering curricula, which helps students with needs assessment, ideation, and iterative problem solving [10]. One of the earlier perspectives of "Design Thinking" were developed by Buchanan (1992), in which DT was described as an approach to solve "wicked problems" [11]. A further explanation of the term "wicked problems" was introduced in the work of Leinonen and Durall (2014) as "problems that are difficult to solve because they are incomplete, requirements are constantly changing, and there are various interests related to them" [12]. A more concise description of DT was introduced by Luka (2019) as "a systematic approach to problem-solving that involves the human perspective" [13]. Human Centered Design (HCD) has been used either hand-in-hand with DT [14] or used synonymously [15]. Empathizing, the first stage of DT, is considered the core of HCD [14], this highlights the focus on the human element in the process of designing or solving a problem. Define is the second stage in DT, it is characterized by working towards defining the problem at hand. Ideation is the third stage in DT, which can be defined as an iterative process to achieve a final design that addresses the user's needs [16].

While having the capacity to work in cross-functional teams is an essential characteristic of design thinking [17], teaching instructions may not prepare students to embrace, grow and appreciate that skill. Industry feedback emphasized that graduates from different disciplines should be able to work on collaborative teams [18]. Educators acknowledged this fact, and took the necessary actions to employed resources and updated curricula to promote interdisciplinary educational experience [18] and to prepare industrial design students to "function fluently in interdisciplinary teams" [17]. While several successful initiatives have been explored and implemented to achieve these objectives, evaluating students' experience with teamwork is sometimes overlooked.

2.2. Team Dynamics and Conflict Resolution

It has been well established that for adult learning to occur, motivation and reflection must be present [19]. To achieve intrinsic motivation, the learner must have a sense of autonomy, competence, and a

feeling of belonging [20]. Educators play a multifaceted role in promoting those needs by actively facilitating inclusive and engaging learning experience while tailoring their approach to meet the diverse needs of adult learning, thereby promoting autonomy and competence[21]. When learners collaborate on a PBL assignment, intrinsic motivation can either be enhanced or disturbed. The determinant factors of intrinsic motivation level in this case are self-evaluation, attitude of the learning about education, and the importance of goals [19]. When the learner has a low expectation of success, their motivation to learn deteriorates [19].

The active involvement of students in the learning process is essential to accomplish the assigned tasks [8]. When students are disengaged due to lack of communication, absence of both empathy and inclusion, and when they are poorly committed to a common goal, and fail to plan their work, conflicts arise. Researchers have found that conflicts weaken team cohesiveness[8], halts innovation during the ideation phase [22], and may lead to social loafing [7]. Working in a team is not just an assignment, it is an experience that students live through and acquire. Student performance on a team can be improved when proper knowledge and guidance are delivered by the instructor [22]. However, if conflicts are left unresolved, a team project will possibly be unsuccessful. In addition to harming their grades, students will perceive teamwork and team collaboration as a negative experience and will affect their future performance on teams. On the other hand, a good experience with a team will encourage students to actively collaborate with other students [8].

2.3. Artificial Intelligence

Artificial Intelligence (AI) has been widely used in education since the seventies of the last century with attempts to create computer based tutoring-agents [23]. Generative Artificial Intelligence (Gen AI) is a class of AI that is not only powerful [24], but is becoming very popular with explosive growth as described by McKinsey& Company. ChatGPT, the infamous creation by OpenAI, unleashed the accessibility of Gen AI to everyone that has access to the internet. ChatGPT and similar platforms like Google-Bard and Claude 2.0 are classified as a Large Language Model (LLM). Deep learning neural network, a type of machine learning, is the algorithm used to develop those LLM models [25]. The ultimate objective of Gen AI models is “to generate human-like content in response to complex and varied prompts” [24]. Gen AI capabilities are extensive and are continuously growing and improving. Gen AI is capable of answering questions, solving difficult problems, and in some models like GPT-4 can exhibit human-level performance on some academic exams [26]. These capabilities paired with the ease of access to such Gen AI tools have raised a lot of questions about ethics, authorship and academic integrity [25], [27].

While academics are still exploring the possible applications of Gen AI in education [27], several researchers agreed that Gen AI literacy is essential in education [28], [29], [30]. Some educators and researchers argue that several AI tools like the writing assistance tools may enhance the learning experience by providing automated assistance [31]. AI has also been explored as a creative collaborator in various fields, such as game level design and computational tools for creative writing, where it is seen as a potential source of new ideas and support for designers' goals [32], [33], [34].

Providing feedback, creating personalized learning and tutoring are additional applications of AI tools in the education process that are remarkably successful [35], [36], [37], [38]. On the other hand, concerns have been raised regarding the use of AI tools in the classroom for several reasons, with plagiarism and academic integrity being on top of the list. Several AI tools including chatbots like ChatGPT have the advanced ability to generate sophisticated content that not only resembles human writing but also cannot be detected by plagiarism check software [39], [40], [41]. The need to regulate the use of AI tools in the learning process is urgent. It can be achieved when the educational institutions become proactive by updating their current academic integrity policies and provide ethical guidance on the proper use of these tools not only in the classroom but also in research [40], [41], [42].

In parallel to updating existing policies, the current pedagogy, instructional design, and curriculum must be enhanced accordingly to allow for AI integration. While educational institutions and educators are investing a significant time exploring the use of AI tools, there has not been an AI tool that is officially integrated with the existing learning environment and adopted by educational institutions. Educators and students that choose to explore Gen AI tools resort to use one of the publicly available tools like ChatGPT, Gemini, Claude 2.0, or similar tools [43], [44]. An exception to those tools is Khanmigo which is a tutoring companion that is integrated within the learning platform of Khan Academy [45]. Khanmigo is designed and built on the existing ChatGPT 4 model. It helps students achieve predetermined learning objectives by tailored support and promoting critical thinking without revealing answers to questions [45].

3. Team Dynamics and Conflict Resolution (TDCR) Module

This section provides an overview of the TDCR module, including details on its contents, and a suggested schedule for module delivery. This section will provide the reader with the needed information to integrate the TDCR module in their courses.

While working on a new product design project unleashes students' creativity, it may also bring several challenges. Striving to maintain team dynamics and proactively tackling conflicts are two of the main challenges that almost every project team runs into. Students attending a Product Design class offered by the Industrial Engineering Department at [University Name] university were no different. Students attending this class were in their junior year and came from two different majors including Industrial Product Design, Industrial Engineering majors, and entrepreneurship minor. Students were instructed to form a multi-disciplinary team of 4 to 5 students depending on class size. During the semester, each team worked on developing a product or a service using "Design Thinking" methodology. It was noticed that some teams struggled to successfully collaborate with their team. Few teams managed to overcome their struggles and collaborated to complete their assignments and design a prototype, while other teams got sidetracked and lost their focus. The teams that struggled suffered from several conflicts which impaired their ability to work together.

This module is developed with direct application of pedagogy to create inclusive team dynamics instructions. The module includes several in-class activities, two lectures, five deliverables for students to complete, and a follow-up plan for the instructor to ensure successful delivery of the module and achieving students' success. Active learning and collaborative learning are integrated in the module. Active learning is defined as "any instructional method that engages students in the learning process", while collaborative learning "refers to any instructional method in which students work together in small groups toward a common goal" [46]. Employing these methods ensures students' engagement, increases collaboration and promotes achieving learning outcomes [46]. It has also been found that active learning in addition to other activities promotes students' well-being [47]. Considering module content and the accompanying instructions, the module will be beneficial to students in other disciplines as well.

A tentative schedule for module delivery is shown in Table 1, this schedule is designed for a 16-week semester. However, the module can be delivered in a shorter semester, please see Appendix A for recommended delivery schedule. While this module focuses on how to improve team performance, it does not address the delivery of instructions and knowledge related to course work. This makes the module flexible to integrate with any existing course.

The delivery of the TDCR module is recommended to start prior to assigning students with PBL assignments. With that view, the semester can be divided into two phases, as shown in Figure 2 the *Learning and Performing*. During the learning phase, the instructor provides formal instructions on the TDCR module. Students focus on learning how to be effective team members and complete the relevant assignments in addition to other project deliverables. In this phase, students are expected to demonstrate different behaviors and attitudes towards the learning environment and the project. This phase is similar to both the forming and storming phases of project team development stages prescribed by It is important

to provide them with enough information on course requirements and project expectations. The instructor is encouraged to address students’ questions on team forming and encourage their active participation.

Table 1:TDCR Model Content and Delivery Schedule

Week	TDCR Module Content	Instructor’s Role	Deliverable by Individual (I) or Team (T)
1	-----	-----	-----
2	Jung Personality Test Team Role Test Availability Schedule	Provides instruction to complete the tests	Test results(I) Availability Schedule Completed (I)
3	Team Building and Team Dynamics	Facilitate lecture and run in-class activities	Individual Goals(I) Team Goals(T)
4	Conflict Resolution	Facilitate lecture and run in-class activities	Conflict Resolution Plan(T)
5	Case study	Facilitate activity	In-class discussion (T)
6-7	-----	Follow up	-----
8	-----	Provide feedback	Peer evaluation (I)
9-15	-----	Follow up	-----
16	-----	-----	Peer evaluation (I)

While students enter the performing phase, the actual project work begins. During this phase, the instructor provides guidance and support to help students navigate their work. Students focus on their course project deliverables and apply their knowledge from the “learning phase” to facilitate their work. It is important to note that teams’ synergy and cohesiveness will increase gradually. It is advisable to consider task complexity and students’ technical knowledge of course topics as a crucial determinant of team performance as well. In the performing phase, the instructor may choose to use a Gen AI tool to assist students with their project work. Additional information on how to introduce Gen AI in a classroom, how to create a customized GPT, and how to cite Human-AI collaboration are detailed in the following sections of this paper.

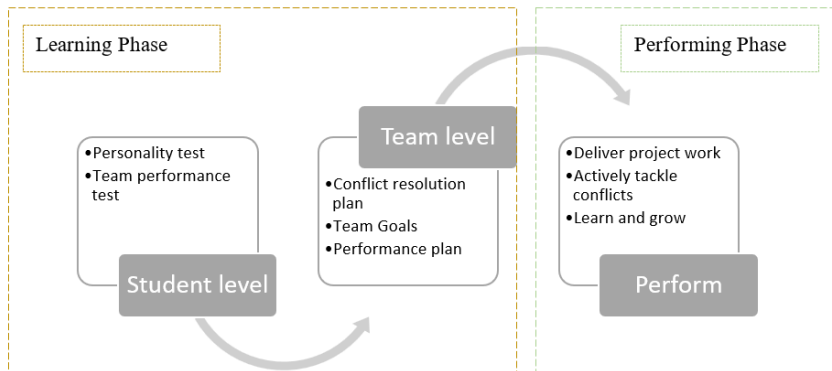


Figure 2: TDCR Module Phases

Week one

During the first week of the semester, students completed several ice-breaking activities and self-introductions to facilitate communication and encourage students to get to know their peers. Delivery of the TDCR module starts in week 2 and continues till week 5. Project deliverables commence in week 4, with the last component of project deliverable due in the last week of the semester. Again, the schedule of relevant project deliverables can be adjusted based on any given course schedule.

Week two

Prior to providing students with instructions on how to work in a team, it is important to help them learn more about themselves and explore their strengths and capabilities. To help them acquire this insight, students are given instructions to complete two tests: the Jung Personality Test and the Team Role Test.

Jung's psychological typology was first published in 1923 [48], and since then several tests have been developed and used by human resources, career coaching, organizational development [49]. It has also been used in higher education as a basis for learning styles and also to shed the light on individual differences [48]. Jung's typology is best known for the concepts of extroversion and introversion [50], and sensation -intuition and thinking-feeling. The test result is displayed in a four-letter acronym which describes the individual personality traits.

Team Role Test provides insight on how an individual will perform on a team by scoring them on nine different team roles including: Executive, Explorer, Innovator, Analyst, Driver, Chairperson, Completer, Team player and Expert. Each individual receives a total score of 100 points divided between all the nine roles. The higher the score in one role, the more the individual is competent in this area.

An availability schedule is completed by each student during the second week of the semester. While there are different causes of conflicts, a conflict over meeting times can hinder all efforts to promote cohesiveness, inclusion, and team performance. In a study conducted by Maguire and Keceli (2023), the researchers found that conflicts over meeting times were significant in self-selected groups when compared to instructor-designed diverse teams [7]. This can be attributed to the fact that students often form teams first prior to exchanging information on their availability. This is why it is important that students have this information available to share with their prospective team members.

There are two strategies to form teams, either self-selected where each student approaches their classmates and decides to pair with them based on their own perspective, or instructor-assigned teams, where the instructor assigns students to a team based on predetermined rules. Researchers studied team performance under both strategies and concluded that self-selected student teams perceived no more cohesiveness than instructor-assigned teams [7]. The author recommends that students self-select their teams. However, it is important to instruct them to make informed choices by promoting their strength and recognizing the skills and characteristics of other team members to ensure their success and decrease the chance of conflicts. For example, a student that scored high in "Executive", may work better with someone who scored high in "Team Player" than when working with another student who scored high also in "Executive".

Week three

Formal instructions are delivered in two successive weeks (weeks 3 & 4 as shown in Table 1) after teams are formed. Table 2 lists the instruction plan for week 3, including the topics to be covered, the activities that students complete in-class and after class, and the instructor's role. Additional information on each topic is listed in Appendix B. Please note that students' responses can be collected either via a clicker, live via an online survey, by choosing to speak out in the class or by any other method that the instructor sees fit.

Table 2: Week 3 Plan

Topic	Activity	Instructor's role
Team forming phases: each team passes by five transformational phases which are forming, storming, norming, performing, and adjourning [51].	Instruct students to share their insight on which phase they believe they are in. Students' responses are collected.	Discuss with students their responses and highlight the characteristics of each phase and how to move forward to the following step
Characteristics of highly performing teams[52]	Before sharing information on the characteristics of highly performing teams, instruct students to share their insight on what characteristics are essential for a team to be highly performing. Students' responses are collected.	Based on student responses, highlight the ones that align with the known characteristics. Share the characteristics and discuss how they are essential for team success
Five dysfunctions of a team [52]	Before sharing information on the dysfunctions of a team, instruct students to share their insight on what would make a team dysfunctional. Students' responses are collected.	Based on student responses, highlight the ones that align with the five dysfunctions of a team. Share the model (see Appendix B), explain how to overcome the dysfunctions of a team
Identify the individual team goals noting that goals must be specific, measurable, achievable, realistic, and timebound	Instruct students to work in their teams to write down their team goals, and individual roles. This assignment can start in the classroom and gets completed after class. The assignment is to be submitted the following week. Each team may present their goals to the class.	Explain the characteristics of team goals and give examples. Encourage students' participation in setting goals.

Week four

Table 3 lists the instruction plan for week 4, including the topics to be covered, the activities that students complete in-class and after class, and the instructor's role. Additional information on each topic is listed in Appendix B. Please note that students' responses can be collected either via a clicker, live via an online survey, by choosing to share their opinion in class or by any other method that the instructor sees fit.

Week 5

In week 5, students are presented with a case study to work on during class. The case study describes a situation where a conflict is present among a team of five members. Students are instructed to identify the conflict resolution profile of each team member, identify the type of conflict and propose a plan to resolve the conflict. This is an active learning activity where each team collaborates to work on the case study to understand how conflicts may arise and how conflicts drain the teams' energy and derail them from performing to achieve their goal. This is also an opportunity for the team to test-drive their

conflict resolution plan and see how they can put it into action. The instructor may use an existing case study, create their own, or instruct a Gen AI tool to create one, more details about that will be provided in the coming section.

Table 3: Week 4 Plan

Topic	Activity	Instructor's role
Three types of conflict types: Task and procedure Relationships and values Purpose [53]	Ask students to share their experience with conflicts, what type of conflicts did they face before? Which type do they assume they will face? Students' responses are collected.	Explain the different types of conflicts with examples. Discuss students' responses and encourage them to reflect on the characteristics of highly performing teams, can they root-cause the conflicts? Can they suggest a remedy to the conflict?
Five conflict resolution profiles: the Thomas-Kilmann Model [54]: avoidance, accommodating, competing, compromising, and collaborating.	Ask students to share their conflict resolution profile. Students' responses are collected.	Discuss the advantages and disadvantages of each profile. Highlight the importance of inclusivity and active listening
Conflict resolution plan [55]. This is an example of a conflict resolution plan; however, the instructor may choose any other model.	Instruct students to work in their team to create a conflict resolution plan. Starting with the different types of conflicts, which conflict resolution profile they will assume, how to encourage the adoption of that profile and finally, how they will resolve the conflict. Assignment to be submitted the following week.	Discuss how the conflict resolution plan works. Encourage students to do a walk-through the process and discuss how they will collect information to define the conflict, how they will collaborate to find solutions, how can they capitalize on their individual strength, how will they evaluate a solution, and how to reach consensus. Remind them to practice active listening, inclusivity, and empathy.

In the following weeks, students will be able to work effectively on their project deliverables. Each team is expected to recognize the strength of each team member, the role they will assume, and the tasks that each student will work on. Teams are also expected to be able to communicate effectively and plan their work. A recommended method of gauging individual performance within a team is by administering peer evaluations. Peer evaluation has been proven to be a successful tool to capture information about team performance that is only known to team members [56]

Students are also encouraged to share if they are facing any conflicts, and if they are, how would they use their conflict resolution plan to address them. The instructor can use this information to gain insight on team dynamics and if teams are facing conflicts. The instructor can provide guidance as needed based on the status of each team. Recommendations include conducting team meetings, one-on-one meetings with low performing students, advising the students to re-visit their conflict resolution plan to figure out how to address the conflicts at hand and /or update it as needed. Instructor may choose to administer one or more peer evaluations; however, the author recommends administering an evaluation between weeks 6 and 8 and another one towards the end of the semester.

While seeking support and feedback from the instructor is critical to achieving students' success [57], sometimes getting feedback in a timely manner may be difficult. This could be attributed to high student-instructor ratio [58], difficulties to establish communication with instructor [59]. To mitigate these hurdles while still offering students the opportunity to seek support when needed, the use of advanced tools like Gen AI may be useful. Recent research investigated the effectiveness of using Gen AI in learning [60], [61], [62].

An extension to the TDCR module is proposed in the following section to provide details on the integration of a Gen AI tool to assist students with their project work. The goal of the Gen AI tools is to provide guidance on project planning, task assignment, team dynamics and aid with conflict resolution. It is important to note that the TDCR module that is described in the previous section is a stand-alone module that is effective in achieving its purpose. The Gen AI tool aims to provide additional support to both the instructor and student as will be discussed in the following section.

4. Integrating Gen AI in Curriculum to Support Students' Performance

In this section, the author introduces the use of Gen AI tools in a formal classroom setting. This module bridges the gaps identified in the literature. For students to effectively learn while using Gen AI tools, it is essential that they receive formal instructions on the ethical, safe, and responsible use of such tools [28], [60]. The lack of awareness could hinder student learning and reduce their critical thinking skills [62]

To overcome these challenges, a framework is proposed to help educators provide instructions and guidance on the ethical and effective use of AI tools. This is a foundational framework that could be extended to include additional elements and components that may arise as the development of AI tools continues. The framework may also be updated to integrate the policies and rules that govern the use of AI tools. The inspiration for this framework came from the Design Thinking (DT) Framework developed by Tim Brown [16] which consists of five stages: empathize, define, ideate, prototype, and test. In developing the framework discussed in this current work, human centered design (HCD) and ideation are foundational. Unlike other AI literacy frameworks, like the one proposed by Christy et al. (2024), this framework is structured with the learner in mind showing adherence to the concept of HCD [29]. The framework adopts ideation as a concept to describe the process guiding the iterative work until a final goal is achieved. In this case, the ultimate goal is to establish proper understanding of how to ethically collaborate with Gen AI tools to achieve a specific learning goal.

4.1. The Foundational Framework for Gen AI Literacy and Deployment in Higher Education

The Foundational Framework for Gen AI Literacy and Deployment in Higher Education consists of five stages: Access, Learn, Explore & Apply, Reflect, and Adopt, as shown in Figure 3.

Stage one: Access

It is important to run a needs assessment to assess the feasibility and equity of access and use of a given AI tool. Students must be provided with means of using the proposed AI tools. This can be achieved by using internet powered devices that are available for students to use in a classroom, on campus or off campus. While there are plenty of tools with a varying pricing scale that ranges from free to premium, it is important to choose a tool that can be accessible by all students without an additional financial burden. Another aspect that should be considered in this phase is AI and tech literacy. A comprehensive definition of AI literacy was developed by Long and Magerko (2020) as “a set of competencies that enables individuals to critically evaluate AI technologies; communicate and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace” [63]. AI and tech literacy

should be assessed and not to be assumed that all learners have sufficient knowledge or similar experiences in using AI tools.

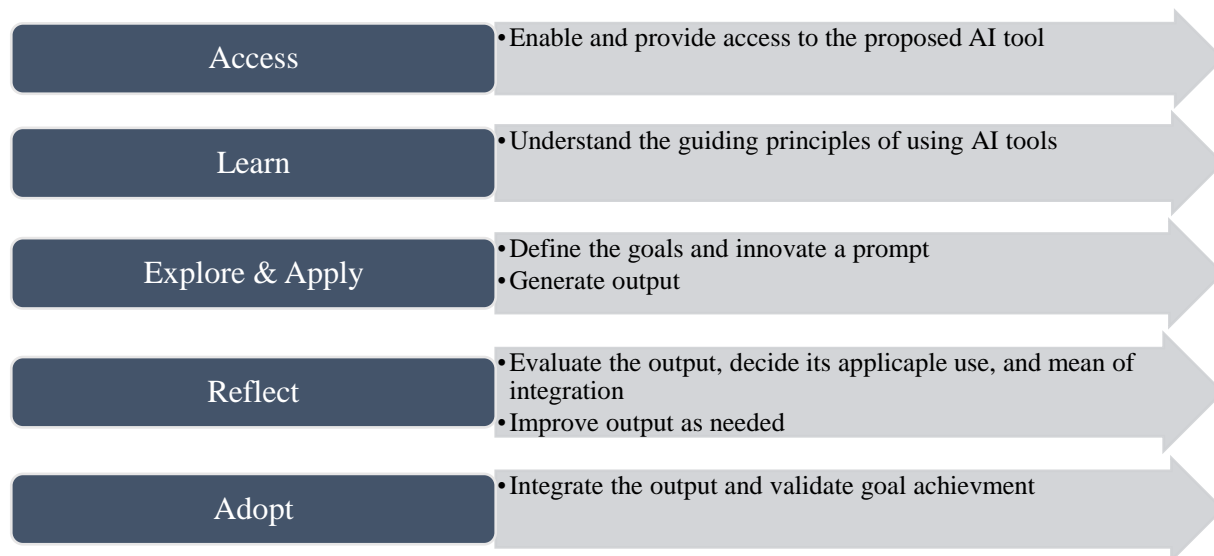


Figure 3: Foundational Framework for Gen AI Literacy and Deployment in Higher Education

Stage two: Learn

In this stage, the educator will introduce the guiding principles of using AI tools. This includes the ethics of using AI tools, the rules and policies adopted by the educational institution on the use of AI tools, what makes an AI tool trustworthy, and demonstrates a proper structure to cite work produced by an AI tool. In the following section, a model to cite human-AI contribution is presented. The educator will also explain the overarching goal of using AI tools and how it enhances the learning process. This may include assistance with course content [64]. Students will also learn the different types of information that may or may not be shared with a Gen AI tool. At the end of this stage, students should be able to recognize the importance of information security and are able to create prompts that are anonymous i.e. does not include any identifiers of the users, the collaborators, the institution, and all other sensitive data.

Stage three: Explore & Apply

In this stage, the learners will be presented with a task to complete using an AI tool. The learners should be encouraged to determine the goal of using the AI tool, create prompts to interact with the tool to achieve the specified goal. This is an iterative process where the learner, whether receiving direct supervision from the instructor or not, should continue to interact with the given AI tool until the learner decides to proceed with the output generated.

Stage four: Reflect & Enhance

In this stage, the learners will reflect on the output. The goal is to determine if the output meets the criteria set forth and the intended goal. In this stage, the learner is encouraged to revisit the ethical guidelines of using AI, apply their knowledge and understanding of the characteristics of the given AI tool.

Stage five: Adopt

In this stage, the learners adopt the output generated by the Gen AI tool and report their collaboration with the Gen AI tool as per the instructions provided by their educator. A proposed rubric to estimate and report the level of collaboration is detailed in the next section.

4.2. GPT Development and Application

To integrate Gen AI in PBL, the author created the ‘Project Pal’ GPT (<https://chat.openai.com/g/g-67EtwaJDU-the-project-pal>). The Project Pal was created and hosted on the OpenAI ChatGPT platform. Project Pal was trained using the TDCR module. Additional instructions were provided to enhance the performance of The Project Pal. These instructions included listing the areas of knowledge that should be considered when responding to student queries like the Project Management Body of Knowledge (PMBOK) and the Design Thinking Methodology. The instructions clearly stated to converse with students and help them focus on the project goal and the goals of the assignment at hand. Project Pal can assist students with project planning, task assignment among team members, managing time effectively, promoting team dynamics, and assisting with conflict resolution. When students have access to this tool or any other Gen AI tool, they will be able to seek help and assistance when needed. This will promote their motivation [65], help them identify knowledge gaps [66], help them develop and enhance their ideas [61], and provide continuous feedback tailored to student’s performance [29].

The Project Pal serves as an advanced tool or agent that has multiple capabilities. Those capabilities can be switched on or off according to the user’s needs and how it is prompted. It is important to highlight that similar to any Gen AI tool, The Project Pal, if prompted beyond the context of what it was designed to do, it will still spill answers and provide an output. There is no possible way – so far- to limit the use of this tool or any other Gen AI tool. For example, Project Pal is designed to give tips on how to create survey questions, see Figure 4. However, if it is prompted to create survey questions, it will generate an output that corresponds to the prompt. For that reason, it is mandatory to provide enough instructions to students on how to use this tool or any similar one. This is why introducing the content detailed in the ‘Foundational Framework of Gen AI Literacy and Deployment’ must precede the use of Project Pal or any similar tool.

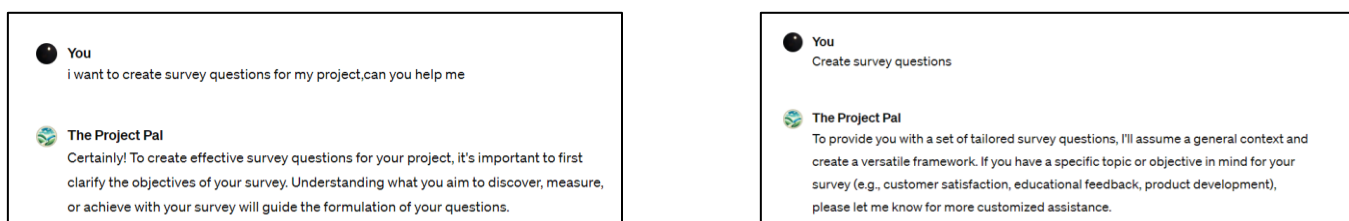


Figure 4: Project Pal- Survey Questions

In line with recent recommendations to integrate Gen AI in teaching and learning [62], the Project Pal can assist the educator as well in several ways. This includes drafting tailored feedback on submitted work, redesigning assignments [62], and suggesting work breakdown and task assignment within team members, See Appendix C for more details. It is important to note that creating a specialized GPT like the Project Pal ensures successful achievement of learning outcomes as opposed to using ChatGPT or any other general LLM model.

4.3. Human- Gen AI Collaboration Evaluation Tool

While the integration of Gen AI in education is still debated, those who oppose the idea provided valid justifications. Academic integrity, plagiarism, and cheating are among the most cited concerns [61]. So far, there has not been a clear and formal method to report human-AI collaboration in educational settings.

To provide students with a tool to help them report their collaboration with a Gen AI tool, the researcher created a rubric to evaluate and quantify this collaboration. The full rubric is available in Appendix D. Upon using the rubric to generate the assessment, it will reflect the degree of original ideation, content development, coherence, review, and content enhancement. The scores are assigned based on the provided criteria, considering the depth and quality of contributions from both the Human and Gen AI sides. The evaluation criteria are shown in Table 4. There is a maximum score for each criterion and a total score of 210 points. Tasks that are assumed to be completed by a human collaborator are scored out of 110, while tasks that are assumed to be completed by a Gen AI tool are scored out of 100.

Table 4: Evaluation Criteria of Human- Gen AI Collaboration

Task	Maximum Score	Task completed by	Score guideline (For rubric, see Appendix D)
Idea and initial argument	30	Human	A higher score indicates a prompt that is thoughtfully created with enough knowledge on the topic and the task to be performed. A higher score is desired
Raw content	20	Human	A higher score indicates that a substantive original text with elaborate arguments is provided. A higher score is desired.
Generation of coherent content	50	Gen AI	A higher score indicates a coherent and correct output is generated by AI to respond to all elements of the prompt. A higher score is desired.
Review and validation of content	10	Human	A higher score indicates a significant effort put by the human collaborator.
Re-prompting	10	Human	A higher score indicates that substantive follow-up was needed in order to achieve the required task
Regeneration of content	30	Gen AI	A Higher score indicates that the Gen AI tool successfully interpreted the re-prompts and generated significant output. A higher score is desired.
References	20	Gen AI	A higher score indicates that the Gen AI tool provided references in a correct format. A higher score is desired.
References validation	20	Human	A higher score indicates that the human collaborator invested in validating the references.
Rewriting and final compiling	20	Human	A higher score indicates that the human provided substantive edits to produce the final output.

Students can use the rubric to evaluate and report their collaboration with a Gen AI tool. They can also upload a copy of the evaluation tool to the Gen AI tool after completing the collaboration and prompt the Gen AI tool to run the evaluation as well. A sample of the evaluation conducted by Project Pal is shown in Figure 5. It is recommended that students submit along with their assignment the following content: a copy of the chat with the Gen AI tool, their own evaluation of the collaboration, and the Gen AI evaluation of the collaboration. They may also be asked to provide a brief reflection on the collaboration with Gen AI to consider learning and growth opportunities, effective prompting techniques, plan for future collaboration with Gen AI tools.

Task	Score (Human)	Score (AI)	Percentage
Idea and Initial Argument	25	N/A	14%
Raw Content	20	N/A	10%
Generation of Coherent Content	N/A	40	24%
Review and Validation of Content	5	N/A	5%
Reprompting	8	N/A	5%
Regeneration of Content	N/A	30	14%
References	N/A	20	10%
Reference Validation	15	N/A	10%
Rewriting and Final Compiling	18	N/A	10%

Total Scores:

- Human: 91/210 (43.33% of total possible score)
- AI: 90/210 (42.86% of total possible score)

Figure 5: Evaluation of Human- Project Pal Collaboration

5. Conclusion

This paper presented detailed information on four different tools to help instructors empower their students as they work on project-based assignments. The first is the Team Dynamic and Conflict Resolution module, which can be directly implemented in courses that are taught in a 16-week semester. While addressing the need to provide instructions on team dynamics and conflict resolution has been established and discussed in several research work like [67], [68], [54], none of that work provided a detailed plan on how to integrate the module in any course. This paper proposed a novel framework to introduce the use of Generative Artificial Intelligence tools in tertiary education. The Gen AI literacy and deployment framework is structured to provide students with formal education on the ethical use of Gen AI tools. The framework is resilient to adapt to ongoing changes in Gen AI capacities. The integration of GPT or Gen AI tools provides additional support to students that can be tailored to their needs and in accordance with the learning objectives. The proposed GPT, The Project Pal, is structured to assist students with their PBL assignments. It draws on information from the TDCR module as well as other areas of knowledge. Finally, a rubric is proposed and tested to quantify human-AI collaboration. This is a novel tool that will help both students and educators by promoting the ethical and responsible use of Gen AI tools.

In future work, the researcher plans to conduct a comprehensive assessment of student performance, leveraging the tools proposed herein. To investigate the effectiveness of these interventions, our methodology will encompass both pre and post evaluations, focusing on a variety of metrics. These will include students' performance in PBL, their insight into team dynamics and conflict resolution strategies, their adherence to the ethical use of Gen AI, the effectiveness of the proposed tool and the proper use of the collaboration rubric.

Appendix A

- Recommended delivery plan for an 8-week semester.

Week	TDCR Module Content	Instructor's Role	Individual (I)/ Team (T) Deliverable
1	Jung Personality Test Team Role Test Availability Schedule	Facilitate the instructions to complete the test	Test results(I) Availability Schedule (I)
2	Team Building and Team Dynamics Conflict Resolution and Case study	Facilitate lecture and run in-class activities	Individual Goals(I) Team Goals(T) In-class discussion (T) Conflict Resolution Plan(T)
3		Follow up	Reflections
4-7	-----		
8	-----	-----	Peer Evaluation(I)

Appendix B

- Team forming stages: moving forward

Forming to Storming (Get to know the team)

- Discuss general project goal and objectives
- Identify individual skills
- Accept differences, appreciate diversity and promote a safe and inclusive environment

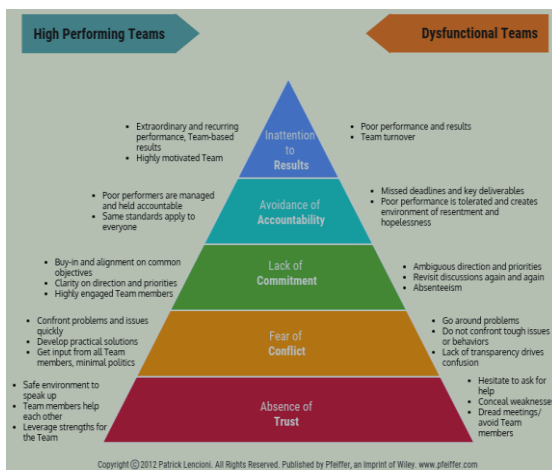
Storming to Norming (Plan your work)

- Clarify roles and responsibilities
- Set common goals
- Reach consensus
- Practice effective listening, give constructive feedback
- Develop conflict resolution plan

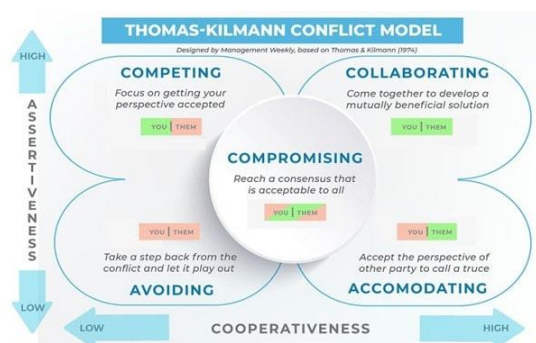
Norming to Performing (prepared for conflicts)

- Build trust (recognition, celebration)
- Standardize work, roles and responsibilities
- Share experiences and identify learning opportunities

- Characteristics of high performing teams and the five dysfunctions of a team[52]



- Conflict resolution profile (Thomas-Kilmann Model)



Source (<https://managementweekly.org/thomas-kilmann-conflict-resolution-model/>)

Appendix C

Example of Project Pal output



You

Students are assigned with a task to complete as part of their project. They need to interview stakeholders for their project, report the narrative of the interviews and identify the pain points. I want you to create a step by step process to help them complete this assignment. Make sure to list what are the skillsets that are needed to complete each task, include the tools and resources that they may need. Students work in groups of 4. Assign students with mini-tasks to complete. Make sure that the workload is equally divided.



The Project Pal

To assist your students in completing their project task of interviewing stakeholders, reporting narratives, and identifying pain points, I recommend the following step-by-step process. This process is designed for a group of four students, with each step including mini-tasks for individual students, required skillsets, and suggested tools and resources.

Step 1: Preparation and Planning

Skillsets: Research, Planning, Communication, Teamwork

1. **Student A:** Research potential stakeholders to interview. Skills needed include research and analytical skills. Tools: Internet, library resources.
2. **Student B:** Develop an interview guide with questions. Skills: Communication and writing. Tools: Document editor (like Google Docs), sample interview questions.
3. **Student C:** Schedule interviews with stakeholders. Skills: Communication, organization. Tools: Email, phone, scheduling tool (like Calendly).
4. **Student D:** Prepare materials for note-taking and recording interviews (if permitted). Skills: Organizational skills. Tools: Note-taking app (like Evernote), digital recorder.

Step 2: Conducting Interviews

Skillsets: Communication, Active Listening, Note-Taking

1. **All Students:** Participate in interviews, with each student assigned specific roles (e.g., asking questions, note-taking). Skills: Active listening, communication. Tools: Interview guide, note-taking tools.

Step 3: Compiling and Analyzing Data

Skillsets: Analytical Skills, Collaboration, Writing

1. **Student A & B:** Transcribe interviews and compile data. Skills: Attention to detail, typing. Tools: Transcription software, spreadsheet software (like Microsoft Excel).
2. **Student C & D:** Analyze interviews to identify key themes and pain points. Skills: Analytical thinking, pattern recognition. Tools: Data analysis tools, mind mapping software (like MindMeister).



Step 4: Report Writing

Skillsets: Writing, Critical Thinking, Synthesis

1. **Student A:** Draft the introduction and methodology of the report. Skills: Writing, comprehension of project objectives.
2. **Student B:** Write about the stakeholder narratives. Skills: Writing, ability to convey stories.
3. **Student C:** Detail the identified pain points and their implications. Skills: Analytical writing, critical thinking.
4. **Student D:** Conclude with potential solutions or recommendations. Skills: Problem-solving, persuasive writing.

Step 5: Finalizing and Presentation

Skillsets: Editing, Design, Presentation Skills

1. **All Students:** Review and edit the report together. Skills: Attention to detail, collaborative editing. Tools: Document editor.
2. **Student A & B:** Prepare a presentation of the findings. Skills: Design, summarization. Tools: Presentation software (like PowerPoint).
3. **Student C & D:** Practice and finalize the presentation delivery. Skills: Public speaking, time management.

Resources and Tools:

- **Interview Guide Templates:** Online resources for crafting effective questions.
- **Digital Recorders:** For recording interviews (with permission).
- **Transcription Software:** To transcribe audio recordings quickly.
- **Data Analysis Tools:** For organizing and analyzing qualitative data.
- **Presentation Software:** To create engaging presentations of the findings.

Final Notes:

- Ensure all interviews comply with ethical standards and privacy laws.
- Regular team meetings should be scheduled to ensure progress and address any issues.
- Encourage open communication and flexibility within the team to adapt to any challenges.

By following these steps and utilizing the outlined skillsets and tools, the students should be able to effectively complete their assignment with an equitable distribution of workload.



You

Students are assigned with a task to complete as part of their project. They need to interview stakeholders for their project, report the narrative of the interviews and identify the pain points. I want you to create a step by step process to help them complete this assignment. Make sure to list what are the skillsets that are needed to complete each task, include the tools and resources that they may need. Students work in groups of 4. Assign students with mini-tasks to complete. Make sure that the workload is equally divided.



The Project Pal

To assist your students in completing their project task of interviewing stakeholders, reporting narratives, and identifying pain points, I recommend the following step-by-step process. This process is designed for a group of four students, with each step including mini-tasks for individual students, required skillsets, and suggested tools and resources.

Appendix D

Rubric to evaluate and quantify Human- Gen AI collaboration.

Task	Scoring Scale and Criteria Description
Idea and initial argument	<ul style="list-style-type: none"> • Minimal to no ideation or original analytical argument/angles initiated by human respondent. 0-5 • Brief or superficial prompt without much substantive original foundation or very vague initial arguments from human. 6-10 • Human outlines key issue and provides original arguments but lacking some depth or details. Establishes overall direction. 11-20 <p>Human provides a highly comprehensive issue overview and detailed substantive arguments that demonstrate deep critical thinking and analysis. Sets clear direction. 20-30</p>
Raw Content	<ul style="list-style-type: none"> • No tangible raw content contributed by human respondent to prime computer for production. 0-5 • Brief or superficial raw content from human without enough background info or elaboration to facilitate robust AI output. 6-10 <p>Human provides substantive original text elaborating arguments, analysis, issues, applications etc. Significant raw content reflecting critical thought for AI to process. 10-20</p>
Generation of coherent content	<ul style="list-style-type: none"> • Little to no coherent content generated at all, or rambling text unrelated to topic. 0-10 • Brief or superficial AI generated text without enough substance or specificity related to prompt. 11-20 • Meaningful amount of coherent writing from AI, loosely aligned with human inputs. Some grammatical issues. 21-30 <p>Substantive length of coherent, eloquent, fluent, and relevant text generated by AI from minimal human prompt. Significant content. 31-40</p>
Review and validation of content	<ul style="list-style-type: none"> • No meaningful review or validation of computer-generated content by human counterpart. 0 • Human validates some aspects of content but does not comprehensively review or provide detailed validation commentary. 1-5 • Humans thoroughly review all machine generated text for coherence, factual accuracy, logical flow, spelling/grammar issues, etc. Provides significant validation feedback. 6-10
Re-prompting	<ul style="list-style-type: none"> • No follow-up prompting by humans after initial AI generation to further improve output. 0 • Minimal secondary prompting without enough directionality for machine to make meaningful content adjustments. 1-3

Task	Scoring Scale and Criteria Description
	<ul style="list-style-type: none"> • Additional prompting from human but lacking specificity or strategy to enable high quality AI content regeneration. 4-7 <p>Humans provide substantive and strategic follow-up prompting, directing AI to make significant content changes to align better with intent. 8-10</p>
Regeneration of content	<ul style="list-style-type: none"> • No meaningful attempt by computer to modify previously generated text/arguments after human inputs. 0-10 • Sparse effort by AI to reconfigure content based on human prompts. Changes are superficial or inadequate. 11-20 • Machine incorporates some updates based on human redirection but lacking comprehensiveness or depth in updated formulation. 21-25 • AI successfully interprets human's re-prompting and makes significant updates by adding/rephrasing multiple paragraphs with useful novel arguments or factual content. 26-30
References	<ul style="list-style-type: none"> • No to sparse sources or references generated without much relevance or attribution to factual claims 0-10 • AI includes some decent citations to AI generates and incorporates a lengthy list of scholarly citations and varied sources relevant to prompt. 11-20
References validation	<ul style="list-style-type: none"> • Limited to Sample validation of source credibility, suitability and factual accuracy by human reviewer 0-10 • All sourced references cross-checked and confirmed by human as accurate sources correctly matched to factual claims made 11-20
Rewriting and final compiling	<ul style="list-style-type: none"> • No tangible rewriting efforts made by humans to improve computer produced text. 0-5 • Minimal rewriting e.g. small tweaks in tone/word choice without significantly enhancing arguments or depth. 6-10 • Moderate rewriting input including some wording changes, source swaps, or flow adjustments to enhance text. 11-15 • Human provides substantive edits and rewriting suggestions like refined arguments, alternate perspectives, tone changes, different sources/facts, counter points to improve output. 16-20

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