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Validity and Reliability Evaluation of An Instrument Measuring Students' Communication and Collaborative Skills

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Abstract: Communication and collaboration are widely recognized as core competencies within the framework of 21st-century skills, requiring systematic assessment to ensure their effective development in educational settings. However, the availability of empirically validated instruments specifically designed to measure these competencies remains limited. This study aimed to evaluate the feasibility and psychometric quality of observation instruments developed to assess students' communication and collaboration skills. A descriptive research design employing a quantitative approach was implemented, focusing on validity and reliability testing. The communication skills instrument consisted of 11 items, while the collaboration skills instrument comprised 27 items. The instruments were administered to 136 students. Item validity was examined using Pearson's product moment correlation analysis at a significance level of $\alpha = 0.05$ (r-table = 0.1672). Reliability testing was conducted using Cronbach's Alpha to determine internal consistency. The results revealed that all 11 items of the communication skills and 20 items of the collaboration skills instrument were confirmed as valid. The reliability analysis demonstrated high internal consistency, with Cronbach's Alpha coefficients of 0.913 for the communication instrument and 0.951 for the collaboration instrument, both categorized as very high reliability. These findings indicate that the developed instruments possess strong psychometric properties and are suitable for use in assessing students' communication and collaboration competencies. The study contributes to the provision of validated observational tools that support objective evaluation practices. Future research is recommended to refine the invalid items and extend validation procedures across diverse educational contexts to enhance generalizability and robustness.

Keywords: Collaboration; Communication; Measurement instrument; Reliability; Validity

INTRODUCTION

The 21st century is characterized by rapid transformation and the widespread availability of information anytime and anywhere, driven by the accelerated development of information and communication technologies. This era presents both challenges and opportunities that require human resources equipped with competencies distinct from those of previous generations. Within this dynamic global landscape, the education system plays a crucial role in determining national progress (Hasibuan et al., 2025).

Education in this century demands competencies that extend beyond content mastery, particularly the four core skills widely known as the 4C: critical thinking, creativity, collaboration, and communication (Jamaludin, 2025). Developing independent and creative learners is considered a strategic response to limitations found in conventional learning practices and serves as preparation for facing 21st-century challenges (Mashudi, 2021). Therefore, schools are expected to integrate these competencies systematically into classroom practices.

Previous studies have emphasized the importance of communication and collaboration in supporting meaningful learning, particularly in science education. Students are expected not only to understand concepts but also to express ideas scientifically, engange in discussions, and work effectively in groups. However, despite the growing recognition of these competencies, their assessment in classroom settings remains limited and often lacks standardized instruments.

Several studies have developed instruments to measure communication and collaboration. Nevertheless, many of these instruments have not undergone comprehensive psychometric evaluation, particularly in terms of empirical validity and reliability testing. As a result, the accuracy and consistency of measurement results may still be questionable.

In the context of biology learning, communication and collaboration skills are particularly significant. Students are required not only to express ideas clearly but also to exchange thoughts, arguments, and scientific reasoning effectively. Thus, these skills should not merely be interpreted as speaking ability and teamwork, but rather as the capacity to communicate conceptual understanding scientifically (Thahir et al., 2024).

Communication is defined as a two-way interaction process involving the reciprocal exchange of messages between individuals (Safitri et al., 2022). Communication skills refer to an individual's ability to convey messages clearly and understandably to others. Effective communication supports idea expression, structures thinking processes, and facilitates problem-solving, ultimately enabling the achievement of intended communication goals (Rambe et al., 2022). Communication encompasses both verbal and nonverbal dimensions. Verbal communication involves spoken and written language used to inform, entertain, broaden insight, and build relationships. Nonverbal communication includes body language, facial expressions, voice intonation, and other non-word elements that express emotions, reinforce verbal messages, and shape impressions. Both dimensions complement each other in constructing meaningful understanding between communicators (Aswaruddin et al., 2025).

Collaboration refers to mutual engagement among individuals to achieve shared goals through collective efforts. Through collaboration, students exchange knowledge, skills, experiences, and strategies necessary to solve problems effectively. Strong collaborative ability enables group members to work cohesively, support one another, and accomplish collective objectives optimally (Fatirul & As'ari, 2022). In educational settings, students' collaborative skills reflect social interaction processes that foster constructive and active learning experiences. Collaboration in learning promotes shared responsibility, mutual respect, and collective decision-making aimed at achieving mutual benefits (Marita et al., 2023)(Morley & Cashell, 2017). These skills supports students in developing responsibility, mutual respect, and effective group interaction during learning activities(Tama, 2018).

Given the importance of this, communication and collaboration skills must be intentionally cultivated in schools. Teachers are expected to facilitate effective communication practices, encourage innovation through negotiation and teamwork, and design classroom learning that promotes collaborative problem-solving (Akmal, 2024).

Preliminary observations conducted through interviews with teachers in several senior and junior high schools in Tanjungpinang indicate that learning activities have begun to integrate 21st-century skills, particularly communication and collaboration. Teachers have implemented group discussions, presentations, and teamwork-based tasks. However, the implementation has not yet reached optimal effectiveness.

During discussions, some students lack confidence in expressing their opinions. Others struggle to articulate ideas clearly and coherently or demonstrate limited responsiveness to peers' arguments. From a collaboration perspective, group work does not always reflect balanced participation, as some members contribute less actively and task distribution remains unequal.

Furthermore, the assessment of communication and collaboration skills is generally conducted informally and without standardized measurement tools. Teachers often rely on general observation without structured guidelines, which may result in inconsistent evaluation outcomes. Such conditions highlight the need for more objective and measurable assessment instruments.

Previous studies have developed instruments to measure communication and collaboration skills; however, not all instruments have undergone rigorous validity and reliability testing. Instruments that lack adequate psychometric evaluation may produce inaccurate or inconsistent data. Therefore, establishing valid and reliable instruments is essential.

Validity refers to the degree to which a measurement instrument accurately measures what it is intended to measure (Ramadhan et al., 2024). An instrument is considered valid when it performs its measurement function precisely and

reflects the actual conditions of the construct being assessed. Importantly, validity is context-dependent and must always be interpreted according to specific measurement objectives.

Reliability, on the other hand, refers to the consistency of measurement results. An instrument is considered reliable when repeated measurements under similar conditions produce relatively consistent results, provided that the measured construct has not changed. Reliable instruments ensure stability and trustworthiness of assessment outcomes.

Based on these considerations, there is a clear need to develop and test communication and collaboration skills instruments that meet feasibility standards. Valid and reliable instruments will assist teachers in conducting more objective, consistent, and accurate evaluations of students' competencies (Farhani et al., 2026; Sarkity et al., 2024; Sarkity, Fernando, & Hindrasti, 2023; Sarkity, Fernando, Pratama, et al., 2023).

This study therefore aims to examine the validity and reliability of communication and collaboration skills instruments to ensure their appropriateness for classroom use. Through systematic testing, this research seeks to produce instruments that meet established psychometric criteria and can accurately measure students' communication and collaboration skills. The availability of such instruments is expected to support more objective evaluation practices and ensure that assessment results genuinely reflect students' actual competencies.

METHODS

This study employed a descriptive research design with a quantitative approach to analyze the collected data. Quantitative descriptive research is commonly used to describe and analyze phenomena through numerical data and statistical procedures (Creswell & Creswell, 2022; Sugiyono, 2019). The focus of this research was to examine the feasibility of the developed instruments through validity and reliability testing. This study was conducted from October to November 2025. The sample consisted of 136 students from several educational institutions, including Junior High Schools (SMP) and Senior High Schools (SMA) located in Bukit Bestari District. The instruments in this study consist of observation sheets designed to assess students' communication and collaboration skills. The communication skills instrument contained 11 statement items, while the collaboration skills instrument consisted of 27 items. Observers used these observation sheets to assess students' communication and collaborative behaviors during the learning process.

The research procedure consisted of several stages. First, indicators of communication and collaboration skills were formulated based on theoretical studies related to 21st-century skills. Second, an instrument blueprint was developed to organize the indicators into measurable components. Third, observation items were constructed in accordance with the established blueprint. Finally, a pilot test was conducted to evaluate the validity and reliability of the developed instruments. Instrument development and testing procedures are essential to ensure that the instrument accurately measures the intended constructs (Arikunto, 2010).

The instrument trial was conducted with students from several educational institutions, including junior high schools (SMP) and senior high schools (SMA) located in Bukit Bestari District. A total of 136 students participated as respondents in the instrument testing process.

Item validity was analyzed using Pearson's product–moment correlation by correlating each item score with the total score (item–total correlation). This method is widely used to determine whether individual items are consistent with the overall construct being measured (Field, 2024). An item was considered valid when the calculated correlation coefficient (r calculated) exceeded the critical value of r_table at a significance level of 5%. Based on the number of respondents (N = 136), the r-table value was determined to be 0.1672.

Reliability analysis was conducted using Cronbach's Alpha coefficient to determine the internal consistency of the instruments. Cronbach's Alpha is commonly used to evaluate the reliability of instruments with multiple items measuring the same construct (Tavakol & Dennick, 2011). An instrument is considered reliable when the Cronbach's Alpha value is equal to or greater than 0.60.

RESULT AND DISCUSSION

The findings of this study are presented in two main sections: (1) students' communication skills and (2) students' collaboration skills.

Students' Communication Skills

Students' communication skills were measured using a non-participant observation technique. In this approach, the researcher observed classroom interactions without directly participating in the learning activities (Sugiyono, 2019). Observations were conducted using a structured checklist based on a Likert scale, which was completed during classroom activities.

The indicators used to assess communication skills were adapted from the framework proposed by Laila (2024) which consists of two main aspects: verbal communication and nonverbal communication. Verbal communication refers to students' ability to express ideas clearly, coherently, and fluently during learning activities. Meanwhile, nonverbal communication includes body language and eye contact that support message delivery and interaction during classroom discussions. The design of the communication skills instrument is presented in Table 1.

Table 1. Communication Skills Instrument Design

No	Aspect	Indikacators	Item Number
1.	Verbal Communication	Content completeness	1, 2
		Pronunciation clarity	3, 4, 5, 6
		Coherence	7, 8
		Fluency	9
2.	Nonverbal Communication	Kinesics (body movement)	10
		Eye gaze	11

The validity test results indicate that all items have correlation values (r calculated) greater than the r_table value (0.1672). This finding shows that each item has a significant relationship with the total score of the instrument. The detailed results of the validity test are presented in Table 2.

Table 2. Communication Skills Validity Test Results

Item	R Calculated	R Table	Decision
1	0.532		Valid
2	0.575		Valid
3	0.575		Valid
4	0.825		Valid
5	0.797		Valid
6	0.823	0.1672	Valid
7	0.828		Valid
8	0.823		Valid
9	0.818		Valid
10	0.678		Valid
11	0.713		Valid

Based on the results shown in Table 2, all 11 statement items were declared valid, indicating that none of the items needed to be eliminated. The correlation coefficients ranged from 0.532 to 0.828, which fall within the moderate to very strong correlation category (Field, 2024). These results indicate that each item adequately represents the construct of students' communication skills measured in this study. Following the validity test, a reliability analysis was conducted to determine the internal consistency of the instrument. The results of the reliability test are presented in Table 3.

Table 3. Communication Skills Reliability Test Results

Reliability Statistics

Cronbach's Alpha	N of Items
.913	11

The reliability analysis produced a Cronbach's Alpha coefficient of 0.913, indicating a very high level of internal consistency (Tavakol & Dennick, 2011). This result demonstrates that the instrument consistently measures the same construct across all items. In other words, the items are strongly interrelated and collectively represent the communication skills construct.

Item-total validity reflects the extent to which each statement item measures the same

underlying concept as the entire instrument. Since no items were removed during the validity testing process, it can be concluded that the indicators included in the observation sheet were appropriately designed to measure students' communication skills.

In science learning contexts, communication skills involve more than simply speaking during classroom discussions. Students are expected to present ideas logically, provide explanations supported by scientific concepts, and respond to peers' arguments in a constructive manner. Within the framework of 21st-century competencies, communication is considered one of the essential skills required for effective learning and problem-solving (P21, 2019).

Furthermore, the high reliability value obtained in this study indicates that the observation instrument provides stable and consistent measurement results. High reliability is particularly important in observation-based assessments, as such instruments can be influenced by subjective judgments from observers. Instruments with strong internal consistency help minimize potential bias and improve the credibility of assessment results (Creswell & Creswell, 2022).

In the context of classroom learning in several junior and senior high schools in Tanjungpinang, where discussion and presentation activities are commonly implemented but standardized assessment tools are still limited, the availability of this validated instrument becomes highly valuable. A valid and reliable instrument enables teachers to evaluate students' communication skills more systematically and objectively. Therefore, the results of this study demonstrate not only the statistical feasibility of the instrument but also its practical relevance in supporting more accurate assessment of students' communication skills in classroom learning.

Students' Collaboration Skills

Students' collaboration skills were also measured using a non-participant observation technique. In this approach, the researcher observed classroom interactions without directly participating in the teaching and learning activities (Sugiyono, 2019). Observations were conducted using a structured checklist based on a Likert scale, which was completed during classroom learning activities.

The indicators used to assess collaboration skills were adapted from previous studies conducted by (Sufiyah & Wijaya, 2024), (Syarofah et al., 2023), and (Nurmayasari et al., 2023) The collaboration instrument consisted of four main aspects: task focus and participation, shared responsibility and reliability, listening and discussion, and teamwork. These aspects represent essential elements of collaborative learning where students work together to achieve common goals and contribute actively in group activities (Johnson & Johnson, 2009). he detailed design of the collaboration skills instrument is presented in Table 4.

Table 4. Collaboration Skills Instrument Design

No	Aspect	Indicator	Item Number
1	Task Focus and Participation	Consistently focuses on assigned tasks and supports group efforts	1–7
2	Shared Responsibility and Reliability	Completes assigned tasks responsibly and on time	8–13
3	Listening and Discussion	Listens respectfully, interacts, and contributes to discussions	14–20
4	Teamwork	Contributes to achieving overall group objectives	21–27

Based on the four aspects presented in Table 4, a validity test was conducted to determine the appropriateness of each item in measuring collaboration skills. The results of the validity analysis are presented in Table 5.

Table 5. Collaboration Skills Validity Test Results

Item	R Calculated	R Table	Decision
1	0.298	0.1672	Valid
2	0.141		Invalid
3	0.236		Valid
4	0.815		Valid

Item	R Calculated	R Table	Decision
5	0.828		Valid
6	0.848		Valid
7	-0.124		Invalid
8	0.874		Valid
9	0.846		Valid
10	0.872		Valid
11	0.721		Valid
12	0.813		Valid
13	0.861		Valid
14	0.000		Invalid
15	-0.72		Invalid
16	-0.134		Invalid
17	0.489		Valid
18	0.713		Valid
19	-0.050		Invalid
20	-0.094		Invalid
21	0.888		Valid
22	0.827		Valid
23	0.807		Valid
24	0.862		Valid
25	0.880		Valid
26	0.704		Valid
27	0.881		Valid

The results indicate that 20 out of 27 items met the validity criteria, as their correlation coefficients exceeded the r-table value of 0.1672. Item 20 showed the highest validity value with an r-calculated value of 0.888, followed by item 27 with 0.881, and item 25 with 0.880. These items demonstrate very strong correlations, indicating that they are highly effective in measuring students' collaboration skills.

Although several items demonstrated particularly high correlations, the remaining valid items also contributed positively to the measurement of collaboration skills. According to (Field, 2024), item–total correlation values that exceed the critical threshold indicate that the item is consistent with the construct measured by the instrument.

On the other hand, seven items (items 2, 7, 14, 15, 16, 19, and 20) were declared invalid because their correlation values were lower than the r-table value. The r-calculated values for these items were 0.141, -0.124, 0.000, -0.072, -0.134, -0.050, and -0.094, indicating weak or negative relationships with the total score. Therefore, these items were excluded from further analysis.

Overall, 74.07% of the items were classified as valid, while 25.92% were invalid. This result aligns with the findings of (Septiani et al., 2019) which state that an instrument can be considered acceptable when at least 70% of the items meet the validity criteria. Therefore, the collaboration skills instrument developed in this study can be categorized as feasible for use in measuring students' collaboration abilities.

After eliminating the six invalid items, reliability testing was conducted on the remaining 20 valid items using Cronbach's Alpha. The analysis produced a reliability coefficient of 0.951, indicating a very high level of internal consistency. According to (Tavakol & Dennick, 2011), Cronbach's Alpha values above 0.90 reflect excellent reliability and strong internal consistency among the instrument items. The detailed results of the reliability analysis are presented in Table 6.

Table 6. Collaboration Skills Reliability Test Results

Reliability Statistics

Cronbach's Alpha	N of Items
.951	20

The high reliability value indicates that the instrument consistently measures the same construct, namely collaboration skills. Instruments with strong internal consistency tend to produce stable and dependable results when used repeatedly under similar conditions. This finding is consistent with (Sugiyono, 2019), who states that a reliable instrument is capable of producing consistent measurement results when applied multiple times to the same object.

Therefore, the results of this study demonstrate that the developed collaboration skills instrument not only meets statistical

feasibility requirements but also has practical potential for assessing students' collaborative competencies in classroom learning contexts.

CONCLUSION

Based on the validity test results, all 11 items in the communication skills observation instrument were declared valid because the calculated correlation values. The reliability test produced a Cronbach's Alpha value falls into the very high reliability category, indicating that the instrument has excellent internal consistency. In contrast, the collaboration skills observation instrument showed that 20 items were valid while 7 items were invalid. The reliability test yielded a Cronbach's Alpha value is also categorized as very high reliability. These findings indicate that the developed observation instruments are feasible for assessing students' communication and collaboration skills in classroom learning. The instruments can assist teachers in evaluating students' abilities to express ideas, participate in discussions, present arguments, and collaborate effectively with group members more systematically and objectively. The use of validated instruments enables communication and collaboration skills to be assessed more accurately, thereby providing meaningful information that can support the improvement of learning quality and the development of students' 21st-century competencies.

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