

**Impact Evaluation
of the Courage Hope Care
Institute's STEAM Program
at the Parklands-Turner Branch
of the DC Public Library
for the 2024-2025 School Year**

Dr. Lan Joo

Founder and CEO of Courage Hope Care Institute

**Special thanks to Ms. Kendra Jordan, Ms. Patricia Ballentine, and staff members
at Parklands-Turner branch for their dedication to the program.**

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1. Introduction

Despite advancements in STEAM education, schools in Washington, DC—particularly those in underserved communities—still lack adequate resources and curricula for STEAM subjects. Additionally, there is limited time allocated for teaching these subjects during school hours. To address these challenges, our organization has implemented a free STEAM program during after-school hours at public schools and libraries in underserved communities. We launched the initial program at the Parklands-Turner DC Public Library in 2023. At the end of the 2024-2025 school year, our organization, led by Dr. Lan Joo, CEO, assessed the program's impact by collecting three main types of data: attendance rates, surveys, and evaluations. We will continue to conduct annual impact evaluations of our program moving forward.

Program overview

Our STEAM programs are designed and managed by Dr. Lan Joo, the Founder and CEO of the organization. Dr. Joo is responsible for developing the content and curriculum, preparing STEAM learning resources, securing instructors, ensuring the quality and effectiveness of the program, and writing the program's impact evaluations. Additionally, she establishes partnerships with individual schools and institutions. Dr. Joo develops these STEAM programs specifically for children because she recognizes the importance of introducing these concepts at an early age. These experiences help shape children's cognitive and reasoning abilities, fostering their creativity and innovation for the future.

The organization provides five areas of the STEAM program to children, ranging from kindergarten to 5th grade, at no cost. The program is delivered through hands-on group projects led by instructors, emphasizing both theoretical concepts and their practical applications. During the 2024-2025 school year, 27 registered children participated in the program at the Parklands-Turner Branch Library. Participants learned about the five core areas of the curriculum outlined below:

Science: Our science activities, conducted through hands-on experiences with various learning kits, are designed to enhance children's problem-solving skills, teamwork, and creativity. These are not just skills for the classroom, but valuable tools that can be applied to various aspects of life, ensuring that the time and effort invested in these activities are truly worthwhile.

Technology: We provide coding program that offers many benefits, including enhancing problem-solving, logical thinking, and creativity while preparing children for STEAM careers. Learning to code builds confidence and resilience and improves performance in subjects like math and science. We also use virtual reality (V.R.) to improve science education and for virtual field trips, as it is an invaluable tool for teaching STEAM subjects. V.R. helps children visualize complex concepts, processes, and environments, making it easier for them to comprehend and remember what they've learned. In addition, V.R. allows children to take virtual field trips to museums, natural environments, historical sites, and outer space.

Engineering and Science: We utilized various engineering kits to provide hands-on, engaging experiences that help students develop problem-solving, critical thinking, and creativity skills. As the students built kits with team members, they shared ideas for solving the problems, fostering a sense of teamwork and collaboration. The team was also encouraged to produce a team project as an outcome product.

Arts and Engineering: Introducing children to 3D concepts is a vital investment in their future, enhancing skills in spatial reasoning, problem-solving, and creativity, which are essential for success in STEAM fields like animation, game design, and architecture. Using 3D pens, we teach three-dimensional thinking, allowing children to design and construct simple structures while understanding the engineering design process.

Math: We utilize a variety of hands-on educational resources, including math games that focus on number sense and money concepts, to help children understand mathematical principles. Our goal is to build students' confidence in their mathematical abilities and encourage them to explore more complex concepts. Additionally, we used various logic games, guided by our instructor, to enhance children's logical reasoning skills.

2. Data-driven Performance Analysis

2.1. Research Scope and Methodology

This case study aims to analyze the effectiveness of the STEAM after-school program operated at the DC Public Library Parklands-Turner branch from various perspectives and identify the factors contributing to its success and areas for improvement. To this end, we set out to explore the following key research questions.

Research Questions:

- Did the STEAM after-school program have a significant positive impact on the STEAM learning abilities, problem-solving skills, and collaboration abilities of participating students?
- How do the subjective learning experiences and satisfaction levels of program participants differ from the objective skill assessments of instructors? What insights do these differences provide regarding the program's specific strengths and areas for future improvement?

Research Scope and Approach:

This study focused on two main aspects to evaluate the effectiveness of the program. The first is the overall participation status of the participants, and the second is the participants' subjective perceptions and objective evaluation of their collaborative and problem-solving skills.

To analyze participants' participation, attendance records for each session were examined to identify overall participation trends. An analysis of the participants' satisfaction and their collaborative and problem-solving skills was conducted using two different data sources. (Please refer to Appendix 1 for the survey results and Appendix 2 for the evaluation items.)

- **Participant Survey** (Subjective Perception): A survey was conducted for 19 participants at the end of the program, and responses were collected on a scale of 1 (very negative) to 5 (very positive). This survey aimed to understand children's subjective perceptions, including their perceived improvement in problem-solving skills resulting from program participation. This data provides essential information for understanding internal changes in children, such as learning satisfaction, confidence, and initiative. For example, questions such as an increase in STEAM knowledge (Q10), an increase in confidence in STEAM learning (Q11), and an increase in problem-solving ability (Q12) were used to evaluate subjective perceptions of overall improvement.
- **Instructor Evaluation** (Objective Instructor Evaluation): To complement the subjective perceptions of the participant survey, an instructor evaluated 13 students' performance on a scale of 1 (poor) to 5 (excellent). This evaluation provides an objective assessment of collaborative and problem-solving skills. Instructor assessed specific behaviors and outcomes, such as how students approached problems, presented creative solutions, applied step-by-step procedures, analyzed results, and made suggestions for improvement. These evaluations help identify specific strengths and weaknesses in students' current problem-solving abilities, providing practical directions for improvement. For example, problem-solving ability was broken down into sub-components such as "problem approach," "creative

solutions," "step-by-step approach," and "result analysis and reflection," enhancing the diagnostic value.

By integrating and analyzing data from two distinct measurement perspectives—the instructor's objective evaluations and children's subjective surveys—we gained a more precise and comprehensive understanding of both the program's successful aspects and the areas for improvement. This thorough understanding will inform future improvements and ensure the program's continued success.

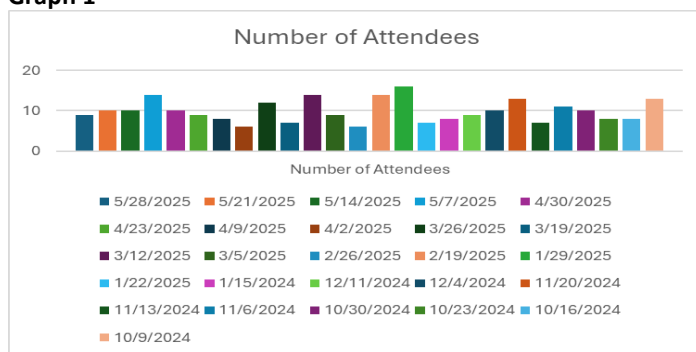
Table 1 perspectives on comparing evaluation data to survey data

Classification	Evaluation data	Survey data
What is measured	Individual students' problem-solving and collaboration skills (observer ratings)	Participants' program experience and perceptions (self-assessment)
How it is measured	1-5 scale scores (per student, per item)	Percentage of responses on 1-5 scale (for all participants)
Key categories:	Problem-solving skills and participation in collaborative activities	Involvement in team projects, learning outcomes, and problem-solving skills
Characteristics	Objective measures of performance	Subjective measures of satisfaction and perception

2.2. Attendance Data Analysis

The average number of attendees per session was approximately 9.92, indicating consistent attendance of around 10 students. The day with the most attendees was January 29, 2025, with 16 attendees, while the days with the fewest attendees were April 2, 2025, and February 26, 2025, each with six attendees. The graph is shown below.

Graph 1



The number of participants varies significantly, ranging from 6 to 16. This suggests that several factors influence attendance rates, such as specific days of the week (e.g., immediately after the holidays and during testing periods) and the external environment.

The attendance data also indicates that six participants maintained a high attendance rate of above 66% during the school year 2024-2025, as shown in the table below.

Table 2 Core participants' attendance rates

Individual	Attendance Count	Total Count	Attendance Rate (%)
Participant 1	23	27	85.2

Participant 2	23	27	85.2
Participant 3	21	27	77.8
Participant 4	21	27	77.8
Participant 5	18	27	66.7
Participant 6	18	27	66.7

The above attendance data demonstrates that some core students are satisfied and engaged in the program, which increases the likelihood of their continued voluntary participation. One of the factors that contributes to the high attendance rates among these students is our successful engagement with their parents, who are responsible for dropping off and picking up their children. Parental involvement plays a crucial role in achieving high attendance rates. Additionally, motivating these six students to return to the program encourages them to ask their parents to bring them back. Their high attendance ensures that these students do not miss out on the educational content offered, allowing them to learn consistently and build on their experiences. This is crucial for long-term learning and skill acquisition.

Although the program has core members with high attendance rates, there remains an opportunity to enhance attendance rates for other students by increasing engagement with their interests and actively involving parents in the program.

2.3. Survey Data Analysis

2.3.1. Findings from survey data

Based on the analysis of the survey data, we found that participants' satisfaction and positive experience with the program were very high. A detailed breakdown of each question category is shown below:

Activity Engagement: This category measures how much participants were interested in and enjoyed the program, their willingness to participate again and recommend it, and their increased interest in STEAM fields.

Q1. Participants were interested in and enjoyed the program: Seventy-nine percent of participants rated it 5 out of 5, and 21% rated it 4, indicating that all participants were delighted and excited.

Q2. Intent on participating in the program again: Eighty-four percent gave a 5, 11% gave a 4, and 5% showed a 3, indicating that most participants strongly desire to participate again, which means the program is highly engaging.

Q3. Would recommend the activity to a friend: Seventy-four percent gave it a 5, 15% gave it a 4, and 11% gave it a 3, showing that most participants would strongly recommend the program to others. These responses are a testament to the program's quality and the satisfaction it provides.

Q4. Increased interest in STEAM fields: Eighty-four percent received a 5, 16% received a 4, and all participants reported a significant increase in interest in STEAM fields, indicating that the program was highly successful in achieving its STEAM education goals.

Overall, the "Engagement with the activity" category received very high favorable ratings across all metrics, especially the increase in interest in STEAM fields, which was positive for all participants.

Participation in team projects: This category assesses collaboration, communication, problem-solving skills, and increased confidence in teamwork.

Q5. Collaboration with teammates: Seventy-three percent of participants received a 5, 18% received a 4, and 9% received a 3, indicating that most participants felt they worked well with their teammates.

Q6. Communication and cooperation among team members: Eighty-two percent received a 5, 18% a 4, and 9% a 3, indicating that all participants rated communication and cooperation within the team as very good.

Q7. Team's problem-solving efforts: Seventy-three percent received a 5, and 27% received a 4, with all participants indicating that the team worked well together to solve problems.

Q8. Increased confidence in teamwork: thirty-six percent gave a 5, 45% gave a 4, 18% gave a 3, and 5% gave a 2. While the percentage of 5s is relatively low compared to other statements, the combined scores of 4 and 5 still indicate a high favorable rating of 81%. These responses indicate an overall increase in confidence in teamwork but also suggest that some participants may have expected greater improvement.

Overall, "Participating in team projects" also received favorable ratings across most metrics, particularly satisfaction with team members' communication, cooperation, and problem-solving efforts.

Learning outcomes and problem-solving skills: This category assesses an increase in STEAM-related knowledge, an increase in STEAM learning confidence, and an increase in problem-solving skills.

Q10. Increased STEAM knowledge: All participants reported a significant increase in their STEAM knowledge, with 79% rating it 5 and 21% rating it 4.

Q11. Increased confidence in STEAM learning: Eighty-percent received a score of 5, and 14% received a score of 4. All participants reported a very significant increase in confidence in STEAM learning, which is one of the program's most notable outcomes.

Q12. Increased problem-solving skills: Fifty-seven percent gave a 5, 29% gave a 4, and 14% gave a 3. While the percentage of 5s is slightly lower than that of other learning outcome statements, the combined percentage of 4s and 5s still yields a high, favorable rating of 86%. These responses indicate an overall improvement in problem-solving skills.

Overall, the results for Learning Outcomes and Problem-Solving Skills were also very positive. Increased Confidence in STEAM Learning received the highest score from almost all participants, indicating that the program was very educationally effective.

2.3.2. Implications drawn from the findings

The participants expressed a high level of satisfaction with the program. A significant percentage of responses rated the questions on the survey with scores of 4 and 5, indicating that participants generally had a positive overall experience. This strong level of satisfaction reveals the program's effectiveness and its potential for future success.

One of the program's greatest strengths is its ability to inspire interest in STEAM fields. This aligns perfectly with the program's goals of providing educational experiences through team projects and hands-on activities. Participants also demonstrated significant improvement in their collaboration and communication skills, as evidenced by their high scores on survey questions related to participating in team projects. This underscores the program's effectiveness in developing these essential skills.

However, there is room for improvement in areas such as problem-solving skills and self-confidence. The data reveal that the percentage of participants scoring a 5 for the statements regarding "increased problem-solving skills" and "increased confidence in teamwork" was relatively low compared to other statements. This suggests that, for some participants, the program's impact on these two areas may not have been as significant.

To address this, we should consider providing additional enrichment activities or personalized feedback to participants who need more support in developing problem-solving skills and

confidence. For example, we can facilitate discussion about challenges students faced during the problem-solving process, encouraging them to reflect on how they could improve next time.

2.4. Evaluation Data Analysis

2.4.1. Average scores and standard deviations

We analyzed the average score for each item of evaluation data along with the standard deviation. Standard deviation is an indicator of how much the data is spread around the average, making it beneficial for understanding the differences in performance among students. The average score and standard deviation for each item, calculated based on the scores of 13 students, are shown in Appendix 5.3.

The program has achieved high average scores, ranging from 4.27 to 4.58, across all evaluation items. This underscores the program's success in providing a positive and practical learning experience for the majority of students, effectively developing the core competencies targeted by the program.

The standard deviation for each item was between 0.62 and 0.76, indicating that there was slight variation in scores among students. This is strong evidence that the program had a consistently positive impact on most students. Although there are some low-scoring groups, the overall standard deviation is not extremely high, leading us to conclude that the program's effects are relatively consistent. The low standard deviation means that most students are clustered around the average score, which can be interpreted as the program having a consistent effect in teaching and learning a specific skill. Conversely, a high standard deviation indicates significant performance differences among students, suggesting that individualized instruction or additional support is needed.

These high average scores with low standard deviations indicate that the majority of students performed well across all evaluation items, with slight variation in scores among students.

2.4.2. Learning outcomes

Problem-solving skills

The program has excelled in strengthening students' basic competencies, particularly in problem-solving. The participants have demonstrated overwhelming strengths, scoring an average of 4.58 in all basic and structured problem-solving processes.

Collaborative Activities

The participants achieved an average score of 4.46 in all items related to collaborative activities, including 'Role Distribution,' 'Degree of Cooperation,' 'Collaborative Problem-Solving Approach,' 'Solution - Collaborative,' and 'Feedback and Reflection,' demonstrating very high performance. This means that the students have developed effective collaboration skills, including "improved role distribution within the team".

Creative problem-solving skills

The "Creative Solution" item received an average score of 4.27, which is relatively low compared to other items. Although a score of 4 or above is still considered high, it is noteworthy that most students scored 5 in various categories. This indicates that additional guidance and encouragement are necessary to help students move beyond conventional thinking and propose unique and innovative solutions.

In summary, the program has proven to be an excellent educational program that successfully cultivates problem-solving and collaboration skills in most participating students. At the same time, the program's effectiveness could be maximized by further developing "creative problem-solving" abilities and providing more attentive and customized interventions for some students.

2.5. Analysis of Evaluation Data in Connection with Survey Data

Evaluation data shows objective scores from external observers on how well students performed on specific competencies (problem-solving, collaboration). In contrast, survey data represent the subjective perceptions of program participants regarding their feelings and level of satisfaction with the experience and performance. By analyzing these two types of data together, we can understand how the actual effectiveness of our program matches or diverges from the perceptions of participants.

Based on our analysis of the evaluation data in connection with survey data, most participants believe that their collaboration and problem-solving skills have improved. This perception of participants is consistent with the evaluation data, which indicates that the majority of students scored higher. However, there are both similarities and differences in the perceptions of instructors and students regarding problem-solving and collaboration skills.

2.5.1. Comparing perceptions

Problem-solving skills

- **Similarities:** Both the instructor and the students agree that most students have improved their problem-solving skills as a result of participating in the program. In particular, the increase in STEAM knowledge and confidence shows that students themselves perceive their learning outcomes very positively.
- **Differences:**
 - Perceived specific weaknesses: The instructor noted that the students still have room for improvement in certain areas, such as "creative solutions," but these particular weaknesses are not evident in the students' surveys. It is possible that students responded by focusing on their overall "improvement" in their abilities.
 - Individual struggles: The instructor identified the students who struggled with problem-solving on an individual basis; however, the survey does not capture these individual deviations in detail, as it shows trends across the class. The students would have been more focused on their own "incremental experiences".

Collaboration skills

- **Similarities:** Both the instructor and the students agree that the program's team projects are successful and that the majority of students have good or improved collaboration skills. Most notably, there is a high level of satisfaction with the communication and cooperation among team members, as well as the problem-solving efforts of the team.
- **Differences:**
 - Individual issues identified by the instructor: The instructor identified the students who struggled with collaboration; however, the high group average in the student survey conceals these challenges.
 - Gap in 'confidence': While students were satisfied with the overall collaboration process, it is interesting to note the relatively low percentage of 5s for 'increased confidence in teamwork'. This suggests that there may be some disconnect between feeling that "we worked well together" and feeling that "my collaboration skills have improved noticeably, and I feel more confident." In other words, while they

contributed to the team's success, they may have had higher expectations for personal growth, or they may have lacked the opportunity to assess their collaboration skills objectively.

2.5.2. Implications

By comparing evaluation data and student surveys, we can gain deeper insight into the program's successes and challenges.

Overall success: The program has had a positive impact on improving problem-solving and collaboration skills for most students as evidenced by the students themselves. This is particularly evident in achieving the core educational goal of increasing interest and confidence in STEAM.

Attention to individual students: Evaluations have identified certain students who individually require additional support in specific competencies (problem solving or collaboration). It is essential to offer them personalized coaching or additional practice opportunities.

Enhancing 'creativity' and 'confidence': While the students report that their overall problem-solving skills have improved, the instructor observed a decrease in the number of perfect scores for 'creative solutions'. In addition, student satisfaction regarding their 'increased confidence' is lower compared to other collaboration-related questions. This suggests that future programs should explore activities that further stimulate creative thinking. Moreover, these programs should provide opportunities for students to recognize their collaborative abilities and boost their confidence through personal contributions.

3. Conclusion

3.1. Successful Outcomes

Contribution to closing the STEAM education gap: By offering free after-school STEAM programs to children in underserved communities, we helped bridge the gap in access to STEAM education. This significant achievement aligns with our organization's vision and values.

Enhancement of participant satisfaction: One of the most critical indicators of success was the high level of satisfaction expressed by students regarding the program, as well as their strong desire to participate again. This is clear evidence that the program provided students with enjoyable and meaningful experiences, which will positively impact its long-term sustainability.

Maintenance of high participation and learning engagement: With the active involvement and close cooperation of parents, we successfully maintained high attendance rates among a core group of students.

Enhancement of the value of the library's programs: Our STEAM program contributed to expanding the educational offerings and enriching the value of the children's library programs by incorporating STEAM subjects.

3.2. Lessons Learned and Success Factors

Effectiveness of hands-on, team-based project learning: The program was delivered through hands-on, team-based project learning. This approach significantly increased student interest and engagement in the learning process. Additionally, it contributed to enhancing collaboration and problem-solving skills among participants. Our findings confirmed that interest and engagement are crucial factors in maximizing learning effectiveness.

Importance of team-based collaborative learning: The team activities in our program greatly enhanced children' communication and collaboration skills. Through problem-solving processes that required teamwork, children acquired knowledge and naturally learned various social and collaborative problem-solving skills. This was evident in the positive evaluations received in both instructor assessments and student surveys.

Establishment of a unique collaboration model: We successfully formed a strategic partnership with the DCPL Central Office, and our collaboration with the Parklands-Turner Branch has been instrumental in the program's success. The library not only provided space for the children's program but also ensured that staff members, including the children's librarian, worked closely with our organization. This unique collaboration model ensured full participation of students for the entire 50 minutes and guaranteed high quality of the program.

Shared common goals: Both partnerships aimed to reduce the STEAM education gap and increase access to STEAM opportunities in the underserved community by providing sustainable, high-quality after-school programs. This shared sense of purpose was a key driver of the partnership's success.

Flexible and adaptive program operations: The program was designed to address the gaps in STEAM education during after-school hours, adopting a demand-driven approach tailored to the needs of students.

3.3. Future Directions and Suggestions

Enhancing creativity and confidence in students: In future programs, we will design activities that stimulate creative thinking and increase confidence. These activities will provide students with more opportunities to recognize their collaborative abilities and build self-assurance through individual contributions.

Maintaining flexibility and adaptability: It is essential to remain open to adjusting and adapting program content to meet the unique characteristics and needs of local communities.

Conducting annual report of impact evaluation: We will continue to publish a yearly impact evaluation report to ensure the continuous improvement and long-term sustainability of our program.

4. Appendices

Appendix 4.1. Survey questionnaire and results

	Questions	Ratings				
		5	4	3	2	1
Interest in activities	1. How much interest and fun did you have while participating in the program? 1 (not at all likely to participate) to 5 (very likely to participate)	79%	21%	0%	0	0
	2. Would you like to participate in the program again? 1 (not at all likely to participate) to 5 (very likely to participate)	84%	11%	5%	0	0
	3. How likely would you recommend this activity to a friend? 1 (not at all likely to recommend) to 5 (very likely to recommend)	74%	15%	11%	0	0
	4. How much has your interest in STEM increased? 1 (not at all increased) to 5 (significantly increased)	84%	16%	0%	0	0
Team Project Engagement	5. How well did you work with your teammates? 1 (not at all well) to 5 (very well)	73%	18%	9%	0	0
	6. How well did the team members communicate and collaborate? 1 (not at all well) to 5 (very well)	82%	18%	0%	0	0
	7. How well did the team work together to solve the problem? 1 (not at all well) to 5 (very well)	73%	27%	0%	0	0
	8. How much has your confidence in working in a team increased? 1 (not at all increased) to 5 (significantly increased)	36%	45%	18%	5%	0
Learning Outcomes/ Problem-Solving Skills	10. How much do you think your STEAM-related knowledge increased during this program? 1 (not at all increased) to 5 (significantly increased)	79%	21%	0%	0	0
	11. How much do you think your confidence in learning STEAM subjects has increased? 1 (not at all increased) to 5 (significantly increased)	86%	14%	0%	0%	0
	12. How much do you think your ability to solve problems increased? 1 (not at all increased) to 5 (significantly increased)	57%	29%	14%	0%	0

9. In which topics do you feel the most improvement?	Science	Tech	Engineering	Math
	4	4	5	4

Appendix 4.2. Evaluation results

	Questions	Participant Number				
		7	8	9	6	10
Problem-Solving Skills						
Problem Approach	How effectively did the student define the problem and gather the necessary information? (1-5 scale)	5	5	5	3.5	5
Creative Solution	How original was the proposed solution compared to existing alternatives? (1-5 scale)	4	5	4	3.5	5
Evaluate the step-by-step approach	How effectively did the student apply a structured approach to solving the problem? (1-5 scale)	5	5	5	3.5	5
Analysis of Results and Reflection	How effectively was the student analyzing the project results and suggesting future improvements? (1-5 scale)	5	5	5	3.5	5
Collaborative Work						
Role distribution	How well did each team member fulfill their designated role? (1-5 scale)	5	5	5	3	5
Degree of cooperation	How effectively did team members communicate with one another? (1-5 scale)	5	5	5	3	5
Problem-Solving Approach	How well did the team work together to address the problem? (1-5 scale)	5	5	5	3	5
Solution	How well did the team work together to find the solution? (1-5 scale)	5	5	5	3	5
Feedback and Reflection	How effectively did team members provide feedback to one another? (1-5 scale)	5	5	5	3	5

	Questions	Participant Number				
		1	12	3	4	1
Problem-Solving Skills						
Problem Approach	How effectively did the student define the problem and gather the necessary information? (1-5 scale)	5	4	5	5	5
Creative Solution	How original was the proposed solution compared to existing alternatives? (1-5 scale)	5	3	5	5	5
Evaluate the step-by-step approach	How effectively did the student apply a structured approach to solving the problem? (1-5 scale)	5	4	5	5	5
Analysis of Results and Reflection	How effectively was the student analyzing the project results and suggesting future improvements? (1-5 scale)	5	4	5	5	5
Collaborative Work						
Role distribution	How well did each team member fulfill their designated role? (1-5 scale)	5	3	5	5	5
Degree of cooperation	How effectively did team members communicate with one another? (1-5 scale)	5	3	5	5	5
Problem-Solving Approach	How well did the team work together to address the problem? (1-5 scale)	5	3	5	5	5
Solution	How well did the team work together to find the solution? (1-5 scale)	5	3	5	5	5
Feedback and Reflection	How effectively did team members provide feedback to one another? (1-5 scale)	5	3	5	5	5

	Questions	Participant Number				
		2	13	5		
Problem-Solving Skills						
Problem Approach	How effectively did the student define the problem and gather the necessary information? (1-5 scale)	4	5	3		
Creative Solution	How original was the proposed solution compared to existing alternatives? (1-5 scale)	4	4	3		
Evaluate the step-by-step approach	How effectively did the student apply a structured approach to solving the problem? (1-5 scale)	4	4	3		
Analysis of Results and Reflection	How effectively was the student analyzing the project results and suggesting future improvements? (1-5 scale)	4	5	3		
Collaborative Work						
Role distribution	How well did each team member fulfill their designated role? (1-5 scale)	4	4	4		
Degree of cooperation	How effectively did team members communicate with one another? (1-5 scale)	4	4	4		
Problem-Solving Approach	How well did the team work together to address the problem? (1-5 scale)	4	4	4		
Solution	How well did the team work together to find the solution? (1-5 scale)	4	4	4		
Feedback and Reflection	How effectively did team members provide feedback to one another? (1-5 scale)	4	4	4		

Appendix 4.3. The average score and standard deviation for each item of Evaluation, calculated based on the scores of 13 students (out of 5 points)

Evaluation Area	Item Name	Average Score	Standard Deviation
Problem-Solving Ability	Problem Approach	4.58	0.63
	Creative Solution	4.27	0.62
	Step-by-Step Approach	4.58	0.63
	Analysis of Results and Reflection	4.58	0.63
Collaborative Activities	Role Distribution	4.46	0.76
	Degree of Cooperation	4.46	0.76
	Collaborative Problem-Solving Approach	4.46	0.76
	Solution - Collaborative	4.46	0.76
	Feedback and Reflection	4.46	0.76