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Effectiveness of Collaboration Skills Assessment Instrument in Physics Practicum: A Case Study with the Rasch Model

Saiyidah Mahtari[1], Syihabuddin Syihabuddin[2] , Agus Setiawan[3] , Mustika Wati[4]
[1]Universitas Pendidikan Indonesia, Bandung, Indonesia, saiyidah_pfis@ulm.ac.id
[2]Universitas Pendidikan Indonesia, Bandung, Indonesia, syihabuddin@upi.edu
[3]Universitas Pendidikan Indonesia, Bandung, Indonesia, agus_setiawan@upi.edu
[4]Universitas Lambung Mangkurat, Banjarmasin, Indonesia, mustika_pfis@ulm.ac.id

Corresponding Author: syihabuddin@upi.edu

Abstract: Collaboration skills in the 21st century are becoming an important aspect in education and the professional world. This study aims to analyse the validity and reliability of collaboration skills instruments using the Rasch Model. Quantitative method with survey design was applied to 100 students of Physics Education Study Programme at Universitas Lambung Mangkurat. Data was collected through a questionnaire consisting of 20 items, and analysis was conducted to measure item difficulty as well as individual ability using Rasch Model. The analysis results showed that after data cleaning, the assessment instrument had good reliability, with Person Reliability reaching 0.80 and Item Reliability 0.90. Results also identified that the most difficult collaboration skills to achieve were individual accountability and personal responsibility, whereas positive interdependence was relatively easier to achieve. This research provides important insights for collaboration skills assessment instruments in the context of physics education practicum, as well as recommendations for improving collaboration skills.

Keyword: Collaboration Skills, Rasch model, reliability, suitability

INTRODUCTION

In the 21st century, collaboration skills have emerged as an essential element in facing increasingly complex global challenges. Technological transformation and global workforce development have changed the way teams operate, where collaboration skills not only support individual success and organisational effectiveness, but also contribute to the advancement of society as a whole (Hendarwati et al., 2021). In the context of education, institutions have a great responsibility in preparing students for a world of work that highly demands collaborative skills, critical thinking, and creativity (Siswanto et al., 2020). Collaboration skills also play an important role in physics practicum, where collaboration not only deepens students' understanding of scientific concepts, but also supports the development of the "4Cs" - critical thinking, creativity, collaboration, and communication.

In a practicum environment, students are faced with the challenge of working in teams, which improves individual learning outcomes while building a sense of community that is essential for motivation and engagement in the learning process (Bryan et al., 2011). Collaboration skills provide a foundation for students to adapt to an increasingly interdisciplinary and collaborative professional world (Hall et al., 2018; Belli & Nenoff, 2022). Therefore, it is important to nurture collaboration skills in educational settings so that students are prepared to contribute meaningfully to scientific advancement in the future. However, the assessment of collaboration skills in physics practicum is often overlooked, despite its important role in the development of teamwork competencies among students. This gap in assessment can be caused by various factors, including methodological, structural and pedagogical shortcomings. Reliance on traditional assessment techniques that emphasise individual performance is one of the main problems. Many physics laboratories tend to focus on developing individual competencies, such as technical skills and conceptual understanding, without giving adequate attention to the evaluation of students' collaborative abilities. This potentially hinders students' understanding of the importance of collaboration in academic and professional contexts.

The assessment of collaboration skills in physics practicum often faces various challenges that make the evaluation of students' cooperation skills less than optimal. One of the main challenges is the reliance on self-assessment, which is often less valid due to the subjectivity bias of the learners themselves. In addition, effective formative assessment is often lacking, so the opportunity to provide constructive feedback on the collaboration process is not maximised (Dhina et al., 2021). Assessment methods in the laboratory focus more on individual performance such as mastery of concepts and technical skills, often neglecting collaborative aspects. In many cases, assessment instruments in physics laboratories are designed to evaluate academic achievement in isolation, without considering how students interact and work together in groups. This creates gaps in assessment, as collaboration skills become an aspect that is less systematically measured. As a result, students are less prepared to face the challenges of the world of work that relies heavily on the ability to collaborate in teams. This shortcoming points to the need for a more comprehensive assessment method, which not only measures individual achievement, but also evaluates the effectiveness of interaction in teams.

Challenges in the evaluation of collaboration skills also include reliance on self-assessment which lacks validity and reliability (Dhina et al., 2021). The Rasch model is a statistical tool that is recognised as an effective method in measuring latent traits, including collaboration skills in educational contexts, particularly in physics practicum. It offers significant advantages over traditional assessment approaches, especially when dealing with ordinal data that is often not handled appropriately. The Rasch Model's advantage lies in its ability to convert ordinal data into interval measures, which allows for a more accurate comparison between student ability and item difficulty. In addition, the Rasch Model also addresses the issue of differential item functioning (DIF), which is important for ensuring fairness in assessment in diverse classrooms (Bennett, 2023). Through this approach, the interaction between students and assessment items can be analysed in depth, providing useful diagnostic insights for educators in identifying areas that require special attention (Widoretno & Hidayati, 2022; Bennett, 2023; Planinić et al., 2019; Aslanoğlu & Şata, 2023).

Most previous studies have not provided a comprehensive solution to assess collaboration skills in physics laboratories. Many studies only focus on cognitive and technical aspects, so collaborative aspects are often overlooked. Therefore, this study aims to fill the gap by analysing the validity and reliability of collaboration skills instruments using the Rasch Model in the context of physics practicum. This research is expected to contribute towards a better understanding of students' collaborative competence.

METHOD

This study used a quantitative design with a survey method to systematically collect data on student collaboration skills in physics practicum. The research subjects consisted of

100 students of physics education study programme at Lambung Mangkurat University. Sampling techniques were used to ensure valid representation of the sample. The purposive sampling technique was used to ensure that the sample represented the relevant population, namely students who had participated in a series of physics practicum.

The assessment instrument was developed based on an adaptation of collaboration theory and education, covering five indicators of collaboration skills: positive interdependence, face-to-face interaction, individual accountability and personal responsibility, communication skills, and group work skills. The instrument was designed to evaluate the extent to which students apply these skills in the context of physics experiments in the laboratory. The construct validity of the instrument was tested through assessment by experts in physics education and psychometrics, to ensure the relevance and accuracy of the instrument in measuring collaboration skills (Creswell, 2014).

The collected data were processed using Excel software before being analysed with the Rasch Model through the Winsteps application. The Rasch model was chosen because of its advantages over classical analysis, especially in measuring in detail the level of item difficulty and individual ability on a logit scale (Stone & Wright, 1999; Sumintono & Widhiarso, 2015). Analyses include measuring item difficulty and individual ability using Mean Square (0.5 < MNSQ < 1.5), Z-Standard (-0.2 < ZSTD < +2.0), and Pt-measure Correlation (0.4 < Pt Measure Corr < 0.85). In addition, the evaluation included question distribution (splits), item reliability, and individual reliability. These analyses allowed the identification of potential problems on items or individuals as well as the assessment of the reliability and validity of the instrument.

RESULTS AND DISCUSSION

At the initial stage of the analysis, data cleaning was performed to detect and address the presence of extreme responses and misfit items, which could significantly affect the results of the analysis.

Table 1. Summary of Statistics of N-100 Respondents (Pre-Data Cleaning)

	Total Score	Count	Measure	Model Error	Infit		Outfit	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	34.5	10.0	2.27	0.87				
Standard Deviation	4.1	.0	2.20	.39				
Max.	40.0	10.0	5.98	1.86				
Min,	22.0	10.0	-3.80	.66				
Real RMSE	1.00	True SSD	1.95	Separation	1.95	Person Reliability .79		
Model RMSE	.95	True SSD	1.97	Separation	2.07	Person Reliability .81		

Standard Error of person Mean= .22
Cronbach Alpha person raw test reliability= .88

Based on Table 1, before data cleaning, there are indications of significant outlier data, as seen from the maximum value in Measure which reaches 5.98. This extreme value indicates the presence of individuals with very high ability, which can be an outlier in the context of Rasch model measurement. The Rasch model is designed to measure continuous ability within a range, and extreme values may indicate that the individual is outside the expected range of measurement, making the model less effective for measuring differences between individuals at that level (Hidayat et al., 2023).

Table 2. Summary of Statistic of N-88 Respondents (Post-Data Cleaning)

		Count	Measure		Infit	Outfit

	Total Score			Model Error	MNSQ	ZST D	MNSQ	ZSTD
Mean	33.7	10.0	1,76	0.74	1.00	-0.5	1.04	-.08
Standard Deviation	3.8	.0	1.84	.12	.54	1.25	.71	1.22
Max.	39.0	10.0	4.66	1.08	2.83	2.86	3.75	2.54
Min,	22.0	10.0	-3.8	.66	.12	-2.57	.11	-2.56
Real RMSE	.82	True SSD	1.63	Separation 2.00		Person Reliability .80		
Model RMSE	.75	True SSD	1.67	Separation 2.23		Person Reliability .83		

Standard Error of person Mean= .20
Cronbach Alpha person raw test reliability= .85

In Table 1, before data cleaning, the maximum value in Measure reached 5.98, which indicates the presence of individuals with very high ability levels, but these are potential outliers. These outliers have the potential to distort model parameter estimates and result in measurement inaccuracies (Aguado et al., 2024). These extreme values indicate that there are respondents whose answers do not fit the Rasch model, both in terms of consistency and filling behaviour (Bueno-Sanchez et al., 2024). This is reinforced by the relatively large Standard Deviation (2.20 for Measure), indicating high variation between individuals. The Person Reliability value before data cleaning of 0.79 is also still in the good enough category, but still shows instability in measurement due to outliers (Aguado et al., 2024).

After cleaning the data listed in Table 2, the data distribution became more homogeneous, as seen from the decrease in the maximum value of Measure to 4.66 and the decrease in Standard Deviation to 1.84. This indicates that individuals with extreme abilities have been removed, so that the data distribution is more even and in accordance with the assumptions of the Rasch model. In addition, the Infit and Outfit Mean Square (MNSQ) are close to 1.00, indicating that the data remaining after cleaning fit the model better. ZSTD values close to 0 also indicate that there are no significant mismatches in the resulting data, making the analysis more valid (Aguado et al., 2024). This reinforces the conclusion that the data remaining after cleaning is more representative and follows the assumptions of the Rasch model (Hidayat et al., 2023).

The reliability of the instrument increased after data cleaning. Person reliability increased from 0.79 to 0.80 in Real RMSE, and from 0.81 to 0.83 in Model RMSE. This shows that the instrument became more consistent in measuring students' collaboration skills after the inappropriate data was removed. Although there was a slight decrease in the Cronbach Alpha value from 0.88 to 0.85, this decrease is considered reasonable because the removal of extreme outliers can reduce variation, but still maintain the internal consistency of the instrument at a high level (Huang et al., 2023). Separation values of 2.00 for person and 3.02 for item indicate that this instrument has a good ability to distinguish student ability levels and item difficulty levels.

Table 3 Summary of Person and Item Statistics

	Person	Item
N	88	10
Measure (Logit)		
Mean	1.76	0.00
Standard deviation	1.83	0.80
Standard error	1.63	0.76
Separation	2.00	3.02
Reliability	0.80	0.90
Cronbach's Alpha	0.85	

Of the 88 respondents remaining after data cleaning, the average Measure (logit) of respondents was 1.76, with a Standard Deviation of 1.83. This shows that there is variation in collaboration ability between students, although the variation is still relatively controllable after the removal of outlier data. The Standard Error of 1.63 shows that the measurement error is relatively small, which means that this measurement can be considered quite accurate. The Separation level of 2.00 with Reliability 0.80 indicates that the instrument is able to distinguish groups of individuals based on their ability level quite well. With Person Reliability close to 0.80, this instrument is considered to have a fairly reliable ability to measure student collaboration skills in physics laboratory practice. On the item aspect, the average Measure item is 0.00 (as expected in the Rasch model), with a Standard Deviation of 0.80, which indicates that there is little variation in difficulty between items. This can be considered positive as it shows consistency in the difficulty of each item given to students.

Table 4. Respondent's of collaboration skills

Indicators	Logit Mean
Positive interdependence	0,545
Face-to-face interaction	-0,560
Individual accountability and personal responsibility	-1,025
Communication skills	-0,210
Group work skills,	0,135

The results of this study indicate that student collaboration skills in physics lab practicum play a significant role in the successful implementation of experiments. Based on the analysis using the Rasch Model, there are variations in the achievement of each indicator of collaboration skills, which are then associated with student performance in the context of physics laboratory practicum. Based on Table 4, which presents the logit mean of the five indicators of collaboration skills, an in-depth analysis of student performance in each aspect of the measured collaboration skills can be conducted. The logit mean shows the relative position of students' ability towards each indicator, where a positive logit value indicates that the aspect is easier to achieve by the majority of respondents, while a negative logit indicates that the aspect is relatively more difficult to achieve (Leske et al., 2015).

The positive interdependence indicator which has the highest logit mean value (0.545) indicates that students tend to be able to work well together in sharing responsibilities during practicum. This is in accordance with the findings of Khairani et al. (2024), where good collaboration skills can improve experimental efficiency. Positive interdependence is evident when students share roles in the task of assembling experimental equipment and collectively retrieving experimental data, where each member has certain responsibilities that contribute to the final result.

The group work indicator with a positive logit mean (0.135) indicates that students are able to work together effectively in groups, although there is still room for improvement. In physics practicum activities, this skill is very important because the success of experiments often depends on good coordination between team members (Firmansyah, 2022). With good group work skills, students can divide tasks more efficiently, namely when arranging equipment or processing data, so that the experimental process runs more smoothly and has minimal errors. However, the communication and face-to-face interaction indicators showed negative logit means (-0.210 and -0.560), indicating difficulties in communicating effectively during the practicum. This could potentially lead to miscommunication, which could have a negative impact on experimental results, such as errors in tool settings or interpretation of experimental results. This difficulty can also slow down the experiment as team members cannot coordinate well in practical situations that require quick responses (Johnson & Johnson, 2014). Therefore, communication skills should be given special attention in further development.

The indicator of individual accountability and personal responsibility which has the lowest logit mean (-1.025) indicates that students struggle to demonstrate personal responsibility while working in groups. This failure to assume individual responsibility can lead to other team members having to bear a greater burden, which ultimately decreases the efficiency and effectiveness of the experiment. Over-reliance on other members not only decreases group performance, but also reduces students' ability to learn independently in practical situations that demand personal responsibility (Cavaco et al., 2013).

Collaboration skills in physics practicum are interrelated with each other. Effective communication can affect individual accountability, because through clear communication, each group member can better understand their respective roles and responsibilities (Kustijono, 2018). Without good communication, coordination in the execution of experiments can be disrupted, which will reduce the overall performance of the group (Milton et al., 2022). In this study, difficulties in communication are evident from the low logit mean on the indicator, indicating that students need further development in this skill. Conversely, improvements in positive interdependence skills can strengthen group work, where students feel mutually supportive and understand that the success of the experiment depends not only on one individual, but on the cooperation of all team members. Students who have a strong understanding of the importance of collaboration tend to be more proactive in contributing and assuming responsibility, thus increasing the success of the practicum.

The results of this study provide significant practical implications for the management of physics practicum in the laboratory. One of the implications is the need for a more structured learning approach in developing students' collaboration skills. For example, setting up a discussion session after each experiment can help students evaluate their collaboration performance, as well as understand the role of communication and responsibility in group performance. In addition, the use of a role rotation system, where each student takes turns leading the group during the experiment, can encourage increased individual accountability.

CONCLUSION

Based on the results of analyses conducted on the student collaboration skills assessment instrument using the Rasch Model, it was found that the instrument showed an adequate level of reliability, with Person Reliability of 0.80 and Item Reliability of 0.90 after data cleaning.Student collaboration skills varied, with positive interdependence as the easiest aspect to achieve, while individual accountability and personal responsibility were the most difficult to achieve. This study highlights the need for a more comprehensive assessment approach in physics practicum to improve students' collaboration skills, and provides a strong basis for the development of better collaboration skills assessment instruments in the future.

REFERENCES

Aguado, V., Sorrel, M. A., Corral, S., & Martínez-Pampliega, A. (2024). Levels of Expressed Emotion Scale: Spanish validation for the general adolescent population and development of a short version.

Almubarak, A. (2023). Assessing students understanding of chemical bonds material by rasch modelling. Indonesian Journal on Learning and Advanced Education (Ijolae), 5(3), 217-232. https://doi.org/10.23917/ijolae.v5i3.22242

Anggita, G., Fatmaryanti, S. D., Ashari, A., & Kurniawan, E. S. (2023). Designing interactive electronic module with collaborative team work in physics learning. Radiation: Journal of Physics Education Periodical, 16(2), 80-89. https://doi.org/10.37729/radiasi.v16i2.3556

Aslanoğlu, A. and Şata, M. (2023). Examining the rater drift in the assessment of presentation skills in secondary school context. Eğitimde Ve Psycholojide Ölçme Ve Değerlendirme Dergisi, 14(1), 62-75. https://doi.org/10.21031/epod.1213969

Bennett, R. (2023). Refinement and validation of the empowerment audiology questionnaire: rasch analysis and traditional psychometric evaluation. Ear & Hearing. https://doi.org/10.1097/aud.0000000000001449

Belli, S. and Nenoff, J. (2022). Cooperation in science and innovation between latin america and the european union. Journal of Open Innovation Technology Market and Complexity, 8(2), 94. https://doi.org/10.3390/joitmc8020094

Bryan, R. R., Glynn, S. M., & Kittleson, J. M. (2011). Motivation, achievement, and advanced placement intentions of high school students learning science. Science education, 95(6), 1049-1065.

Bueno-Sánchez, L., Alhambra-Borrás, T., Bonilla-Campos, A., & Durá-Ferrandis, E. (2024). Psychometric characteristics of the core FertiQoL questionnaire in a Spanish sample of infertile women. Anales de Psicología/Annals of Psychology, 40(3), 364-372.

Cavaco, S., Gonçalves, A., Pinto, C., Almeida, E., Gomes, F., Moreira, I., ... & Teixeira-Pinto, A. (2013). Trail Making Test: Regression-based norms for the Portuguese population. Archives of clinical neuropsychology, 28(2), 189-198.

Chang, C., Chang, M., Liu, C., Chiu, B., Chiang, S., Chen, W., ... & Chai, C. (2017). An analysis of collaborative problem-solving activities mediated by individual-based and collaborative computer simulations. Journal of Computer Assisted Learning, 33(6), 649-662. https://doi.org/10.1111/jcal.12208

Hall, K., Vogel, A., Huang, G., Serrano, K., Rice, E., Tsakraklides, S., ... & Fiore, S. (2018). The science of team science: a review of the empirical evidence and research gaps on collaboration in science. American Psychologist, 73(4), 532-548. https://doi.org/10.1037/amp0000319

Dhina, M., Hadisoebroto, G., Mubaroq, S., & Gustiana, I. (2021). Implementation of digital performance assessment to measure pharmacy physics laboratory skills. Momentum Physics Education Journal, 65-72. https://doi.org/10.21067/mpej.v5i1.5146

Firmansyah, J., Suhandi, A., Setiawan, A., & Permanasari, A. (2022). Evaluation of virtual workspace laboratory: cloud communication and collaborative work on project-based laboratory. Journal on Efficiency and Responsibility in Education and Science, 15(3), 131-141. https://doi.org/10.7160/eriesj.2022.150301

Futri, V. I., Rosnawati, R., & Rahim, A. (2022). Rasch Model Study on Mathematics Examination Test Using Item Response Theory Approach. International Journal on Emerging Mathematics Education (IJEME), 6(1).

Garrison, D. R., Anderson, T., & Archer, W. (2020). Critical thinking, cognitive presence, and computer conferencing in distance education. American Journal of Distance Education, 15(1), 7-23.

Hall, K., Vogel, A., Huang, G., Serrano, K., Rice, E., Tsakraklides, S., ... & Fiore, S. (2018). The science of team science: a review of the empirical evidence and research gaps on collaboration in science... American Psychologist, 73(4), 532-548. https://doi.org/10.1037/amp0000319

Hattie, J., & Timperley, H. (2019). The power of feedback. Review of Educational Research, 89(3), 248-272.

Hedlund, J., Bodin, Ö., & Nohrstedt, D. (2020). Policy issue interdependency and the formation of collaborative networks. People and Nature, 3(1), 236-250. https://doi.org/10.1002/pan3.10170

Hendarwati, E., Nurlaela, L., & Bachri, B. (2021). Collaborative problem-solving based on mobile multimedia. International Journal of Interactive Mobile Technologies (Ijim), 15(13), 16. https://doi.org/10.3991/ijim.v15i13.23765

Hidayat, M. L., Astuti, D. S., Sumintono, B., Meccawy, M., & Khanzada, T. J. (2023). Digital competency mapping dataset of pre-service teachers in Indonesia. Data in Brief, 49, 109310.

Khairani, M., Jasruddin, J., & Arsyad, M. (2024). The effect of stem approach and student's collaboration ability on physics problem solving skill. International Journal of Social Science and Human Research, 07(03). https://doi.org/10.47191/ijsshr/v7-i03-22

Kurniawan, D., Kurniawan, D., & Irdianti, I. (2019). Physics education students' science process skills. International Journal of Evaluation and Research in Education (Ijere), 8(2), 293. https://doi.org/10.11591/ijere.v8i2.16401

Kustijono, R. (2018). The effect of scientific attitudes toward science process skills in basic physics practicum by using peer model. International Journal of GEOMATE, 15(50). https://doi.org/10.21660/2018.50.ijcst50

Leske, D., Holmes, J., Melia, B., Miller, A., Jackson, J., Suh, D., ... & Kieser, T. (2015). Evaluation of the intermittent exotropia questionnaire using rasch analysis. Jama Ophthalmology, 133(4), 461. https://doi.org/10.1001/jamaophthalmol.2014.5622

Milton, J., Andersson, A., Åberg, N. D., Gillespie, B. M., & Oxelmark, L. (2022). Healthcare professionals' perceptions of interprofessional teamwork in the emergency department: a critical incident study. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 30(1). https://doi.org/10.1186/s13049-022-01034-0

Pilowsky, J. K., Elliott, R., & Roche, M. A. (2024). Data cleaning for clinician researchers: Application and explanation of a data-quality framework. Australian Critical Care.

Planinić, M., Boone, W., Sušac, A., & Ivanjek, L. (2019). Rasch analysis in physics education research: why measurement matters. Physical Review Physics Education Research, 15(2). https://doi.org/10.1103/physrevphyseducres.15.020111

Rosidin, U., Sesunan, F., & Fitria, D. (2022). Development of assessment instruments to measure collaboration and responsibility skills of students in physics learning on cased method-based. AMPLITUDO: Journal of Science and Technology Innovation, 1(2), 29-35. https://doi.org/10.56566/amplitudo.v1i2.7

Schnaubert, L. and Bodemer, D. (2018). What interdependence can tell us about collaborative learning: a statistical and psychological perspective. Research and Practice in Technology Enhanced Learning, 13(1). https://doi.org/10.1186/s41039-018-0084-x

Sebok-Syer, S., Chahine, S., Watling, C., Goldszmidt, M., Cristancho, S., & Lingard, L. (2018). Considering the interdependence of clinical performance: implications for assessment and entrustment. Medical Education, 52(9), 970-980. https://doi.org/10.1111/medu.13588

Shimizu, I., Kikukawa, M., Tada, T., Kimura, T., Duvivier, R., & Vleuten, C. (2020). Measuring social interdependence in collaborative learning: instrument development and validation. BMC Medical Education, 20(1). https://doi.org/10.1186/s12909-020-02088-3

Siswanto, S., Trisnowati, E., Firmadani, F., Haryati, S., Aryanti, D., & Andrianto, H. (2020). Workshop on inquiry learning based on virtual laboratory in Magelang for preparing natural sciences teachers in 21st century: an evaluation of implementation's programme. Indonesian Journal of Education and Learning, 3(2), 367. https://doi.org/10.31002/ijel.v3i2.3036

Smith, J., Johnson, L., & Lee, R. (2022). Collaborative skills in education: A comprehensive guide. Educational Psychology Review, 34(4), 567-589.

Sung, Y., Kim, H., Joo, S., Kim, S., Ndosi, M., & Cho, S. (2020). Developing the korean educational needs assessment tool (korean enat) in rheumatoid arthritis: cross-cultural validation using rasch analysis. The Korean Journal of Internal Medicine. https://doi.org/10.3904/kjim.2019.422

Torrado, M., Blanca, M. J., & García-Castro, F. J. (2024). Future anxiety in young Spanish adults: Psychometric properties of the Dark Future Scale. Anales de Psicología/Annals of Psychology, 40(1), 31-37.

Widoretno, S. and Hidayati, N. (2022). Reflection on student collaboration skills assessment by biology teachers. Journal of Science Education Research, 8(3), 1102-1107. https://doi.org/10.29303/jppipa.v8i3.1258

Yang, S., Tsou, M., Chen, E., Chan, K., & Chang, K. (2011). Statistical item analysis of the examination in anaesthesiology for medical students using the rasch model. Journal of the Chinese Medical Association, 74(3), 125-129. https://doi.org/10.1016/j.jcma.2011.01.027

Zhong, Q. (2021). Fostering group autonomy through collaborative learning in an online environment. Studies in Self-Access Learning Journal, 79-91. https://doi.org/10.37237/120106