MIER Journal of Educational Studies, Trends & Practices
May 2023, Vol. 13, No. 1 pp. 81-97
DOI:10.52634/mier/2023/v13/i1/2376

DEVELOPMENT OF COLLABORATIVE SKILLS SCALE: RELIABILITY AND VALIDITY

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This study aims to develop a collaborative skills scale for pre-service teachers. A total of 308 pre-service teachers of three different colleges in Amritsar (Punjab) participated in the study. After preparing a pool of items, the researchers employed an exploratory factor analysis (EFA) and a principal component matrix (PCA) with varimax rotation. After performing EFA, 12 items were excluded out of 35. Three factors of Knowledge Negotiation, Social Interactions and Positive Interdependence were extracted. The final scale consists of 23 items. The overall Cronbach alpha coefficient for the scale was 0.73. Validity of the scale was determined using Face and Content validity. Thus, the total score for each item ranges from 1 to 5, whereas the total score of the collaborative skills scale ranges from 1 to 115. Higher scores reveal a higher degree of collaboration skills, whereas lower scores reveal a lower degree of collaboration skills.

KEYWORDS: Pre-Service Teachers, Exploratory Factor Analysis, Collaborative Skills

INTRODUCTION

As the global economy has moved to Information and communication, the demand for teaching new 21st century skills require educational transformation (Aslan, 2015). Therefore, there is pressure on the education system to teach these new skills identified. Teaching in the present era is not

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merely confined to delivering facts to the students. It is much more than that. To meet these challenges, teachers need to adopt a collaborative learning environment. Collaborative learning is not a new instructional strategy in our classroom. Teachers can train their students in the skills of collaboration so they will be able to accomplish group tasks not just in the classroom but also in work settings, social settings and other aspects of life. Collaborative learning involves working together in small groups. Learning in collaborative settings can only be achieved if group members have skills to collaborate and collaborative learning is applied in teacher education programs (Ruys, Kheer & Aelterman, 2010). Due to lack of skills and insufficient training, teachers are reluctant to apply collaborative pedagogical practices in their classrooms (Baines, Blatchford, and Kutnick, 2003). Collaborative skills can only be developed if group members interact effectively in social settings, negotiate knowledge and are positively interdependent on each other.

NEP (National Education Policy) 2020, recognized the need for training of teachers with respect to high quality content and pedagogical knowledge. Pre-service teachers lack the experience of teaching in schools. Therefore, a four-year integrated teacher education programme will provide an experience of teaching in schools before joining as a teacher (Mahato, 2022). Also, trained future teachers will act as a valuable asset in the education system and they will be future ready. In line with NEP 2020, collaborative learning, integration of educational technology, pedagogical techniques will be taught through integrated B.Ed. degree. Collaborative learning requires effective collaboration. This adds to greater expectations from those who aspire to be teachers. Therefore, the present study emerged from the demand to explore the collaborative skills of those who aspire to be future teachers.

Review of Literature

There are several qualities that characterize truly collaborative interactions in a collaborative learning environment. It involves Quality of social interactions, Negotiability and positive interdependence among group members. While reviewing the past studies, it was observed that most of the studies concentrated more on learning outcomes rather than focusing on various factors enhancing collaboration. Very few studies in the past made an attempt to observe the factors which enhance collaboration. Dillenbourg and Schneider (1995) opinionated that working in small heterogeneous groups and the kind of task assigned to group members helps in triggering interactions among group members during collaborative learning.

A quasi-experimental study by Merdekawati, Kasjib and Febriana (2021)

studied the effectiveness of the TGT (Teams games tournaments) model on students' collaborative skills and academic achievement in chemistry. Indicators of collaborative skills in this study included contribution, respecting others, responsibility and working as a team. Results of the study revealed that students' achievement and collaborative skills were better in the experimental group taught through the TGT model than the group taught through conventional learning. Furthermore, Henukh and Astra (2021) employed a qualitative descriptive method to understand perceptions and opinions of Physics students regarding use of google classroom in improving collaboration skills in Musamus university. This study included five indicators of collaborative skills namely, working productively, showing respect, compromising, sharing responsibility and everyone's contribution. Results showed that use of google classroom improved students' collaboration skills. Similarly, Hidayati, Zubaidah, Suarsini and Praherdhiono (2020) assessed the communication and collaborative skills of Biology education students through observations during the learning process in Indonesia. The areas of collaborative skills were determined as respect, working as a team, contribution, responsibility and organizing work.

Appropriate channel for exchanging information also plays a significant role in case of web-based collaboration. A slight difference of opinion or misinterpretation can be an efficient way to find a solution to a problem during group work and leads to positive outcomes. Le, Janssen and Wubbels (2018) identified negotiating the knowledge and interdependence s as a prominent factor of measuring collaborative skills while investigating the problems encountered by teachers and students during collaboration by conducting semi structured interviews on 19 teachers and 23 students from various disciplines who voluntarily participated at Vietnam University and reported that lack of collaborative skills is a first and major obstacle in effective collaboration followed by free-riding, competence status and friendship among students. The reason students lacked collaborative skills was that they were not aware about how to effectively collaborate or work in groups, unequal participation of peers during group tasks and viewpoints of all the students in a group were not accepted by fellow group members. They were not able to negotiate their knowledge, receive or provide help and were not able to give elaborative explanations during group tasks. Some peers contributed more to group tasks and some contributed negligibly as most of the group work was completed by brighter students whereas few students were reluctant to participate in group tasks as they felt that they were not competent enough to contribute to group tasks. Measurement of collaborative skills is one of the major goals of collaborative learning (Web, 1995). Therefore,

simply formulating small heterogeneous groups can only be a prerequisite for collaborative learning but it does not ensure effective collaboration.

In another study, assessment of collaborative skills was carried out by Piniuta and Meyerzon (2018) which focussed on assessing collaborative skills as an educational outcome in which students used a variety of web-based applications like google docs, OneNote, meeting words and completed a variety of activities together. Sharedness, equality and participation were the key dimensions used to assess collaborative skills. It concluded that collaboration needs effective social interactions among group members. Effective social interactions can only occur if group members trust, encourage, respect each other and interact with each other to reach the group's goal. They learn together and help each other to reach the common goal. Gentry (2012) identified communication, professional competence, respect, commitment, equality, advocacy, trust as eight competency areas of collaborative skills.

Further, Kreijns et al. (2003) analysed two vital drawbacks for social interaction in collaboration in a computer supported environment. Firstly, taking for granted that social interaction will automatically occur by providing communication media. In other words, social interaction not only requires communication media but also trust, respect, belongingness, and sense of community among group members. Secondly, absence of socio-emotional aspects among the group. Therefore, socio-emotional aspects play a prime role in developing effective and meaningful social interactions. Therefore, group members should be initially acquainted with each other. Furthermore, Beers, Boshuizen, Kirschner and Gijselaers (2005) emphasized on the role of negotiation as a chief factor in Collaborative learning environments. According to them, contribution message, verification message, Clarification, Acceptance, Rejection, Agreement and Disagreement are the five principles needed for an effective process of negotiation. Later Beer (2005) added two additional categories i.e., elaboration and regulation. Elaboration is when people in a group give their own viewpoints or perspectives on the newly introduced topic or learning task assigned. Task regulation deals with the conversation by regulating what the participants were doing. Also, Dillenbourge et al. (1996) talked of mutual adjustment, competitive augmentation, standing pat and negotiation of meaning as four types of negotiation behaviours to be observed during interactions. In addition to above studies, Kirschner et al. (2007) identified neglecting the socio-emotional aspects as another major cause that created a threat to collaborative learning. Social conditions necessary for good collaboration are acceptance, support, belongingness, respect, warmth, trust and liking. Positive Interdependence is considered as another key factor of collaboration. It generates promotive interactions among group members as

they motivate and assist each other to accomplish group tasks (Collazos et al., 2003). Positive interdependence is referred to as "the success of an individual relies upon the accomplishment of others" (Collazos et al., 2003 & Laal, 2013). Scager et al. (2016) reported that collaboration is strengthened due to positive Interdependence, and it acted as a critical element which influenced the collaborative process. Every group member became answerable and liable for their contributions during the group task. Therefore, Positive Interdependence establishes individual accountability and responsibility among group members during group tasks. Mc Alpine (2000) developed an online master's course at University of Melbourne by using collaborative learning as the teaching-learning method. Evaluation data revealed that students got motivated and valued the activities designed through collaborative learning and they felt it was a very challenging way and they learned much better in groups rather than working alone. In other words, collaboration helped students learn various life skills (Blingnaut, Venter & Stoltz, 1998; Chou & Chen, (2008).

NEED OF DEVELOPMENT OF THE SCALE

Extensive research has been conducted in the past to assess collaborative skills. These studies identified various indicators for assessing collaborative skills. Based on the past studies it was found that Negotiating knowledge was a key factor in assessing collaborative skills (Beers, Boshuizen, Kirschner & Gijselaers, 2005; Le, Janssen & Wubbels, 2018) and interdependence as another prominent factor of measuring collaborative skills. Also, Dillenbourge et al. (1996) classified negotiation behaviours into four types namely, competitive augmentation, standing pat, mutual adjustment and negotiation of meaning. Piniuta and Meyerzon (2018) emphasized that interaction among group members (participation), exchanging of thoughts and opinions among group members (sharedness) and contributions made by each group member during group tasks (equality) as three main criteria to assess collaborative skills of pre-service teachers. In addition, Gentry (2012) identified eight areas of collaborative skills namely, communication, professional competence, respect, commitment, equality, advocacy, trust as eight competency areas of collaborative skills. social interactions as a significant dimension in collaboration was highlighted by Kreijns et al. (2003). Positive interdependence was considered another critical element in the collaboration process (Collazos et al., 2003; Scager et al., 2016; Laal, 2013). Furthermore, working productively, showing respect, compromising, sharing responsibility and everyone's contribution were the indicators used to assess collaborative skills among physics students (Henukh & Astra, 2021). In another study, the areas of

collaborative skills determined were respect, working as a team, contribution, responsibility and organizing work (Hidayati, Zubaidah, Suarsini & Praherdhiono, 2020). Also, Dewi, Hanoum and Mulyadi (2020) mentioned collaborative skills as a combination of interpersonal skills, group management and inquiry skills. Furthermore, the areas of collaboration determined in the study carried out by Gonzales and Dinagsao (2020) were complimenting others, acknowledging other's work and viewpoints, accepting other viewpoints, asking for others suggestions, communication and interaction skills. Therefore, different studies in the past identified various indicators for measuring collaborative skills.

In the present study, all the indicators determined to assess collaborative skills in past studies were merged into three major themes namely, knowledge negotiation, social interactions, and positive interdependence based on expert views which are presented as given in Table 1.

Table 1

Indicators to Assess Collaborative Skills.

Dimensions	Indicators of Collaborative Skills in Literature
Knowledge Negotiation	• Contribution message, verification message, Clarification, Acceptance, Rejection, Agreement & Disagreement (Beers, Boshuizen, Kirschner & Gijselaers, 2005) . • Elaboration and regulation (Beers, 2005). • Negotiation behaviours namely, competitive augmentation, standing pat, mutual adjustment and negotiation of meaning (Dillenbourge et al ., 1996). • Exchanging of thoughts and opinions among group members (Piniuta & Meyerzon, 2018) . • Communication (Getry, 2012) . • Compromising (Henukh & Astra, 2021). • Inquiry skills (Dewi, Hanoum & Mulyadi, 2020). • Complimenting others, acknowledging other's work and viewpoints, accepting other viewpoints, asking for others suggestions, communication (Gonzales & Dinagsao, 2020).
Social Interactions	• Socio-emotional aspects (Kirschner et al ., 2007). • Promotive interactions among group members as they motivate and assist each other to accomplish group tasks (Collazos et a.l, 2003). • Interaction among group members (Piniuta & Meyerzon, 2018). • Respect, commitment, trust (Getry, 2012). • Respect (Hidayati, Zubaidah, Suarsini & Praherdhiono, 2020). • Interpersonal skills (Dewi, Hanoum & Mulyadi, 2020).
Positive Interdependence	• Contributions made by each group member during group tasks (Piniuta & Meyerzon, 2018) . • Equality, advocacy (Getry, 2012). • Individual accountability and responsibility (Scager et al ., 2016). • Sharing responsibility and everyone's contribution (Henukh & Astra, 2021). • Working as a team, contribution, responsibili ty and organizing work (Hidayati, Zubaidah, Suarsini & Praherdhiono, 2020). • Group management (Dewi, Hanoum & Mulyadi, 2020). • Interaction skills (Gonzales and Dinagsao, 2020) .

Evidence from Table 1 shows that social interaction, positive interdependence and knowledge negotiation plays a key role in determining collaborative skills. Therefore, collaboration requires not just presence of infrastructural settings, and communication but also requires collaborative skills. Effective collaboration requires certain skills among collaborators. Training student teachers to negotiate, socially interact and positive interdependence on each other is necessary to achieve effective and fruitful collaboration.

Also, the investigator found that most of the related studies which tried to assess collaborative skills among pre-service teachers were either qualitative in nature which were based on observations and interviews (Zabiah, Fatima, Sunaryo, Aman, 2020., Molano, 2020., Gonzales & Dinagsao, 2020). Few studies tried to analyse collaborative skills by merging them along with 21st century skills instead of determining them apart and various dimensions which were related with collaborative skills were not taken into consideration separately (Somosot, 2020). Moreover, none of the studies were done in the Indian context so far. After much deliberation and detailed review of related literature, it is indicated that effective collaboration requires certain skills like social interactions, knowledge negotiation and positive interdependence among group members. Therefore, to measure collaboration, we need a reliable and valid tool. As in the absence of reliable and valid tools, examining collaborative skills can bring out aimless learning outcomes of collaboration (Le, Janssen & Wubbels, 2018) and it becomes challenging and hard to examine the process of collaboration and its outcomes.

Objective of the Study

The study has the following objective:

- To analyse the various dimensions or factors of collaborative skills scale through construct validity (CSS).

To achieve the above objective, a sample of 308 pre-service teachers at secondary level enrolled in teacher education program (Semester-I) in education colleges affiliated to Guru Nanak Dev University were taken up.

Procedure

Preparation of Pool of Items

In the beginning a questionnaire consisting of 35 items was prepared by going through relevant literature. The list was given to three experts (teacher educators) to review the suitability and relevance of items. The experts include

experienced teachers of education, technology and psychology. For the purpose of critical evaluation, accuracy, coverage and relevance of content in the present scale by requesting to adopt following criteria ("Mark „R for retaining item; Mark "M" for item that needs modification; Mark "RT" for rejecting items and Mark "C" for comments on any particular item") for evaluation of content validity, based on the feedback of experts. The experts' suggestions were taken into consideration and then incorporated.

Try-Out

The scale was administered, and data was gathered from a random sample of 308 pre-service teachers of Semester-I pursuing Bachelor of Education (B. Ed) in the Education colleges of Amritsar, Punjab (India) for the academic session 2019-2020. Therefore, researcher developed a Likert-type 5-point scale ranging from strongly agree (5) to strongly disagree (1). For positive items, if a respondent marks "strongly agree", weightage is given 5 points. Similarly, 4, 3, 2 and 1 points are given for markings on 'agree', 'neutral', 'disagree' and 'strongly disagree respectively. There were no negative items. Overall, the self –reported questionnaire consisted of a total 35 items.

Execution of Exploratory Factor Analysis

To proceed further, the researcher decided to conduct exploratory factor analysis. The goal of conducting exploratory factor analysis was to reduce data, identify relationships among variables, and classify a number of undefined variables into various groups or factors and look for underlying structures. It helped the researcher to understand the number and nature of factors.

Before carrying out exploratory factor analysis, few assumptions need to be fulfilled. The first step was to decide whether the data was appropriate for carrying out factor analysis. It involves selection of appropriate sample size, KMO value, reliable coefficient which is checked by Bartlett test of sphericity and avoidance of multicollinearity as the basic underlying assumptions which needs to be fulfilled for EFA (Cattell, 1966).

Understanding the Composition of Data.

Different studies suggested various recommendations with respect to least sample size for factor analysis. Some studies reported 200 as a minimum sample size whereas few other studies suggested 200 as fair, 300 as good, 500 as very good and 1000 as excellent. In literary review it is accounted for that factor analysis requires a minimum of 300 individuals. In light of this declaration, the collaborative skills Likert scale was applied/administered on at least 308 preservice educators.

Another criterion to be fulfilled was Kaiser-Mayer-Olkin which measures sampling adequacy, and its value should be greater than 0.5, Bartlett test of sphericity investigates the correlations between variables and should show statistical significance $p<0.05$ and should be significant. To understand whether the correlation matrix is appropriate, Determinant of Correlation matrix is calculated, and it is recommended to be greater than 0.00001.

To check whether correlation matrix was appropriate for factor analysis, determinant of correlation matrix, KMO and Bartlett's test of sphericity were taken into account (Table 2). In the present study, determinant of correlation matrix was 0.001, KMO was determined as 0.827 and Bartlett's test of sphericity came out to be significant (approx. Chi-Square 2163.743, df - 406) This shows that the data fulfils the assumptions and is well suited for doing factorial analysis. Since the values obtained as a result of the above-mentioned analyses fit the basic hypotheses at a good level, it was decided that the factor analysis could be conducted (Kothari & Garg, 2014). The researchers used principal component matrix (PCA) in this study and for rotation used the Varimax method. With this, researcher checked the factorability of the 35 statements of collaborative skills scale of pre-service teacher's sample.

Table 2

KMO and Bartlett's Test of Sphericity.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.827
	Approx. Chi-Square	2163.743
	df	406
Bartlett's Test of Sphericity	Sig.	.000

Determining Number of Components to be Retained

The decision of the number of factors to be retained was supported by previous studies. Previous studies supported three major factors which contribute largely to effective collaboration. These three factors were named as negotiation, social interaction and positive interdependence.

On the other hand, through IBM, SPSS-21, no factors to be retained can be assured through scree plot in which an elbow is observed on the plot. The x-axis on the plot represents the various variables and the y-axis represents the Eigenvalues. The points in the scree plot above the elbow or Eigenvalue greater than 1 were considered for retaining a number of factors. Based on it, only those factors were retained which had larger variance or larger Eigen values whereas those factors were discarded which had smaller Eigen values (Figure 1).

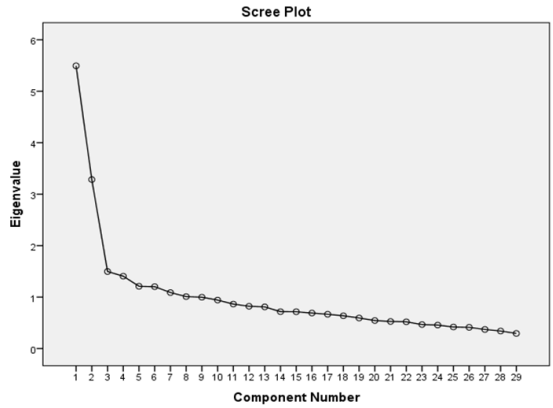

Figure 1. Scree Plot Depicting Eigen Values (Y-Axis) and Variables (X-Axis).

Therefore, In the current investigation, the decision to retain three factors was supported by observing scree plot and through previous studies. Three factors were extracted and a varimax rotation method was employed. Only those factors were retained whose eigenvalues were close to or greater than 1. Looking at the scree plot and based on the literature review, three components of the collaborative skills scale were retained which were later named as Negotiation, social interaction and Interdependence. The scree plot represented four factors whose eigenvalue was higher than 1 but in accordance with the previous studies done so far on collaborative skills the researcher decided to retain three factors with absolute values suppressed below 0.4.

In Table 3, Extraction Sums of Squared Loadings column illustrates the Eigen value of component 1 is 5.495 with the highest variance of 18.947 %. Component 2 reports 11.325% of variance with Eigenvalue 3.284 while the third component accounts the least variance of 5.16 % with Eigenvalue 1.497. Under rotation sums of squared loading columns, the first component accounts for 14.895% variance and factor 2 and 3 accounts for 11.943% and 8.598% of variance.

Table 3

Total Variance Explained.

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Eigen Values	% of Variance	Cumulative %	Eigen Values	% of Variance	Cumulative %
1.	5.495	18.947	18.947	4.320	14.895	14.895
2.	3.284	11.325	30.272	3.463	11.943	26.838
3.	1.497	5.164	35.436	2.493	8.598	35.436

Table 4
Component Transformation Matrix

Component	I	II	III
1	.821	.532	.210
2	.270	-.684	.678
3	−.504	.499	.705

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization

Table 5
Statements of Collaborative Skills Questionnaire and their Factor Loadings.

Items	Statements	Factor Loadings
	Dimension: One (Knowledge Negotiation)	
Item 30	"I share various educational resources related to group tasks with my peers."	0.598
Item 26	"I believe every learning task in the group is responded with clarification."	0.596
Item 33	"I always acknowledge other's point of views during group tasks even if they disagree with mine."	0.589
Item 29	"I elaborate my opinions to my peers in a group task	0.572
Item 25	I express my thoughts & ideas clearly and directly in the group."	0.560
Item 27	"I clearly understand the purpose of the group task assigned to my group."	0.543
Item 24	"I always give suggestions to my friends in group discussions."	0.529
Item 21	"I always speak up in the group when I disagree."	0.525
Item 28	"I clarify other's doubts in a group before reaching a common conclusion."	0.486
Item 17	"I always agree or disagree to make my position known to my group mates"	0.466
Item 13	"I actively listen to what the other group member is saying."	0.439
Item 22	"Before initiating a talk during a group task, I always wait a minute to see if any group member needs more time to express what they are going to say."	0.409

	Dimension: Two (Social Interaction)	
Item 16	"Other participants in the group are helpful and cooperative to me."	0.741
Item 18	"I always respond by smiling or using soft eye contact while the other person is talking in the group."	0.696
Item 15	"I trust and respect the group members while working in the group."	0.645
Item 31	"I am emotionally attached to my group mates."	0.634
Item 32	"I could carry out the learning tasks a ssigned alone more efficiently rather than working in groups ."	-0.599
Item 7	"Working in groups increases my anxiety levels."	-0.551
Item 14	"I feel enthusiastic to participate in group tasks."	0.524
	Dimension: Three (Positive Interdependence)	
Item 24	"I believe that every group member makes a joint effort to complete the group task."	0.630
Item 28	"Each group member divides the work to complete the group task"	0.572
Item 8	"The task assigned in the group can't be completed unless all other members help."	0.559
Item 2	"If there is a failure, everyone takes the responsibility for the failure"	0.486

Total = 23 Items

From Table 4 and 5 we can see that factor one consists of 12 variables with lowest value 0.409 and highest value 0.598, factor two contains 7 variables ranging from 0.741 to 0.524 and factor three has 4 variables whose factor loadings range from 0.486 to 0.630. Item number 1, 3, 4, 5, 6, 9, 10, 11, 12, 19, 20, 23 were eliminated while conducting factor analysis as their factor loadings were below 0.40. Hence, the amended scale comprised of 23 items with three factors and 12 items got eliminated as only those items were retained whose value was 0.4 or above. No cross loadings were detected.

RELIABILITY ANALYSIS

The Cronbach's alpha for the final set of statements was found out to be 0.730 (Table 6). This illustrates a high degree of internal consistency among the items. For this scale Cronbach's alpha indicated good internal reliability (α=0.730). So, reliability analysis suggests that collaborative skills scale is internally consistent. Dimension wise reliability was also calculated. The Cronbach's alpha value for factor one is 0.799, Factor two is 0.727 and factor three is 0.552. The internal consistency of the present scale is found to be

accurate according to the criterion for coefficient alpha of 0.06 and above as recommended by Nunnally and Bernstein, 1944).

Table 6

Reliability Statistics of Collaborative Skills Scale (Dimension-Wise).

Factor	Name of the Factor	Number of Items	Cronbach's Alpha
1	Knowledge Negotiation	12	0.799
2	Social Interaction	7	0.727
3	Positive Interdependence	4	0.552

Operational Definitions of Dimensions of Collaborative Skills Scale

In the present scale, three factors were extracted which were named as Knowledge Negotiation, Social Interactions and Positive Interdependence.

- Knowledge Negotiation refers to as openly and willingly sharing, rejecting and agreeing with the ideas or opinions, and actively listening to the perspectives of others, discussing alternatives, reaching compromises and persuading others during group tasks to reach a common goal or objective. 12 items were found to be related to Knowledge Negotiation as depicted in Table 5.
- Social Interactions refers to mutual trust, liking, warmth, belongingness, encouragement for collaboration among group members to reach the group's goal. It involves the act of mutually cooperating and helping each other. Seven items were found to be related to the dimension of social interaction illustrated in Table 5.
- Positive Interdependence refers to the belief among group members that they can achieve their learning goals when other members in a group achieve their learning goals. It included four items representing the positive interdependence.

CONCLUSIONS

Past studies assessed collaborative skills of pre-service teachers and students through variety of tools and methods namely, survey (Molano, 2020; Gonzales and Dinagsao, 2020; Somosot, 2020), project based assignment (Dewi, Hanoum & Mulyadi, 2020; Zakiah, Fatimah, Sunaryo & Amam, 2020), interviews (Le, Janssen & Wubbels, 2018), observations (Hidayati, Zubaidah, Suarsini & Praherdhiono, 2020), quasi- experimental (Susilawati, Ramalis, Kaniawati & Rusdiana, 2021; Merdekawati, Kasjib & Febriana, 2021). Few others analysed collaborative skills together as 21st century skills through

observations and interviews (Molano, 2020; Zakiah, Fatimah, Sunaryo & Amam, 2020). The fundamental difference between the present and previous tools constructed was with regard to use of larger sample size, presenting separate three key dimensions of collaborative skills in the present collaborative skills scale as it was noticed that most of these previous studies were either qualitative in nature, restricted to pre-service teachers belonging to specific subject (Molano, 2020; Hidayati, Zubaidah, Suarsini & Praherdhiono, 2020; Gonzales and Dinagsao, 2020; Henukh & Astra, 2021) or constituted small sample sizes, no standardized tools and collaborative skills were merged along with 21st century skills (Molano, 2020; Zakiah, Fatimah, Sunaryo & Amam, 2020; Somosot, 2020).

Therefore, the application of collaborative skills scale as an instrument will help in analysing collaborative patterns of pre-service teachers at secondary level. The existing scale is administrable on pre-service teachers to measure their collaborative skills as it fulfils the validity and reliability criteria. Furthermore, it will help to identify the weak and strong competence areas among pre-service teachers and to establish focussed training plans, curriculum designing & its implementation.

Discussion

In the present study, construct validity of the scale is determined through exploratory factor analysis. In this respect, a five-point Likert scale consisting of 23 items (Appendix I) is developed. The dimensions of the scale are carefully classified separately in this study whereas previous research studies didn't consider separate dimensions for evaluating collaborative skills scale. After conducting the analysis, three factors were identified: Knowledge negotiation, collaborative skills and positive interdependence. These factors are of utmost importance when employed by the future teachers in schools. In this regard, collaborative skills scale has proved to be distinct from other tools measuring collaborative skills among pre-service teachers. Although insufficient and small sample size may prevent generalization of the findings to other contexts. Group of experts for validation were teacher educators only and not subject experts which adds to another limitation of the study. Therefore, in extended research, instrument can be validated by subject experts also. In succeeding studies, experimental studies on larger sample or confirmatory factor analysis could be carried out to evaluate the pre-service teacher's collaborative skills.

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