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Teacher Assessment Profile of Student Collaboration Skill in Science and Biology Learning

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Abstract. Education is a means of creating a generation that is capable of coping with 21st- century challenges. The generation of the 21st century must master various skills that support high-order thinking. One of those skills is collaboration skill. This study aims to analyze the assessment profile of collaboration skills performed by Junior High School science teachers and Senior High School biology teachers in Solo Raya. This research employed a survey method involving 125 samples, comprising 49 Junior High School science teachers and 76 Senior High School biology teachers in Solo Raya. Collecting data use an instrument which was a development of the collaboration skill aspect based on NEA and P21. The data analyzed using the Rasch model. It was found that the items of the questionnaire in each construct had varied discriminatory powers showing that the instrument had a measuring ability. The overall analysis result of the respondents' opinions was above the mean logit score (+0.00 logit) which proved that the teachers had implemented the assessment of collaboration skills. The results of the univariate analysis based on the respondents' characteristics concluded that Junior High School science teachers (39.2%) had assessed the students' collaboration skills.

Keywords: *Assessment, collaboration skills, Rasch*

INTRODUCTION

Globalization inevitably brings impacts on education, which is a means of producing a vigorous generation to face up to all challenges of the 21st century. The government has designed 21st century learning through a student-oriented 2013 curriculum. Students are guided to master 4Cs (Critical Thinking, Communication, Collaboration, and Creativity) as provisions for the challenges of the 21st century. According to Trilling & Fadel (2009), Partnership for 21st Century Learning (2012), and Ledward & Hirata (2011), 21st-century skills that include 4Cs are crucial in achieving the required transformation to face the industrial era 4.0.

Research conducted by Trilling and Fadel (2009) depicts the low level of competence of all graduates, including higher education graduates, in terms of communication, critical thinking, professionalism, collaboration, technological expertise, project management, and leadership. It is in line with the data published by the ASEAN Business Outlook Survey in 2018 showing that Indonesia is one of the tops countries with the biggest foreign investment (OECD, 2018). This fact indicates that Human Resources in Indonesia are both low-competence and low-cost. Therefore, an educational program is needed to produce highly skilled graduates who will ultimately generate high-quality local products (Redhana, 2019).

A high-quality product cannot be produced by someone alone. It needs a collaboration to build a productive atmosphere for discussion that hones one's critical thinking and eventually leads to creativity. A single individual may not be able to produce a superior product due to limited expertise; therefore, collaboration is required.

Collaboration skills are a very crucial aspect that must be owned by the next generations for the sake of the nation's progress (Redhana, 2019).

Collaboration is an interactive process among individuals within either formal or informal negotiations that are interrelated and done simultaneously aiming to plan and carry out something or resolve a problem (Thomson et al., 2009). To follow a discussion, every participant must have good collaboration skills to create a smooth interaction and achieve common goals.

In schools, collaboration skills are trained using a collaborative approach in the hope that students can collect more knowledge through dialogues and sharing and build a mindset of cooperation. Collaborative learning is an approach of using small groups to achieve the same goal or solve a problem (Sulistyowati, 2017). An important thing to highlight when implementing collaborative learning is that the students must solve the same problem; they do not do separate or irrelevant tasks individually (Laal, 2013). Therefore, the students will learn how to work cooperatively and build a conceptual understanding with other group members when solving a problem (J. Boone et al., 2014).

Collaborative skills training requires an evaluation to know the success of an institution in training collaboration skills to the students. According to OECD (2003), Programme for International Student Assessment (PISA) is designed to give a portrayal of the students' abilities in overcoming, structuring, explaining, and effectively solving a problem. Hence, an evaluation of collaboration skills aims to collect some evidence that students can integrate their collaborative skills when solving a problem within a group discussion. According to NEA (2012) and P21 (2011), the indicators of collaboration skills include (1) Responsibility, a sense of responsibility of each group member in carrying out his/her duty to achieve the common goal; (2) Respect, the way one respects others' opinions, decisions, and roles; (3) Contribution, the involvement of each member in the goal accomplishment; (4) Work organization, the way that duties are distributed and rules are determined amongst the group members; (5) Teamwork, all members work cooperatively instead of individually and carry out their roles as part of the team.

The research question of this study is how far the teachers have carried out a collaboration skill assessment with students? Whether the collaboration skill assessment carried out to include all indicators of collaboration skills? Are there differences in assessment collaboration skills carried out by SHS teachers and JHS teachers?

METHOD

This research is survey research that explains the variables being studied. The respondents were 49 Junior High School science teachers and 76 Senior High School biology teachers in the Surakarta residency area. This research was conducted in Surakarta residency including the city of Surakarta, Boyolali, Sragen, Ngawi, Klaten, Sukoharjo, and Wonogiri regencies.

The measurement instrument included a questionnaire that was developed for the teacher. The questionnaire is about how teachers assessing students' collaboration skills. Using a 4-point Likert scale, the questionnaire contained questions of the collaboration skill assessment performed by the teachers during the learning activity.

This research measured to what extent the teachers used collaboration skill assessments during science and biology learning. Educational stages supervised by the teachers and sexes were the collected characteristic aspects. The type of scale used to measure the variable was a 4-point Likert scale. The measurement variable aimed to differ between the ideal condition of students' collaboration assessment and collaboration assessment in the field. The Rach model was employed to analyze the questionnaire data.

The Rasch model was the type of analysis to know to what extent the collaboration assessment was used by the teachers. The Rasch modeling was also an analysis tool to test the validity and reliability of a research instrument, as well as to examine the suitability of person and items simultaneously. Moreover, it could be utilized to analyze responses to the questionnaire items and the correlation between the teachers' responses and the item difficulty levels. The instrument was designed following the variable that had been defined impeccably, then identified by relevant constructs (Sumintono, 2014). The Rasch could also review the items statistically, revise them when necessary, determine the validity, and claim the reliability of the item instruments. The Winsteps program on the table of Summary Statistic was used to see the results of the reliability analysis. Figure 1 provided comprehensive information about the quality of teachers' response patterns and the relevance of the questionnaire items to the teachers (J. Boone et al., 2014). The reliability value of the teachers and questionnaire items are presented in the following table.

Table 1. Reliability Value

No	Range	Category
1	< 0,67	Poor
2	0,67 – 0,80	Fair
3	0,80 – 0,90	Good
4	0,91 – 0,94	Very Good
5	> 0,94	Excellent

The measurement results in the form of an ordinal scale were converted into an interval scale using the Rasch modeling and Winstep software. The Rasch model solved problems related to interval data by accommodating logit transformations and applying logarithms of the odds ratio to the raw data from respondents (J. Boone et al., 2014). The univariate analysis of this research, based on the distribution of person and items on the Wright map, showed to what extent the teachers assessed the students' collaboration. The validity can be seen in the table Outfit Order that portrays the suitability of items in the normal category to measure the level of understanding of how the teachers implemented the collaboration assessment by concerning requirements in Table 2.

Table 2. Validity Criteria of the Question Item

No	Benchmark	Limit Value
1	Outfit Mean Square (MNSQ)	0,5 < MNSQ < 1,5
2	Outfit Z-Standard (ZSTD)	-20 < ZSTD < +2,0
3	Point Measure Correlation (Pt Mean Corr)	0,4 < Pt Mean Corr < 0,85

RESULT AND DISCUSSION

This research involved 125 respondents characterized by the educational levels they worked in as shown in Table 3. According to the following table, 49 respondents (39.2%) were Junior High School science teachers and 76 respondents (60.8%) were Senior High School science teachers.

Table 3. Characteristics of the Respondents

No	Variable	Number of Respondents
1	Junior High School science Teachers	49 (39.2 %)
2	Senior High School science Teachers	76 (60.8%)
	Total	125 (100%)

The analysis results of person and items using the Rasch modeling are depicted in Figure 1. Figure 1 shows that the test result of item reliability of the teachers' profile instrument to assess students' collaboration was 0.99, and the person reliability of the teachers was 0.89 that included in the "good" category. Meanwhile, the Cronbach Alpha (KR-20) measuring the interaction between person and items resulted in a 0.91 reliability value. It proved that the data from the instrument test corresponded with the Rasch model's requirements, so the research instruments were considered reliable to be used. The value of the item separation was eight which signified eight groups of item difficulty levels that showed item discrimination. The value of the person separation was two, implying that there were 2 categories of answers that separated the respondents' agreement. The person categories referred to a group of teachers who had carried out the collaboration assessment and those who had not.

SUMMARY OF 125 MEASURED (EXTREME AND NON-EXTREME) Person

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	98.3	30.0	2.38	.40				
S.D.	9.3	.0	1.46	.14				
MAX.	120.0	30.0	8.20	1.84				
MIN.	80.0	30.0	.06	.30	.21	-3.7	.20	-3.7
REAL RMSE	.47	TRUE SD	1.38	SEPARATION	2.95	Person RELIABILITY	.90	
MODEL RMSE	.42	TRUE SD	1.40	SEPARATION	3.29	Person RELIABILITY	.92	
S.E. OF Person MEAN = .13								

Person RAW SCORE-TO-MEASURE CORRELATION = .98
CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .91

SUMMARY OF 30 MEASURED (NON-EXTREME) Item

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	409.7	125.0	.00	.19	.99	-.3	.98	-.3
S.D.	32.3	.0	1.16	.02	.44	2.7	.55	2.8
MAX.	483.0	125.0	2.23	.28	2.44	7.9	2.95	8.2
MIN.	334.0	125.0	-3.11	.15	.52	-3.7	.47	-4.1
REAL RMSE	.20	TRUE SD	1.14	SEPARATION	5.69	Item RELIABILITY	.97	
MODEL RMSE	.19	TRUE SD	1.14	SEPARATION	6.01	Item RELIABILITY	.97	
S.E. OF Item MEAN = .21								

Figure 1. Summary Statistic of Teacher Performance on Assessing Student Collaboration Skill

Based on the results of data analysis, the instrument construct was considered valid and resulted in a match between the teachers' responses and the instrument. The MNSQ scale ranging from 0.5 to 1.5 was used to know whether the items were accepted. The results showed that 26 items got accepted and the other 4 items did not comply with the requirements (Figure 2). It could be inferred that the teachers had misconceptions about the question items on that instrument. Furthermore, according to ZSTD scale values, an item would be accepted if its value ranges from -2.0 to +20. This shows that 4 out of 30 items did not meet the criteria for good questions because they did not comply with the requirement. Thus, the responses to the invalid items were being omitted to maintain the validity of the data.

Person CLASSES	SUMMARY DIF CHI-SQUARE	D.F.	PROB.	BETWEEN-CLASS MEAN-SQUARE	t=ZSTD	Item Number	Name
2	.8373	1	.3602	.4018	-.0846	1	CG01
2	.0986	1	.7536	.0491	-.8730	2	CG02
2	.0084	1	.9268	.0059	-1.2659	3	CG03
2	.0076	1	.9306	.0045	-1.3000	4	CG04
2	.3246	1	.5688	.1577	-.5037	5	RB05
2	.1956	1	.6583	.0962	-.6780	6	RB06
2	5.5635	1	.0183	2.7697	1.3292	7	RB07
2	.0172	1	.8957	.0088	-1.2125	8	RB08
2	.9943	1	.3187	.4793	.0102	9	RB09
2	1.3983	1	.2370	.6754	.2113	10	RB10
2	.5248	1	.4688	.2550	-.3048	11	RO11
2	.1311	1	.7173	.0649	-.7976	12	RO12
2	.0076	1	.9306	.0045	-1.3000	13	RO13
2	1.7754	1	.1827	.8689	.3743	14	RO14
2	.1218	1	.7271	.0596	-.8215	15	RO15
2	.0571	1	.8111	.0273	-1.0111	16	RO16
2	.1683	1	.6816	.0800	-.7359	17	RO17
2	3.7282	1	.0535	1.8513	.9548	18	CR18
2	.0092	1	.9235	.0059	-1.2663	19	CR19
2	.2487	1	.6180	.1211	-.6004	20	CR20
2	.2274	1	.6335	.1081	-.6393	21	CR21
2	2.8848	1	.0894	1.4044	.7257	22	OW22
2	.0654	1	.7981	.0322	-.9747	23	OW23
2	.0000	1	1.0000	.0007	-1.4597	24	OW24
2	1.0511	1	.3053	.5123	.0475	25	WW25
2	.1964	1	.6576	.0956	-.6798	26	WW26
2	.0234	1	.8784	.0116	-1.1697	27	WW27
2	.8704	1	.3508	.4236	-.0568	28	WW28
2	.0854	1	.7701	.0405	-.9212	29	WW29
2	.0323	1	.8574	.0151	-1.1259	30	WW30

Figure 2. Rasch Analysis of Person DIF

Regarding the teachers' responses to the items, Figure 2 shows the majority of the respondents' responses were above the mean logit (+0.00 logit). In other words, 121 respondents (96.8%) had done and perceived the importance of a collaboration assessment. Assessing students' collaboration skills includes a teachers' must-do list in 21st-century learning because Knowledge Building (Bereiter, 2002) is a leading model for developing 21st-century skills (Scardamalia et al., 2012). In the knowledge-building community, the concept of 'embedded and transformative assessment' has been proposed by Y. Matsuzawa et al (2011). for the assessment of knowledge-building activities, one of them is through the collaboration assessment.

The left side of Figure 2 is the person column, and the right side was the item column. An item with a value above the mean logit (+0.00 logit) denoted that the respondents found it relatively difficult to agree with. On the contrary, an item with a value below the mean logit was considerably easy to agree with. The statement items that were considered difficult for the respondents to agree on were seldom done by most respondents. Teachers who did not answer items in certain categories had never done the collaboration assessment on the aspects designated by the items.

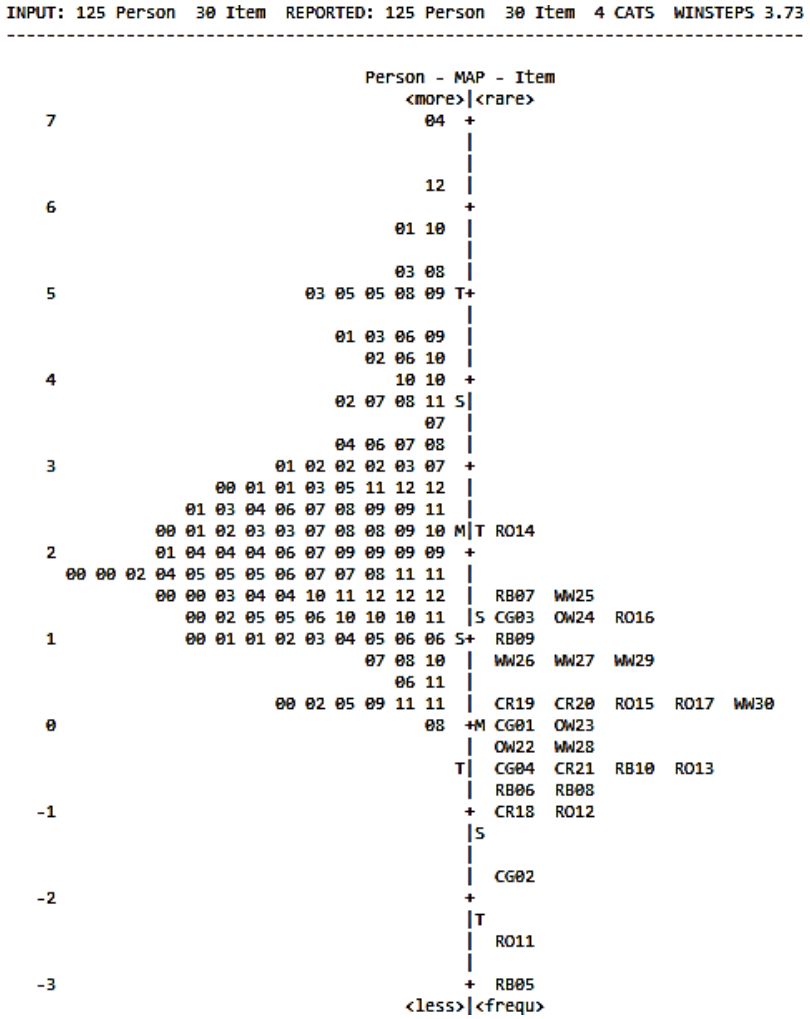

Figure 2. *Wright Map*

According to Figure 2, statements that are hardly answered by the respondents are between the T and S codes at -1 and -2 logit scale, for instance, items RO14, RB07, and WW25. Those items are presented in Table 4.

Table 4. Hard Category Items

Item Codes	Aspects of Collaboration Skills	Items
RO14	Respect	In my opinion, mutual respect will not automatically grow by relying only on the characters of the students, and thus it needs to be trained.
RB07	Responsibility	It would be a problem for me when students get late in their assignment submission.
WW25	Teamwork	I measure the students' ability in establishing ground rules for group work.

According to Table 4, it is noticeable that (1) the vast majority of the respondents considered that mutual respect in group work would automatically grow without any training, (2) the respondents' tolerance of tardiness was quite high which meant they lacked discipline, although training student discipline was both teachers and students' responsibility, and (3) most respondents did not measure the students' ability in establishing ground rules for group work.

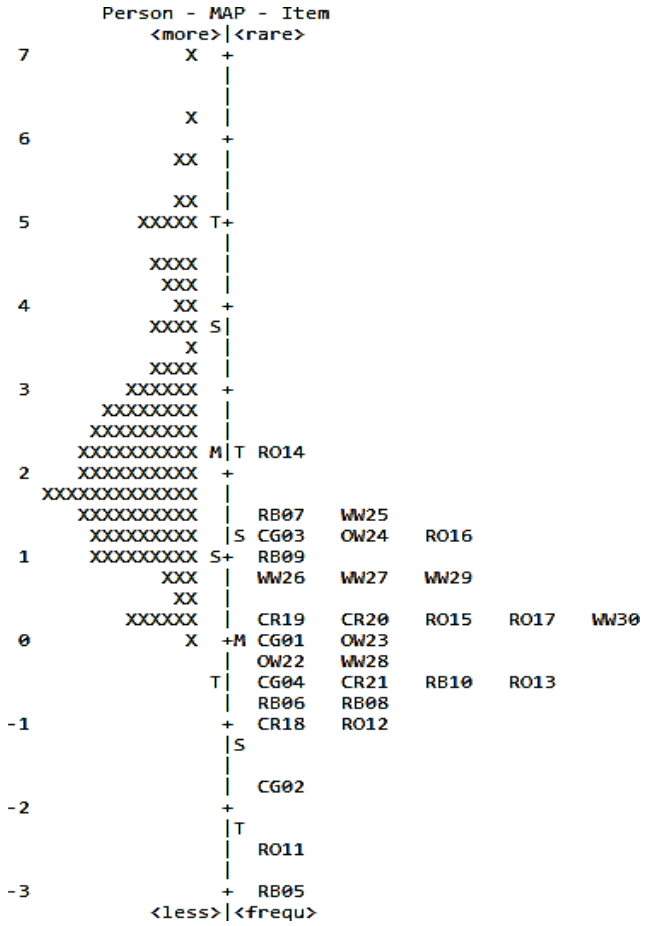

Figure 3. Item Distribution Map

According to Figure 3, aspects of collaboration skills that were mostly measured were items with the WW code, namely the teamwork aspect. Teamwork refers to all group members' skills to work cooperatively instead of individually and carry out their roles as part of the team In general, each aspect of collaboration skills had equally been assessed by the teachers. None of the aspects were excessively measured or not measured at all.

Assessments of collaboration skills performed by all the respondents with the educational level characteristics of Junior High School and Senior High School did not exhibit significant differences. The difference in the assessments can be seen in Figure 4.

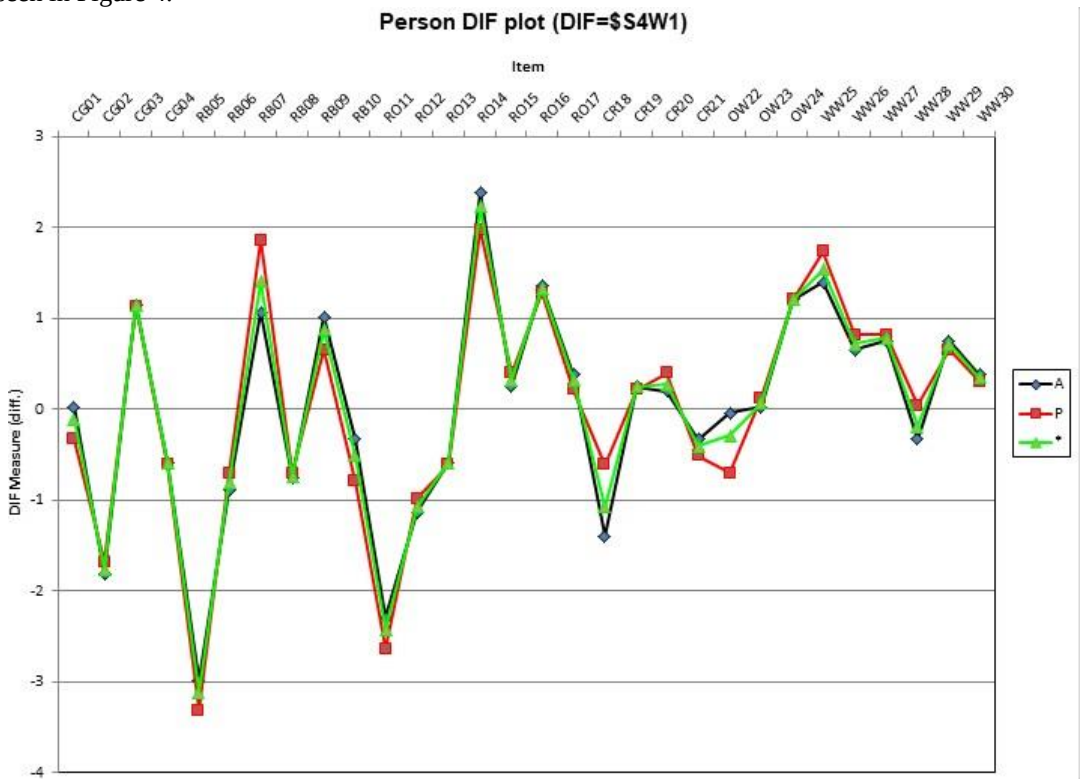

Figure 4. The Graph of Person Differentiation

According to Figure 4, no significant difference was found in the questions that could be answered by Junior High School teachers and Senior High School teachers. A slight difference was detected on items RB07, CR18, and OW22, namely the aspects of responsibility, contribution, and work organization. However, other items on the same aspects were almost identical, and thus no significant difference. This means that items with the same level of difficulty were easily answered by Junior and Senior High School teachers. The similarity in the level of difficulty pointed out the assessments performed by the Junior and Senior High School teachers looked alike.

CONCLUSION

To sum up, the respondents, Junior High School and Senior High School teachers in Solo and its surroundings, had been assessed the students' collaboration skills in every aspect. There was not much difference between the assessments of collaboration skills performed by the Junior and Senior High School teachers. The respondents had also perceived the importance of collaboration skills to be successful in global competitiveness in the 21st century.

To support the assessment of students' collaboration skills, it is important to develop the measuring instrument of collaboration skills and improve the teachers' competence in assessing the students' collaboration skills.

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