Measuring Peer Collaboration Among Secondary School Students: Instrument Development And Validation

Pooja Jaswal and Biswajit Behera

This study aims to create and validate a scale that measures peer collaboration among secondary school students. The study had three objectives: 1) to identify the constructs of collaboration, 2) to develop a collaboration scale, and 3) to validate the collaboration scale. The study included 363 9th-grade students, and after an extensive literature review, it identified four constructs of collaboration: social interdependence, conflict resolution, cooperation, and sharing of resources. The consistency between these constructs was found to be positive. The scale reliability was established with a Cronbach's alpha coefficient of 0.768 and a test-retest reliability coefficient of 0.71. The content validity of the scale was also established with a Cohen kappa coefficient of 0.66. The study found that differences between boys and girls can be determined by obtaining standard scores on the collaboration scale. This new collaboration scale will be a useful tool for practitioners who use constructivist pedagogy to measure collaboration.

KEYWORDS: Social Interdependence, Conflict Resolution, Cooperation, Sharing of Resources, Peer Collaboration, Measurement Scale

Introduction

The goal of learning is not only the cognitive development of the child but also the building of cooperation and interpersonal relationships. This focuses on the well-rounded development of an individual who is equipped with

Pooja Jaswal ✉
Department of Education, Central University of Punjab, Bhatinda, India.
Email: jaswalpooja89@gmail.com. ORCID: https://orcid.org/0000-0001-6865-683X

Biswajit Behera
Associate Professor, Division of Educational Research, NIE, NCERT, New Delhi, India.
Email: biswajit70behera@gmail.com. ORCID: https://orcid.org/0000-0001-5994-9219

21st-century skills. Ministry of Human Resource Development, Government of India (2020) has suggested for promotion of students' 21st-century skills in classrooms through assessment, review, and analysis of knowledge for holistic development. 21st-century skills include collaboration, communication, discussion, and debate skills in the classroom. Nevertheless, one of the sustainable development goals (SDG) focusing on education is visualizing all to the 21st-century literate. This will help us to develop sustainably. One of the key objectives of SDG is to develop collaboration among learners during group learning. Collaboration is the skill of learning from others, understanding and respecting the needs, perspectives, and actions of others, and dealing with conflicts with others in a group (Rieckmann, 2017). It provides an opportunity for students to demonstrate and develop their learning.

Learners learn better in small groups (Downey et al., 2012). Small group learning allows them to plan and organize different aspects of learning tasks collaboratively. The common form of group learning is collaborative learning (Blumenfeld et al., 1996). Collaboration occurs when two or more individuals work together to achieve long-term and interdependent goals Mccormack and Smith-Tamaray (2018). When peers are working together, they use different strategies, receive help from their peers and it helps to resolve their issues in the group. Students' capabilities, strengths, interests, and weaknesses are shared with others during group learning. In small group learning, they argue with each other's work, they learn to respect their disagreements by exchanging thoughts, their understanding deepens, they appreciate each other's questions, and peer collaboration is valued (Vriesema & Mccaslin, 2020). Collaboration promotes the exchange of various ideas and develops a sense of community. Learners who participate in small group classrooms have a higher sense of community, trust among each other, and faith in the group members (Wendt & Rockinson-Szapkiw, 2015). They recognize the importance of tasks and goals and thus, peer learning is enhanced (Papanikolaou & Boubouka, 2010). Hence, Peer collaboration is also a type of small-group learning.

Peer Collaboration

Peer collaboration is a process by which learners work together on a collective task (Fawcett & Garton, 2005). A problem-based task is posed during group learning where members interactively contribute towards the solution of the task. Interactions in the group involve a long series of discussions among peers and teachers which help to develop the cognitive understanding of students (Setianingsih & Suparno, 2019). Interactions guide the group in the peer collaboration process. Peer collaboration enables one to discuss, defend, modify and actively seek solutions during disagreements in a peaceful manner. It also helps to integrate other children's ideas, modify their ideas, and ask for

clarification and explanation (Asterhan & Schwarz, 2009). There is a scope of cognitive benefits of peer interactions in the development of knowledge. According to Fawcett and Garton (2005), peer collaboration leads to develop cognitive development of students. Peer collaboration helps to improve the learning potential of students through group interactions.

Peer Collaboration is one of the effective techniques in a classroom to help students achieve their best (Swenson & Strough, 2008). Collaboration develops the student's ability to think both independently and with others, enabling them to consider a wide range of perspectives. The interaction process allows students to think for themselves. The appropriate interaction involves a search for and use of information, asking questions, clarifying issues, evaluating the credibility of sources of information, thinking precisely, and discussing different opinions in the group. Thus, Peer collaboration engages students in a community of inquiry. Learner-learner interaction engages active interaction between peers such as answering questions, social greetings, and acknowledgement (Engwall & Lopes, 2020). Task-related interaction in the small group gives students a chance to interact with their peers, explain how to solve the problem, and allow others to show their understanding of the problem (Webb, 1991). The importance of peer collaboration in group learning is represented in Figure 1.
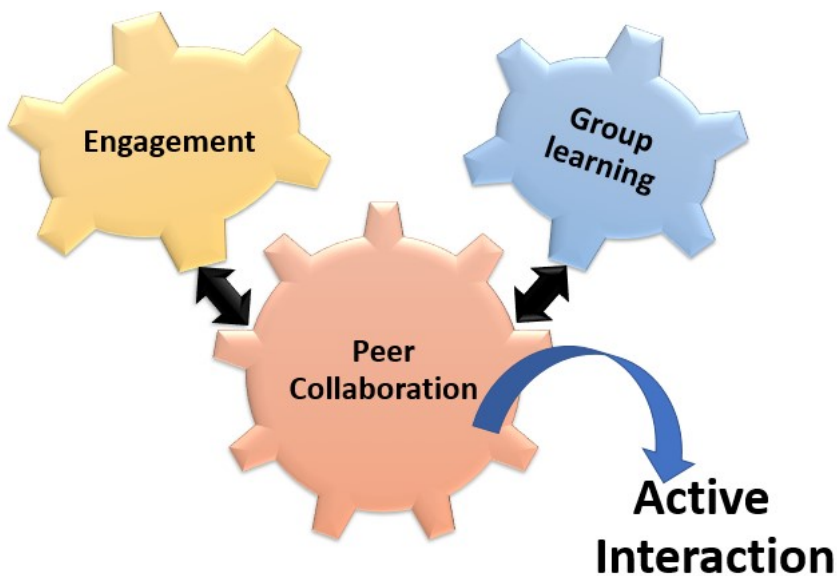

Figure 1. Peer Collaboration

Measures on Collaboration

Collaboration is an important variable in the success of group learning. Affection is the key constituent of collaborative learning. Its focus is on the affective development of individual members (Laurillard, 2012; Smith & Macgregor, 1992). The affective dimension includes attitude, interest, motivation, and other social skills. Laal (2013) considered that five elements are essential for collaborative learning. These are positive interdependence, promotive interaction, individual & group accountability, social skills, and group processing. Group learning brings a positive attitude among students as they collaborate; and promotes high academic achievement, positive interpersonal relationships, and social skills (Johnson et al., 2007). Collaborative learning addresses the diverse needs of the students involved in a group. It helps members to get along with their peers. When students work with their peers in collaborative learning it gives them a high level of intrinsic motivation and satisfaction (Sgro et al., 2020). Students practice collaborative learning by working together as a team. They build social relationships with their peers. Working together boosts to share their ideas and encourages friendship. This enables us to support the ideas of others. The interpersonal relationship grows in the form of assertiveness, sociability, excitement, openness to experience, agreeableness, and conscientiousness (Gensen, 2005). This enhances active engagement among the group members (Han & Son, 2020). The Constructs discussed in organizing adolescent collaboration are centred on the extent of encouragement associated with the interaction.

The Rationale of the Study

Twenty-first-century learning is connected to the skill of collaboration. There is an increasing understanding that collaboration, critical thinking, problem-solving, and communication skills need to be integrated into curricula to prepare the young for the global society. Darling-Hammond (2011) has emphasized the education system to shape the curriculum and instructions around problem-solving, critical thinking, and collaboration skills. The OECD's Program for International Student Assessment Organisation for Economic Co-operation and Development (OECD) (2016) has identified collaboration as a necessary skill for school students and their success in any workplace. Collaboration allows an effective division of work, integration of information, and gaining experiences from various sides Organisation for Economic Co-operation and Development (OECD) (2012) (PISA, 2012). The conventional system of education does not guarantee students' collaboration competencies of paying attention to others' opinions, concert with others and considering different suggestions in group work. As a result, group discussion among students is below average in both primary and secondary classrooms (Ross, 2008).

Students identify their common goal of learning during collaboration. The collaborative effort is considered an integral part of the shared work, shared accountability towards outcomes, and shared resources with materials (Friend, 2016).

Classroom learning with a focus on the creation of collaboration facilitates interaction. This focuses on team spirit among the group members. Team spirit is the most important aspect of collaboration Cayzer (2020). Socio-contextual perspectives of group learning focus on the enhancement of a reciprocal and mutually beneficial relationship. Secondary school students pass the period of adolescence. Students' collaboration characterizes the reciprocal processes involved in the interactions. Students' collaboration is significant in the social and personal context. Berg et al. (1998) reiterated that collaboration is working together, brainstorming, and negotiating. Positive behaviours like teamwork, sharing, listening to each other, accepting ideas of each other, open communication, and interpersonal relationships are established during collaboration. The student's behaviour during collaboration is socially regulated. Interdependence, sense of belongingness, and other psycho-social outcomes of adolescents influence peer collaboration during learning. Adolescents need to interact effectively with one's environment and experience opportunities for expressing and developing their capacities. They feel that they are authentically associated with others and sense of belongingness among others in the group. Adolescents face academic pressure, gain independence from others, and make relationships with peers, physical development, and the presence of emerging responsibility in life (Byrne et al., 2007; Hankin et al., 2007). The sources for adolescents in dealing with changes are peers, social organizations and groups, and online social networks. They disclose their problems with peers and having friends allow them to share experiences and feelings and learn to resolve conflicts Tomé et al. (2012). Peer grouping depends on how adolescents behave based on their needs, how their behaviours interfere with the needs of other members, and how group dynamics shape interpersonal relationships in a group. So, the understanding of the collaborative process of secondary school students in group learning is emphasized in this study. The concept of collaboration for assessing one form of interaction among secondary students is measured.

Objectives of the Study

The study is concerned with the development and validation of a tool for the assessment of collaboration among secondary school students. It has the following objectives:

1. To find out the constructs of collaboration.

2. To develop the scale of collaboration.

3. To validate the scale of collaboration.

Stages of the Study

This study was conducted in three stages. Stage one involved finding out the constructs. Development of the scale was done in stage two and validation of the scale was done in the last stage. The standard process of scale construction and validation was used.

1. Finding out the Constructs of Collaboration

An extensive review of related literature was used to operationalize the concept of collaboration. Based on the reviews key points were extracted to identify the constructs of collaboration. Then collaboration was operationally defined for this study.

a) Identification of Constructs of Collaboration

Researchers have taken an interest in the measurement of collaboration skills (Child & Shaw, 2015; Frey et al., 2006; Gajda, 2004; Ushiro, 2009). Child and Shaw (2015) agreed that a task given to students can provide opportunities to the students for collaboration. Students optimize the opportunities by successfully engaging in a collaborative process. Working together in a group always promotes the performance of the group members (Dittmann et al., 2020). They try to solve a problem by sharing their understandings in a group and can reach a common solution. The effort required to come to a solution and bring together their knowledge, skills, and efforts to reach that solution is the success of the collaboration. So, students prefer to study collaboratively with their peers so that they can work in a group (Lazar, 1995).

Child and Shaw (2015) recommended six facets for measuring 21st-century collaboration skills such as cooperation, sharing of resources, conflict resolution, social interdependence, the introduction of new ideas, and communication. Frey et al. (2006) recommended five dimensions such as networking, cooperation, coordination, coalition, and collaboration. Gajda (2004) developed the Strategic Alliance Formative Assessment Rubric (SAFAR) that captures central principles of collaboration. SAFAR signifies multiple levels of integration and their varying purposes such as tasks, leadership, decision-making, interpersonal and communication characteristics. Ushiro (2009) developed a collaboration scale to check the collaboration between

nurses and physicians and how they share information about patients, participate in decision-making concerning patient care, and provide comprehensive care to patients from a patient-centred perspective. The dimensions of the collaboration scale were sharing of information, mutual understanding, joint participation in planning, common objectives, the joint resolution of problems, trust and respect, awareness of role and responsibility, mutual support, and open communication.

Collaboration can occur everywhere, whether in the whole classroom, among the group in the classroom, with people, or outside the classroom (Blumenfeld et al., 1996). Students develop a degree of interdependence with each other for the completion of a collaborative task. The interdependence that they develop with each other is of two types: positive and negative. Positive interdependence creates an opportunity for cooperation, while negative interdependence creates competition among the group members. The members become socially dependent on each other towards the accomplishment of goals. This is known as social interdependence. Cooperation is directly related to positive interdependence. The members who are cooperative toward others can achieve their goals successfully. Frykedal et al. (2021) evidenced that positive interdependence is one of the most important conditions for the development of cooperation among group members. Cooperation tends to increase mutual support, exchange of resources, and trust (Deutsch, 1949). When individuals cooperate in group work, it is obvious that they can exchange their resources. The exchange of resources includes sharing their ideas, beliefs, thoughts, and opinions Johnson and Johnson (2005). In collaborative work, group members attempt to achieve the goal by sharing their resources (Brna, 1998; Bruffee, 1995; Child & Shaw, 2015).

Conflict is raised when there is group disagreement between thoughts and ideas (Marquis & Huston, 2017; Rahim, 2000). The conflict is resolved through dialogue during group collaboration. The solution does not eradicate conflicts but helps to find out the different resolution techniques (Pike et al., 2000). Implementation of conflict resolution techniques helps adolescents resolve challenging issues and remove their inferiority complex (Akanwa et al., 2020).

b) Operationalisation of Collaboration

The current study defined collaboration as an interactive process involving the constituent constructs which make group learning effective. The constituent constructs of adolescent collaboration are defined below. Based on this operationalisation and the constructs extracted from the review of literature, the items were developed. Literature reveals that collaboration can be measured through its constructs. Five constructs were identified to develop the collaboration scale for adolescents. These dimensions are social interdependence,

conflict resolution, cooperation, and sharing of resources.

i) Social Interdependence

This is considered in two forms:

a. Positive Interdependence

This behaviour exists when adolescents believe that they can achieve their goals if others achieve their goals. Positive interdependence results from interpersonal attractions that develop strong interactions among adolescents. Adolescents who are socially conversant with their peers perform better as compared to socially isolated students (Lew et al., 1986).

b. Negative Interdependence

Negative interdependence exists when individuals believe that they can achieve their goals if another fails. It includes an unfriendly and unfavourable learning atmosphere in which peers are not comfortable with each other. It results in oppositional interaction. Members deliberately try to damage each other's efforts towards the achievement of the goals.

ii) Conflict Resolution

The intervention of conflict viewpoint in a collaborative task is conflict resolution (Fawcett & Garton, 2005; Rosen, 2014). There are five styles of conflict resolution such as:

• Collaborating Style – This includes the ability to use active listening and discuss problems with everyone in the group.

• Competing Style- This style is observed when a student demands his/her point as correct without considering opposing points of view.

• Avoiding Style- It involves avoiding facing the issue directly, and not helping others to achieve their goals. Students practising this style try to change the subject and put off discussion during group interaction.

• Accommodating Style- This style engages students in maintaining a relationship with others at the expense of their own.

• Compromising Style- Students involved in the give-take or sharing of work to make a mutually acceptable decision.

iii) Cooperation

Cooperation means the association of group members for the completion of the collaborative task. All collaborative tasks have a degree of cooperation (Lai & Viering, 2012). Collaboration signifies cooperative behaviour in group work.

iv) Sharing of Resources

Adolescents share their resources during group learning to achieve a com-

mon goal. It involves the sharing of learning materials, ideas, thoughts, and feelings for interaction with others, accepting others' opinions, learning from others' experiences, and carrying out part of the collaborative task (Bruffee, 1995).

c) Consistency between Constructs

Four related constructs operationally illustrate the variable collaboration. The student's behaviours exhibited during collaboration cover up these constructs. Adolescents engage in activities to explain, argue, and negotiate socio-cognitive conflicts during collaborative learning. Constructs are related to each other. So, the correlation coefficient was calculated to know the degree of consistency between these constructs (Table 1).

Table 1

Correlation between Collaboration and Related Constructs.

Dimension	SI-CR	SI-C	SI-SR	CR-C	CR-S	C-SR
Calculative Value	0.23	0.27	0.48*	0.58*	0.37*	0.39*

p<0.05* SI: Social Interdependence, CR: Conflict Resolution, C: Cooperation, SR: Sharing of Resources

Moderate positive relationships were observed between conflict resolution and cooperation, and social interdependence and sharing of resources. However low positive correlation was observed between social interdependence and conflict resolution. The results revealed that the adolescents, who are socially well conversant with others, interact actively and are active listeners.

2. Construction Phase

It involves the following steps:

a) Generation of Items

An initial pool of 40 items was prepared on a five-point Likert scale (Always, Very Often, Sometimes, Seldom, and Never). The dimension-wise numbers of items were ten on social interdependence, fifteen on conflict resolution, eight on cooperation, and seven on sharing of resources. The sub-dimension of conflict resolution was the natural response to conflict, it contains four items, and the second sub-dimension was an application of appropriate conflict resolution style which consists of eleven items. Scoring is accomplished by assigning

numerical weights of 1 through 5 to each category, such as 5 representing the most favourable response and 1 representing the least favourable response.

b) Editing of the item and provisional scale

The preliminary 40 items were evaluated by experts for grammatical correctness, overlapping, ambiguity of the items, and domain of knowledge. Four experts with long-standing experience in the field of psychology and education were approached for the evaluation of items. All the items for each dimension were discussed with the experts. All the experts' suggestions were carried out. Thirteen items were rejected, and other items were modified. Table 2 displays the items retained on a scale of 27 out of 40.

Table 2

Items Retained in the Scale.

S.No	Dimensions	Preliminary Items	Items Retained	
			Positive	Negative
1	Social Interdependence	10	4	4
2	Conflict Resolution			
	a) Natural Response to Conflict	4	4	0
	b) Application of Appropriate Conflict Resolution Style	11	8	0
3	Cooperation	8	2	2
4	Sharing of Resources	7	2	1
	Total	**40**	**20**	**7**

c) Pilot Testing of the Scale

The pilot testing of the scale was done to check its way of administering and measuring items. The scale was administered to 86 adolescents (who belong to grade 9). There were a few words in the statement that were simplified. Adolescents facing doubts in words like 'individual task' and 'group task' were changed. Other words such as vision, accountability, and accommodate were replaced by the words: idea, responsible, and help, respectively. The level of difficulty of the items was searched. The estimated time for the administration of the scale was checked. Confusing statements were improved. Thus, 27 items were retained. The pilot testing helped to remove the weaknesses of the scale and to establish a reasonable time limit for the administration of the

scale (Guilford, 1954).

d) Discrimination Power of the Scale

The social component of interdependence, exchanging of views, and resolving the differences between viewpoints of others were measured through this scale. The extent to which items elicit similar types of responses from adolescents can be known through the calculation of the discrimination index. This index can be interpreted as an indication of the extent to which mastery of the skills is related to the response to an item. The discriminative power of the items was calculated by using Kelly's (1939) formula. An item with $D \geq 0.26$ was considered as a positive discrimination value (Kubiszyn & Borich, 1987). Accordingly, five items (item numbers 2,11,12,18, and 23) were deleted from the scale (Table 3).

Table 3

The Discrimination Value of the Items.

Item Number	Discrimination Index	Item Number	Discrimination Index
1	0.29	15	0.40
2	**0.21***	16	0.40
3	0.58	17	0.27
4	0.5	18	**0.23***
5	0.32	19	0.41
6	0.48	20	0.39
7	0.29	21	0.29
8	0.30	22	0.30
9	0.36	23	**0.21***
10	0.35	24	0.58
11	**-0.1***	25	0.50
12	**0.22***	26	0.58
13	0.34	27	0.50
14	0.54	-	-

*Item deleted

Finally, twenty-two items were retained after determining the discrimination power of each item on the scale (Table 4).

Table 4

The Final Scale.

S.No	Dimensions	Final Items		Total
		Positive	**Negative**	
1	Social Interdependence	3	1	4
2	Conflict Resolution			
	a. Natural Response to Conflict	4	0	4
	b. Application of Appropriate Conflict Resolution Styles	8	0	8
3	Cooperation	2	2	4
4	Sharing of Resources	1	1	2
Total		**18**	**4**	**22**

3. Validation Phase

The final scale was named as Secondary Students' Collaboration Assessment Scale. The 22-item scale was administered to a sample of 363 students which included 165 (45.45%) female and 198 (54.54%) male students. The samples were selected using a simple random sampling method. The psychometric characteristics of the scale such as reliability, validity, and gender norm were determined.

Reliability of the scale

Reliability demonstrates a degree of consistency when the scale is administered on the same sample repeatedly under the same conditions. It was determined in two ways:

   i) A Measure of Stability

   ii) A measure of Internal Consistency

Measure of Stability

Stability was found by the test-retest reliability method. According to Rosenberg (1965), a scale can be administered two times in test-retest reliability week apart. The same scale was administered on the same sample with a gap of sixteen days. Pearson's product-moment correlation coefficient was calculated between test scores and retest scores. It was found to be a high positive score

of 0.71 indicating consistency of the scale over time.

Measure of Internal Consistency

The internal consistency of the scale was measured using Cronbach's Coefficient Alpha. The alpha value was calculated to be 0.768. So, the scale was found to be reliable. These results depict that the collaboration scale has high reliability (Table 5).

Table 5

Reliability of the Scale.

Type of Reliability	Correlation Coefficient
Test-Retest Method	0.71
Internal Consistency Method	0.76

Validity and Norm of the Scale

Content validity was estimated to ensure the degree to which the items of the scale are relevant to and representative of the constructs for the assessment of collaboration. Two expert ratings were collected through a rubric on the items on the scale. Relevance and representativeness were judged based on the defined nature of collaboration. Validity was calculated by applying the Cohen Kappa formula. The Cohen kappa was calculated to be 0.66. The result depicted a substantial agreement between the raters (Landis & Koch, 1977). The result of a positive correlation established the content validity of the scale. Standard score values were calculated to reflect the gender differences in collaboration scores. The data were collected from both male and female adolescents. The school students were categorised into three levels based on the calculated standard scores (Table 6).

Table 6

Gender Norm of the Scale

S.No	Z Score	Raw Score of Male	Raw Score of Female	Levels of Scale
1	-1.26 and Below	64 and Below	71 and Below	Low
2	-1.25 +1.25	66-96	72-97	Average

Table 6 continued

3	+1.26 and Above	97 and Above	98 and Above	High

Discussion and Conclusions

Assessment of collaboration is primarily based on the analysis of the collaborative process (Dillenbourg et al., 2001). However, the assessment of dimensions of collaboration that characterize learning and peer collaboration in a classroom context is less focused. The gap was looked at in this study. To address the gap, the process of different components in the constructivist nature of learning that foster collaboration was emphasized. Related literature was reviewed to identify the dimensions of the collaboration scale. Researchers like Child and Shaw (2015); Frey et al. (2006); Gajda (2004) and Ushiro (2009) have explored various dimensions in the measurement of collaboration. They identified cooperation, sharing of resources, conflict resolution, social interdependence, the introduction of new ideas, and communication are dimensions of collaboration. Findings from this study suggested that peer collaboration can be measured through four dimensions such as social interdependence, conflict resolution, cooperation, and sharing of resources. These constructs had the following connotations: collaboration augmented students' skill of how others view the world; learning to appreciate differences of opinion and learning together. These characteristics fall under the sharing of resources and conflict resolution. The sharing of resources and the construction of knowledge are collaborations. These are formed by group members who are engaged in a process of collective learning in a shared way (Wenger et al., 2002). Students who work in a group generate more understanding. Collaboration builds students' progression towards learning. When two or more students are engaged in a task, they depend on each other to solve the issues. This describes social interdependence to resolve the issues.

Social interdependence exists when the behaviours are affected by their own and others' actions. This may help or block the achievement of their goals (Johnson & Johnson, 2009). It was found that collaborating and compromising the style of conflict resolution were frequently used by the students in a collaborative environment. Each type of conflict had a positive impact on collaboration. It helps group members to settle the task and improve decision-making. On the other hand, the competing style had a negligible impact on collaboration and was the least used style in an educational environment (Kantek & Gezer, 2009).

Cooperation promotes positive interpersonal relationships and greater social support for each other. Cooperation is a social behaviour, where

the success of a particular behaviour depends on the activity of others. Cooperation among peers was one of the most important conditions for achieving the collaborative task (Swain, 2001). This study revealed that social interdependence, conflict resolution, cooperation, and sharing of resources are important constructs of collaboration.

This scale possessed a reliability of 0.71 which confirmed the stability and consistency of the scale. Similar studies by Ushiro (2009) and Frey et al. (2006) demonstrated a value of 0.80 as the reliability of the scale. This proved that the scale had positive and high reliability. Hence this scale may also be helpful for school teachers, educators, and practitioners in the measure of collaborative learning.

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