Advancing SEL Assessment in STEM Education: Tools and Methodologies

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**ADVANCING SEL ASSESSMENT IN STEM EDUCATION: TOOLS AND
METHODOLOGIES**

Abstract

This research aims to confirm the clustering of Social Emotional Learning (SEL) constructs within small group Science Technology Engineering and Math (STEM) Project-Based Learning (PBL) environments. Using the Collaborative for Academic, Social, and Emotional Learning (CASEL) framework, the study focuses on the development and validation of survey items and observation instruments that educators can use to assess and enhance SEL dynamics in these settings. Over two years, a Confirmatory Factor Analysis (CFA) was conducted on the SEL constructs, followed by an Exploratory Factor Analysis (EFA) to identify unique SEL factors in STEM contexts. The findings highlight distinct SEL alignments for elementary, middle, and high school levels, underscoring the need for tailored SEL strategies. The developed observation instrument captures behaviors in STEM PBL that align with these constructs and provides formative feedback, while the survey tracks progress for accountability in educational grants. These tools are designed to help educators better understand and foster effective SEL dynamics in STEM PBL environments.

Introduction

Social Emotional Learning (SEL) is recognized as crucial for enhancing academic and behavioral outcomes across diverse educational settings. Empirical evidence suggests that strong SEL skills are linked to improved academic performance, higher student engagement, and reduced negative behaviors [1]. However, the dynamics of SEL in STEM Project-Based Learning (PBL) environments, characterized by unique group interactions and collaborative demands, may differ significantly from those in traditional educational frameworks. This study aims to explore these unique dynamics and develop tailored SEL strategies that address the specific needs of STEM PBL settings. By providing validated instruments for assessing SEL and documenting key factors, this research seeks to offer practical tools for educators to enhance SEL, fulfill grant accountability requirements, and promote effective group dynamics in STEM education.

Literature Review and Theoretical Framework

This study is grounded in the complex dynamics of group interactions within STEM Project-Based Learning (PBL) environments and their implications for Social Emotional Learning (SEL). Drawing on key insights from recent research, we developed a comprehensive framework for SEL assessment tailored to the specific challenges and opportunities of small group dynamics in STEM

education. This framework integrates concepts such as social loafing, technology-supported group dynamics, equitable group dynamics, feedback and motivation, supportive educational climates, and the promotion of academic success and cultural competence. Understanding these elements is essential for developing SEL survey items that accurately capture the diverse experiences and challenges students face in STEM PBL activities, ensuring educational strategies are effectively tailored to meet these dynamics.

Social Loafing and Group Dynamics

Social loafing, where individuals exert less effort in a group compared to working alone [2], presents a significant challenge in collaborative settings [3]. Understanding this phenomenon is crucial for designing SEL survey items that accurately measure student engagement and identify strategies to counteract social loafing.

Technology-Supported Group Dynamics

Research by Chidambaram and Tung (2005) highlights the influence of group size and physical setup (collocation vs. distribution) on individual contributions within technology-supported groups [4]. These insights inform the development of SEL items that capture how virtual and physical group interactions affect student dynamics in STEM settings.

Equitable Group Dynamics

Cohen et al. emphasize the critical role of equitable access and relationships within cooperative learning environments. Their approach through Complex Instruction (CI) demonstrates how educational strategies can ensure all students have equal opportunities to participate and succeed. Principles of CI are integrated into the SEL survey and observation instrument design, focusing on measuring equity in participation and the impact of diverse instructional strategies on group dynamics [5].

Feedback and Motivation

Research on the Köhler effect by Kerr et al. (2005) highlights the importance of performance feedback in motivating group members [6]. This guides the inclusion of survey and observation items that assess how different feedback mechanisms in STEM PBL settings influence motivation and group performance.

Supportive Educational Climates

A supportive educational climate, characterized by open communication, trust, and mutual respect, is fundamental to successful group learning [7,8]. SEL survey and observation instrument include items that evaluate the emotional and social climates of STEM PBL environments, assessing their influence on learning outcomes and student well-being.

Promoting Academic Success and Cultural Competence

Group work dynamics significantly impact academic success. Structured group dynamics and clear communication of roles can enhance performance through motivational gains such as the Köhler effect [6,3]. Inclusive practices that foster equitable participation are crucial in diverse settings, enhancing problem-solving and innovation [9].

Social Emotional Wellbeing

The emotional and social well-being of students in group settings is paramount, impacting their ability to collaborate effectively and innovate [10,11]. SEL surveys must measure these aspects to support collaborative learning effectively in STEM PBL environments. The observation instruments can provide formative feedback on how to promote a supportive collaborative learning environment.

These elements illustrate the intricate interplay between group dynamics, social emotional learning, and educational outcomes. They emphasize the necessity of developing SEL survey items that capture the diverse experiences and challenges students face in STEM PBL activities, ensuring educational strategies are tailored to meet these dynamics.

Methodology

Overview

This study evaluated Social Emotional Learning (SEL) components using the competencies defined by the Collaborative for Academic, Social, and Emotional Learning (CASEL). Data was gathered from 1,974 students in grades 2-12, participating in small group STEM teams across various school levels, from elementary to high school.

Participants

  The following tables provide demographic information about the participants. Table 1 presents the racial distribution of elementary, middle, and high school students, while Table 2 summarizes the gender distribution for these groups.

Table 1.

Racial Distribution of Survey Participants by Levels

		White	Black	Asian	Native American	Hispanic	Multi-Racial
Elementary	360	83	81	3	14	29	137
Middle	1065	233	214	11	33	161	397
High	501	136	144	7	17	69	123
Totals	**1926**	**452**	**439**	**21**	**64**	**259**	**657**

Table 2.

Gender Distribution of Survey Participants by Levels

	Male	Female	Other/Rather not say
Elementary	158	186	16
Middle	469	539	53
High	192	277	30
Totals	**819**	**1002**	**99**

Data Collection Procedures

  Students were surveyed using instruments designed to capture SEL constructs relevant to small group dynamics in STEM settings. The items were designed to capture CASEL competencies. Qualitative observations supplemented the survey data to provide a richer understanding of student interactions.

Instrumentation

  After a thorough review of supporting literature and identifying SEL items, the research team defined the behaviors and social dynamics to be observed in STEM PBLs, ensuring alignment with established research constructs. Leveraging this research, we developed a multifaceted observation instrument to capture these specific behaviors and dynamics, rigorously assessing interrater reliability.

  The instrument documents characteristics of group project dynamics, categorized into key criteria: Performance Boosting, Attitudes and Beliefs toward Problem-Solving, Inclusive Culture, and

Supportive Climate. Each criterion is explicitly defined, highlighting appropriate assignments, perseverance in problem-solving, expanding opportunities for participation, and respectful treatment of diverse ideas and approaches.

Structured on a 4-point scale, the instrument provides meaningful insights and ensures reliability. After extensive review and modifications by the researchers, school system STEM PBL teachers, and project administrative staff, it achieved a robust interrater reliability exceeding 80% for observing grades 5 - 8.

Observation Instrument Description

To effectively assess SEL constructs within STEM PBL environments, we developed a comprehensive observation instrument. It captures nuanced group dynamics and interactions, aligning observed behaviors with SEL elementary and middle school constructs.

Purpose and Design. The instrument documents specific characteristics of group dynamics, focusing on behaviors and interactions that promote SEL and foster a supportive climate. Following are the key criteria:

- **Performance Boosting**
  - Appropriate Assignments: Evaluates task focus and cognitive control.
  - Enhancing Performance: Assesses support for members struggling with tasks.
  - Promoting Social Cohesion: Observes teamwork and emotional support.
- **Attitudes and Beliefs Toward Problem-Solving**
  - Willingness to Solve Problems
  - Measures curiosity and proactive solution-seeking.
  - Perseverance: Evaluates persistence in overcoming challenges.
  - Improving Problem-Solving Skills: Assesses collaborative efforts to enhance skills.
- **Fairness, Diversity, and Inclusion**
  - Expanding Opportunities for Participation: Observes equal engagement from all members.
  - Bringing Diverse People Together: Evaluates integration of diverse perspectives.
- **Supportive Climate**
  - Respecting Different Ideas and Approaches: Measures respect for and integration of various ideas.
  - Respecting Perseverance and Risk-Taking: Observes support for creativity and resilience.
  - Reflecting on Progress: Evaluates the depth of reflections on group progress.

Scoring System

The instrument uses a 4-point scale:

- **Observed as a Primary Attribute**
- **Observed Moderately**
- **Observed Rarely**
- **Not Observed**

This scale allows for a nuanced evaluation of group dynamics. The instrument describes what would be observed for reach rating.

Validation and Reliability

Extensively reviewed and modified by the research team, STEM PBL teachers, and project administrative staff, the instrument was validated with interrater reliability exceeding 80%, ensuring consistent application by different observers.

Guidelines for Observers

Observers receive detailed guidelines, a 30-minute observation framework, and a comprehensive Data Collection Form. An online version of the form was available to ease recording and data capture. They rate each criterion based on observations, carefully noting supporting evidence. This structured approach ensures systematic and grounded observations.

Implementation

School system staff used the instrument to assess small-group STEM activities during summer camps and the regular school year, providing valuable feedback to educators to monitor and enhance supportive climates.

Analysis Procedures

Analytical Approach

A mixed-methods approach was employed, combining qualitative observations with quantitative survey data. SEL-focused survey items were designed to reflect both general CASEL competencies and specific attributes relevant to small group dynamics in STEM settings. Data analysis of survey items used both classical and Rasch measurement theories, employing Winsteps software. The classical test theory, known for its reliability but limited by item dependence, was complemented by the Rasch measurement model. This model, independent of item count, provided detailed analysis of item-separation and person-separation reliability. Results showed strong reliability for our SEL survey instruments, with the Rasch model indicating a person reliability score of .84 and an item reliability of .99, while the classical model yielded a Cronbach's alpha of .87.

Confirmatory Factor Analysis (CFA)

CFA was performed using Jamovi to validate the alignment of SEL items with the CASEL framework within STEM PBL contexts. The residual correlation matrix from CFA revealed discrepancies, suggesting that some items did not align as expected. These misalignments, influenced by the unique dynamics of small group interactions in STEM settings, prompted further investigation.

Exploratory Factor Analysis (EFA)

To address these inconsistencies, EFAs were conducted separately for elementary, middle, and high school students. Principal Axis extraction and Varimax rotation were used, with the number of factors determined by parallel analysis. The Kaiser-Meyer-Olkin (KMO) test values were greater than 0.870, and Bartlett's test of sphericity was significant at $p<.001$ for all samples, confirming their suitability for factor analysis. The EFA identified four distinct components for elementary, middle, and high school students.

Results

Detailed presentation of the statistical results for each level follow.

High School Results

The following section presents the results of the high school analysis. Table 3 provides the exploratory factor analysis (EFA) results, including the items and their corresponding factor loadings. Figure 1 illustrates the scree plot used to determine the number of factors retained for the analysis. Finally, Table 4 reports the Cronbach's alpha values for each of the high school Social and Emotional Learning (SEL) components, demonstrating the reliability of the identified factors.

Table 3.

High School EFA Items and Factor Loadings

Items	Factor loadings	Uniqueness
Component 1: Persistence and Self-Management		
If I don't understand something at first, I keep trying.	0.616	0.373
I am easily distracted when doing my schoolwork.	-0.573	0.603
I listen carefully to directions.	0.552	0.639
When I don't understand something, I ask questions and keep trying.	0.415	0.648
Component 2: Teamwork and Positive Interactions		
I feel like I am part of a team when I am working with other students.	0.542	0.561
I try to do my share when I am working or playing with another student.	0.496	0.691
I compliment others when they do something well.	0.481	0.707
Component 3: Social Fit and Emotional Well-being		

Items	Factor loadings	Uniqueness
I feel like I fit in at my school.	0.731	0.392
I am usually in a good mood.	0.545	0.579
Component 4: Self-Awareness		
I notice how my feelings affect how I act.	0.43	0.798
I know what I am good at and what is hard for me.	0.421	0.754

Figure 1.

High School Scree-Plot
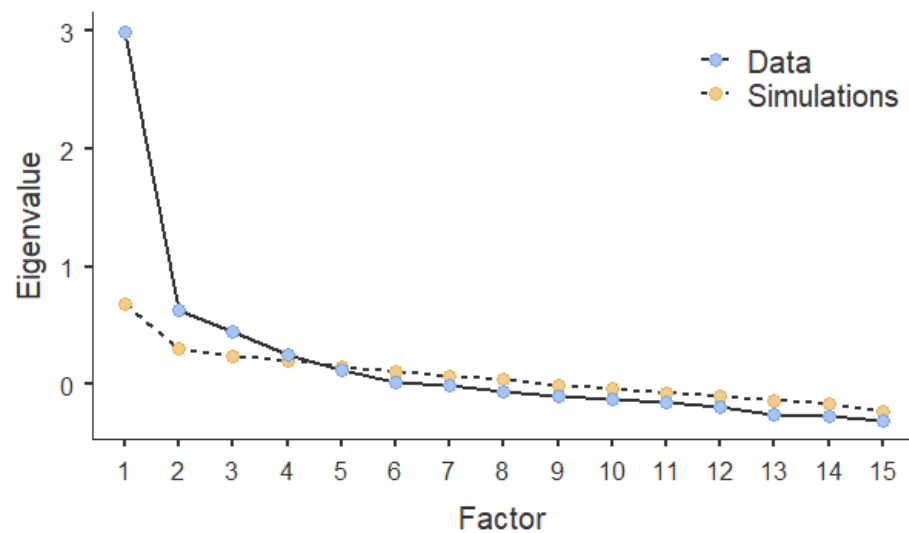
Table 4.

Cronbach's Alpha for High School SEL Components

Factor	Cronbach's α
Component 1: Persistence and Self-Management	0.611
Component 2: Teamwork and Positive Interactions	0.564
Component 3: Social Fit and Emotional Well-being	0.639
Component 4: Self-Awareness	0.337

Middle School Results

The following section presents the results of the middle school analysis. Table 5 summarizes the exploratory factor analysis (EFA) results, displaying the items and their corresponding factor loadings. Figure 2 shows the scree plot used to determine the number of factors retained for the analysis. Table 6 provides the Cronbach's alpha values for each of the middle school Social and Emotional Learning (SEL) components, highlighting the reliability of the identified factors.

Table 5.

Middle School EFA Items and Factor Loadings

Items	Factor loadings	Uniqueness
Component 1: Learning Engagement and Self-Management		
If I don't understand something at first, I keep trying.	0.625	0.516
Learning new things is fun.	0.522	0.642
When I don't understand something, I ask questions and keep trying.	0.516	0.665
I listen carefully to directions.	0.454	0.616
I care about getting good grades.	0.426	0.693
Component 2: Social Integration and Emotional Regulation		
I feel like I fit in at my school.	0.696	0.474
I am usually in a good mood.	0.56	0.6
I feel like I am part of a team when I am working with other students.	0.547	0.57
Component 3: Cooperative Behavior		
I try to do my share when I am working or playing with another student.	0.529	0.603
I compliment others when they do something well.	0.466	0.664
I notice how my feelings affect how I act.	0.46	0.717
My friends and I enjoy sharing some interests, but also have some separate interests.	0.452	0.784
Component 4: Attention Regulation		
I am easily distracted when doing my schoolwork.	-0.521	0.644

The EFA for middle school students showed the factor "Attention Regulation" emerged with only a single item: "I am easily distracted when doing my schoolwork." Despite the lack of multiple items to calculate Cronbach's alpha, we decided to retain this item due to its importance in understanding student behavior and its unique contribution to our analysis. This item provides valuable insights into attention regulation, a critical aspect of student performance that does not correlate with other constructs in our study. Retaining this single item allows us to highlight its significance and guide future research efforts to develop additional items for a more comprehensive assessment.

Figure 2.

Scree Plot -Middle School
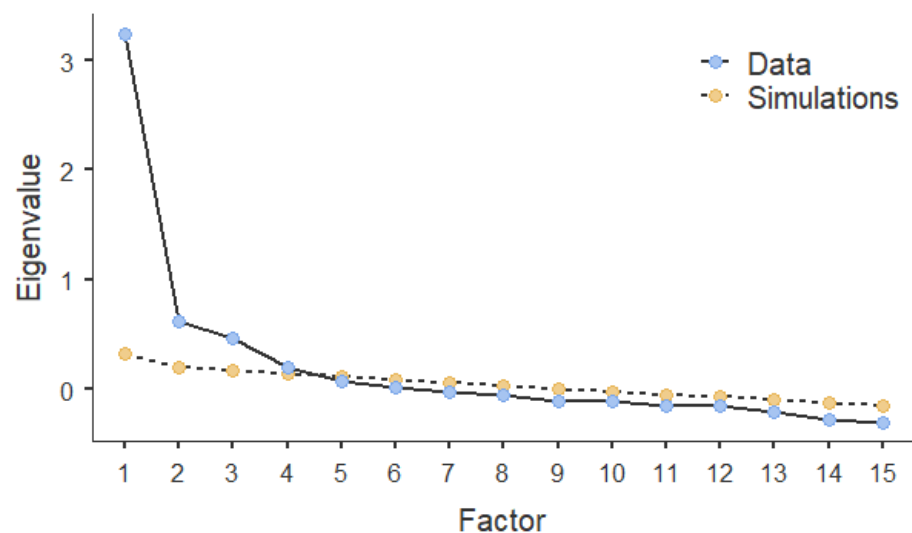

Table 6.

Cronbach's Alpha for Middle School SEL Components

Factor	Cronbach's α
Component 1: Learning Engagement and Self-Management	0.726
Component 2: Social Integration and Emotional Regulation	0.678
Component 3: Cooperative Behavior	0.580
Component 4: Attention Regulation	-

Elementary School Results

      The following section presents the results of the elementary school analysis. **Table 7** details the exploratory factor analysis (EFA) results, including the items, their corresponding factor loadings, and measures of uniqueness. **Figure 3** displays the scree plot used to determine the number of factors retained for the analysis. **Table 8** reports the Cronbach's alpha values for each of the elementary school Social and Emotional Learning (SEL) components, demonstrating the reliability of the identified factors.

Table 7.

Elementary School EFA Items and Factor Loadings

Items	Factor loadings	Uniqueness
Component 1: Social Engagement and Emotional Well-being		
I feel like I fit in at my school.	0.668	0.518
I feel like I am part of a team when I am working with other students.	0.559	0.53
I am usually in a good mood.	0.533	0.634
Learning new things is fun.	0.414	0.629
Component 2: Persistence and Peer Interaction		
I listen carefully to directions.	0.665	0.41
If I don't understand something at first, I keep trying.	0.632	0.397
When I don't understand something, I ask questions and keep trying.	0.482	0.589
Sometimes I make fun of other people so I will fit in.	-0.407	0.832
Component 3: Collaborative Efforts		
I compliment others when they do something well.	0.508	0.66
I try to do my share when I am working or playing with another student.	0.444	0.738
Component 4: Self-Awareness and Academic Motivation		
I notice how my feelings affect how I act.	0.603	0.604
I care about getting good grades.	0.411	0.717

Figure 3.

Scree Plot -Elementary School
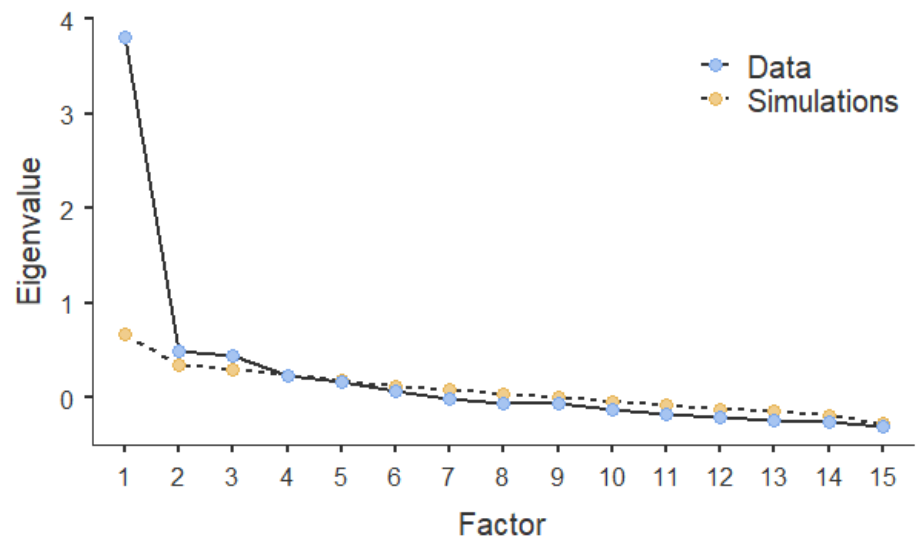

Table 8.

Cronbach's Alpha for Elementary School SEL Components

Factor	Cronbach's α
Component 1: Social Engagement and Emotional Well-being.	0.694
Component 2: Persistence and Peer Interaction	0.693
Component 3: Collaborative Efforts	0.458
Component 4: Self-Awareness and Academic Motivation	0.452

Discussion

Interpretation of Results

The distinct SEL constructs identified at different educational levels highlight the importance of tailored interventions. Elementary-level findings emphasize fostering social engagement and emotional well-being, while high school-level findings prioritize the development of self-awareness and self-management skills. These differences suggest that SEL strategies should be adapted to the developmental stages and needs of students. For instance, mindfulness programs may be more effective for younger students, promoting emotional regulation and social connection, whereas resilience training and self-management workshops may benefit older students preparing for complex academic and social challenges.

Implications for Practice

Curriculum Design

Integrating SEL components into STEM PBL activities can significantly enhance both social-emotional and academic outcomes. Collaborative problem-solving tasks offer opportunities for students to build teamwork, persistence, and communication skills. Curriculum designers should embed SEL objectives into lesson plans, ensuring activities promote empathy, collaboration, and perseverance. Regular reflections on group dynamics and individual contributions can further reinforce these skills and foster continuous improvement.

Professional Development

Educators are pivotal in fostering SEL within STEM PBL settings. Effective professional development programs should focus on equipping teachers with strategies for facilitating group work, offering constructive feedback, and creating inclusive and equitable learning environments. Workshops can introduce practical tools like the observation rubric developed in this study, enabling educators to integrate SEL into their teaching practices effectively.

Limitations

While this study provides valuable insights, there are notable limitations. First, the sample, while diverse, may not fully represent the variability in STEM PBL environments across different regions or demographic groups. Second, the study's reliance on observational and self-reported data could introduce biases that affect the interpretation of results. Finally, the instruments, though validated, may require further refinement to address the nuanced differences in SEL dynamics across varying educational settings.

Future Research

Future research should investigate the longitudinal impact of tailored SEL interventions on both social-emotional and academic outcomes. Long-term studies could track SEL skill development and its influence on group dynamics and academic success over time. Additionally, exploring the role of technology in supporting SEL in virtual or hybrid learning environments is critical. Digital tools designed to enhance collaboration and SEL skills in online settings are increasingly relevant as educational practices evolve.

Conclusion

This study identifies distinct SEL constructs across educational levels within STEM PBL settings, underscoring the need for tailored SEL strategies. By providing validated tools for assessing SEL and documenting critical factors, this research equips educators with practical methods to enhance SEL, fulfill grant accountability requirements, and foster effective group dynamics. These findings contribute to the broader understanding of SEL in group settings and offer actionable insights for educators and curriculum developers. Continued research, particularly longitudinal studies and investigations into the role of technology in virtual learning, will be essential to advancing the field and supporting student success in STEM education.

Citations

[1] Ross, K. M., & Tolan, P. (2018). Social and emotional learning in adolescence: Testing the CASEL model in a normative sample. *Journal of Early Adolescence, 38*(8), 1170–1199.

[2] Spires, H. A., Hervey, L. G., Morris, G. A., & Stelpflug, C. (2008). Energizing project-based inquiry: Middle-grade students read, write, and create videos. *Journal of Adolescent & Adult Literacy, 51*(6), 478–486.

[3] Cherry, K. (2020). How social loafing is studied in psychology. Retrieved from https://www.verywellmind.com/what-is-social-loafing-2795883#citation-3

[4] Chidambaram, L., & Tung, L. L. (2005). Is out of sight, out of mind? An empirical study of social loafing in technology-supported groups. *Information Systems Research, 16*(2), 149–168.

[5] Cohen, E. G., Lotan, R. A., Scarloss, B. A., & Arellano, A. R. (n.d.). Equity in cooperative learning classrooms. Retrieved from https://complexinstruction.stanford.edu/about/Equity-in-Cooperative-Learning-Classrooms

[6] Kerr, N. L., Messé, L. A., Park, E. S., & Sambolec, E. J. (2005). Identifiability, performance feedback and the Köhler effect. *Group Processes & Intergroup Relations, 8*(4), 331–354.

[7] Hammar Chiriac, E., Lindblad, A. C., & Svensson, L. (2021). The effect of group dynamics, collaboration, and tutor style on the perception of profession-based stereotypes: A quasi-experimental pre- post-design on interdisciplinary tutorial groups.

[8] Zins, J. E., & Elias, M. J. (2007). Social and emotional learning: Promoting the development of all students. *Journal of Educational and Psychological Consultation, 17*(2–3), 233–255.

[9] Eddy, S. L., & Hogan, K. A. (2017). Getting under the hood: How and for whom does increasing course structure work? *CBE—Life Sciences Education, 14*(3), ar36. https://www.lifescied.org/doi/10.1187/cbe.14-03-0050

[10] McClellan, D. E., & Katz, L. G. (1992). Assessing the Social Development of Young Children.

[11] McClellan, D. E., & Katz, L. G. (2001). Assessing Young Children's Social Competence. Urbana, IL.

Appendices
Appendix A: Survey Items and Observation Instrument

The following items comprise each component. The survey was a five choice Likert scale.

High School (EFA-High)

- **Component 1: Persistence and Self-Management**
  - When I don't understand something, I ask questions and keep trying.
  - If I don't understand something at first, I keep trying.
  - I listen carefully to directions.
  - I am easily distracted when doing my schoolwork.
  - **CASEL Competency:** Self-Management and Responsible Decision-Making.
- **Component 2: Teamwork and Positive Interactions**
  - I feel like I am part of a team when I am working with other students.
  - I try to do my share when I am working or playing with another student.
  - I compliment others when they do something well.
  - **CASEL Competency:** Relationship Skills and Social Awareness.
- **Component 3: Social Fit and Emotional Well-being**
  - I feel like I fit in at my school.
  - I am usually in a good mood.
  - **CASEL Competency:** Social Awareness and Self-Management.
- **Component 4: Self-Awareness**
  - I know what I am good at and what is hard for me.
  - I notice how my feelings affect how I act.
  - **CASEL Competency:** Self-Awareness.

Middle School (EFA-Middle)

- **Component 1: Learning Engagement and Self-Management**
  - When I don't understand something, I ask questions and keep trying.
  - If I don't understand something at first, I keep trying.
  - I listen carefully to directions.
  - Learning new things is fun.
  - I care about getting good grades.
  - **CASEL Competency:** Self-Management and Responsible Decision-Making.
- **Component 2: Social Integration and Emotional Regulation**
  - I feel like I am part of a team when I am working with other students.
  - I feel like I fit in at my school.
  - I am usually in a good mood.
  - **CASEL Competency:** Relationship Skills and Social Awareness.
- **Component 3: Cooperative Behavior**
  - I try to do my share when I am working or playing with another student.
  - I compliment others when they do something well.
  - I notice how my feelings affect how I act.
  - My friends and I enjoy sharing some interests, but also have some separate interests.
  - **CASEL Competency:** Relationship Skills and Self-Awareness.

- **Component 4: Attention Regulation**
  - I am easily distracted when doing my schoolwork.
  - **CASEL Competency:** Self-Management.

Elementary School (EFA-Elem)

- **Component 1: Social Engagement and Emotional Well-being**
  - Learning new things is fun.
  - I feel like I am part of a team when I am working with other students.
  - I feel like I fit in at my school.
  - I am usually in a good mood.
  - **CASEL Competency:** Social Awareness, Relationship Skills, and Self-Management.
- **Component 2: Persistence and Peer Interaction**
  - When I don't understand something, I ask questions and keep trying.
  - If I don't understand something at first, I keep trying.
  - I listen carefully to directions.
  - Sometimes I make fun of other people so I will fit in.
  - **CASEL Competency:** Responsible Decision-Making and Relationship Skills.
- **Component 3: Collaborative Efforts**
  - I try to do my share when I am working or playing with another student.
  - I compliment others when they do something well.
  - **CASEL Competency:** Relationship Skills.
- **Component 4: Self-Awareness and Academic Motivation**
  - I notice how my feelings affect how I act.
  - I care about getting good grades.
  - **CASEL Competency:** Self-Awareness and Responsible Decision-Making.

Evaluation Rubric

Date:_____   Observer: _____

Assignment: _____

Group Members: _____
_____

_____

_____

1. Performance Boosting: Performance among group members can be enhanced if social loafing is avoided and team members are given appropriate assignments. Evaluation and feedback can also boost students to perform better.				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
1a. Appropriate assignments	All members effectively focused on their tasks, showing strong cognitive control and minimal distractions.	Most members managed their tasks well but occasionally got distracted.	Some confusion and distractions were evident, affecting task engagement.	Widespread disengagement and confusion due to poorly defined roles and distractions.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

1. Performance Boosting: Performance among group members can be enhanced if social loafing is avoided and team members are given appropriate assignments. Evaluation and feedback can also boost students to perform better.				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
1b. Enhancing performance of group members for whom these tasks were not among their strengths	Group dynamics facilitated a focused and supportive setting, enabling all members to understand and engage deeply with their tasks.	Most members were engaged and clear on their responsibilities, with assistance readily offered to those needing help to focus on their tasks.	Focus was uneven across the group, with some members predominantly handling tasks while others struggled without sufficient support to engage fully.	Lack of clear task assignments and support led to poor engagement, with some members disengaged from the project entirely.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

1. Performance Boosting: Performance among group members can be enhanced if social loafing is avoided and team members are given appropriate assignments. Evaluation and feedback can also boost students to perform better.				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
1c. Promoting social cohesion	Group members exhibited excellent teamwork, with everyone actively participating and supporting one another. The environment was characterized by a strong sense of belonging and mutual emotional support.	Most group members displayed good teamwork, sharing ideas and offering support, though not consistently across all members. The group environment was moderately positive and supportive.	Members of the group tolerated each other but interacted very little. There was limited collaborative engagement. Interactions were infrequent, mostly focusing on task completion without fostering a supportive or positive environment.	Group members worked independently without collaboration. There was no evidence of teamwork or emotional support, leading to a disjointed group dynamic.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

2. Attitudes and beliefs toward problem-solving				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
2a. Showing a Willingness to Solve the Problem	Members displayed high curiosity, actively seeking solutions and helping others.	Engagement in problem-solving was present but not consistent; some members sought help.	Reluctance to engage in problem-solving, with minimal attempts to seek solutions.	Complete avoidance of problem-solving tasks.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

2. Attitudes and beliefs toward problem-solving				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
2b. Persevering To Find A Solution To A Problem	Group members persistently worked through challenges until solutions were found.	Some perseverance was noted; members tried to solve problems but sometimes gave up.	Minimal effort was made to persist in solving problems.	No attempts were made to address or resolve problems.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

2. Attitudes and beliefs toward problem-solving				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
2c. Improving Ability To Solve Problems	Members actively collaborated to enhance problem-solving skills, sharing insights and learning from each other.	Some members contributed to problem-solving, but assistance was inconsistent.	Little to no collaborative problem-solving occurred; members mostly worked in isolation.	There was no engagement in collaborative problem-solving or sharing of strategies.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

3. Fairness, Diversity, and Inclusion: Students from different demographic groups should be able to work well together and learn from their diversity				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
3a. Expanding Opportunities For Everyone To Participate	All members were fully engaged, with equal opportunities to contribute to decision-making, reflecting strong interpersonal competence.	Most group members participated, but opportunities to contribute were uneven, with some members taking a more passive role.	Few members dominated the discussions and decisions, with little effort made to include others or balance participation.	Several group members were consistently excluded from contributing, showing a clear lack of fairness in participation.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

3. Fairness, Diversity, and Inclusion: Students from different demographic groups should be able to work well together and learn from their diversity				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
3b. Bringing Diverse People Together	Vibrant and effective integration of diverse views actively enriches discussions and decision-making.	Occasional exchange of diverse ideas, though not fully engaging all members.	Limited efforts to integrate diverse perspectives, resulting in minimal interaction.	Homogeneity in interactions with no visible attempt to incorporate diverse perspectives.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

4. Supportive climate: A supportive climate with group cohesion emerges when students practice openness, trust, support, and respect.				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
4a. Respecting Different Ideas And Approaches	All ideas were actively respected, discussed, and integrated into group activities, fostering a highly inclusive and innovative environment.	Most ideas were respected and considered, though some ideas were less explored.	Some ideas were overlooked or not given enough attention, leading to a lack of inclusivity.	Ideas were dismissed or ignored, leading to a negative group atmosphere.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

4. Supportive climate: A supportive climate with group cohesion emerges when students practice openness, trust, support, and respect.				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
4b. Respecting Perseverance And Risk-Taking	Group members consistently supported and encouraged each other's efforts and risk-taking, celebrating creativity and resilience.	Support for perseverance and risk-taking was evident but not consistently applied to all group members.	Support for extended effort and new ideas was limited and not encouraged.	There was a general disregard for perseverance and innovative thinking, hindering group progress and cohesion.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

4. Supportive climate: A supportive climate with group cohesion emerges when students practice openness, trust, support, and respect.				
	Observed that this was a primary attribute	**Observed Moderately**	**Observed Rarely**	**Not observed**
4c. Reflecting On The Progress	Regular, structured reflections on progress; members openly discuss their strengths and challenges, facilitating mutual learning.	Occasional reflections on progress, though lacking consistent depth across the group.	Infrequent reflections, with minimal insights shared or discussed.	No reflections or discussions on progress; members work in isolation without feedback.
Check appropriate box	☐	☐	☐	☐
Examples or Notes				

The following tables provide detailed insights into the fit of our SEL items within the CASEL framework and help identify specific areas where the model alignment can be improved.

Table B1

Residuals for Observed Correlation Matrix (High School)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Q1		0.059	-0.027	0.003	-0.02	-0.021	-0.013	0.009	0.026	0.002	-0.064	-0.023	0.169	0.082	-0.014
Q2			0.013	-0.041	-0.007	-0.012	0.002	0	-0.059	0.067	0.009	0.007	0.037	0.056	-0.008
Q3				0.036	-0.014	0.004	-0.031	-0.039	0.093	0.145	0.013	-0.058	0.008	-0.037	-0.057
Q4					-0.01	-0.052	-0.025	-0.114	0.169	0.102	-0.074	-0.081	0.121	0.022	-0.027
Q5						0.079	0.041	-0.028	-0.079	0.014	-0.007	-0.014	0.068	0.083	0.07
Q6							0.019	0.03	-0.01	-0.03	-0.007	-0.028	-0.031	-0.04	-0.048
Q7								-0.061	-0.015	-0.004	0.023	0.009	0.022	0.067	0.047
Q8									0.037	-0.002	-0.02	0.044	-0.028	0.07	-0.023
Q9										0.241	-0.087	-0.044	0.088	-0.017	0.004
Q10											-0.036	-0.077	0.011	-0.098	-0.018
Q11												0.037	-0.144	-0.013	-0.018
Q12													-0.029	0.052	0.052
Q13														0.134	0.113
Q14															0.001

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Q15															

Residuals for Observed Correlation Matrix (Middle School)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Q1		0.051	-0.018	0.011	0.034	-0.062	-0.039	-0.002	-0.071	-0.068	0.002	-0.032	0.15	0.06	0.027
Q2			0.017	-0.04	0.008	-0.051	-0.056	-0.014	-0.055	0.051	-0.003	-0.015	0.067	0.013	-0.007
Q3				0.07	-0.05	0.026	0.051	-0.021	0.177	0.129	-0.042	0.002	0.008	-0.086	-0.051
Q4					0.014	-0.014	0.001	-0.102	0.021	-0.03	-0.101	-0.032	0.139	0.046	-0.004
Q5						0.023	0.063	0.008	-0.103	0.002	-0.002	0.014	0.1	0.083	0.027
Q6							-0.008	0.03	0.03	-0.066	-0.023	0.051	-0.039	-0.023	-0.02
Q7								-0.019	-0.02	0.02	-0.019	0.009	0.035	-0.018	0.038
Q8									-0.006	-0.071	0.041	-0.002	-0.053	0.011	0.008
Q9										0.189	-0.072	-0.053	0.036	-0.088	0.07
Q10											-0.022	-0.077	-0.008	-0.082	0.03
Q11												0.054	-0.121	-0.061	0.076
Q12													0.012	-0.027	0.082
Q13														0.169	0.126
Q14															0.001
Q15															

Residuals for Observed Correlation Matrix (Elementary School)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
Q1		0.062	0.008	0.055	0.047	-0.031	-0.031	-0.019	-0.023	-0.005	-0.06	-0.025	0.168	-0.017	0.08
Q2			-0.004	0.099	0.098	-0.046	-0.002	0.068	-0.032	0.058	-0.01	-0.079	0.123	0.021	-0.017
Q3				0.094	-0.022	-0.029	0.055	-0.049	0.077	0.094	0.008	-0.026	-0.053	-0.015	-0.022
Q4					-0.011	-0.09	-0.026	-0.017	0.024	-0.041	-0.186	-0.14	0.152	0.024	-0.037
Q5						0.028	-0.015	0.013	-0.112	-0.035	0.056	-0.032	0.123	0.041	0.011
Q6							0.009	-0.05	-0.023	-0.037	0.029	0.058	0.044	-0.045	0.007
Q7								0.042	0.037	0.034	-0.064	-0.008	0.012	0.004	-0.039
Q8									-0.022	-0.057	0.009	-0.011	0.026	0.138	0.032
Q9										0.157	-0.091	-0.013	-0.091	0.064	-0.021
Q10											-0.052	-0.015	-0.011	-0.032	0.027
Q11												0.006	-0.11	-0.012	0.013
Q12													0.009	-0.061	0.036
Q13														-0.002	0.129
Q14															0.001
Q15															

Question Key

Question	Item
Q1	My friends and I enjoy sharing some interests, but also have some separate interests.
Q2	I try to do my share when I am working or playing with another student.
Q3	I feel like I am part of a team when I am working with other students.
Q4	Sometimes I make fun of other people so I will fit in.
Q5	I compliment others when they do something well.
Q6	When I don't understand something, I ask questions and keep trying.
Q7	Learning new things is fun.
Q8	I care about getting good grades.
Q9	I feel like I fit in at my school.
Q10	I am usually in a good mood.
Q11	I listen carefully to directions.
Q12	If I don't understand something at first, I keep trying.
Q13	I am easily distracted when doing my schoolwork.
Q14	I notice how my feelings affect how I act.
Q15	I know what I am good at and what is hard for me.