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Development of Assessment Instruments to Measure Collaboration and Responsibility Skills of Students in Physics Learning on Cased Method-Based

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Abstract: This study aims to develop an assessment instrument to measure student collaboration and responsibility skills in the context of case-based physics learning that is valid, reliable, and practical. This type of research is called research development (R&D) using the 7 stages adapted from (Borg & Gall, 1989). Product validation was carried out to assess aspects of construction, substance, and language. The results of expert validation of the assessment instrument to measure collaboration and responsibility skills were 88.72% and 85.43%, with very valid criteria. Then, this assessment instrument was tested on 30 students and analyzed using the Rasch model. Based on the results of the test data analysis, we obtained that: (1) 14 items of the collaboration instrument and 9 items of the responsibility instrument were declared valid; (2) the reliability of the collaboration and responsibility skills assessment instrument was 0.82 and 0.71 with perfect and good criteria; and (3) the average value of the practicality test of the collaboration and responsibility skills assessment instrument was 90.72% and 91.80% with very high criteria.

Keywords: Assessment instrument; Collaboration skill; Responsibility; Case based learning

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Introduction

Education is the foundation of a country's progress. Based on the statement from the OECD on the quality of education, Indonesia is 69th out of the 76 countries. This is in line with the statement from UNESCO data in the 2016 Global Education Monitoring (GEM) Report that Indonesia is 10th out of 14 developing countries. One step that can be taken to improve the quality of education is implementing a curriculum in 2013 (Rusman, 2018). The 2013 curriculum encourages students to develop 4C skills (Verawati *et al.*, 2020). The 4C skills are a set of skills that are included in the type of soft skill that implementation is more valuable than hard skills. One of the skills that are able to face challenges in the 21st century is collaboration skill.

The collaboration skill is also able to encourage and cultivate student character so that if it is used in a good collaboration with each other, it will foster a sense of responsibility in them (Kurniawan, 2020, p. 62). Responsibility is an aspect that is needed by students because this attitude is said to be the main moral in moral education programs (Lickona, 2015, p. 59). This is also consistent with the goals of national education, as stated in the Law of the Republic of Indonesia No. 20 of 2003, which is to develop the potential of students to become students who believe and fear the Almighty, have a noble character, are well-informed, powerful, creative, independent, and become democratic and responsible citizens. Therefore, students are expected to have a high sense of responsibility during the learning process.

The learning process carried out by the teacher should be in accordance with the implementation of the curriculum 2013 that learning is led to be active, independent, critical, problem-solving, team-based, and the use of learning characteristics based on competency (Syam *et al.*, 2018). This is also in line with Government

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Regulation Number 19 of 2005 that states that the learning process in the educational unit is carried out interactively, inspiring, fun, challenging, motivating students to participate actively, and providing sufficient space for the initiative, creativity, and independence by talents, interests, physical development, and psychology of students. One of the appropriate methods to create that learning process is *the case method*.

The case method is a discussion-based learning approach to solve cases or problems. The application of this method will improve critical thinking skills for problem-solving, communication, collaboration, and creativity (Suwandi, 2021). In addition, case-based learning has contributed to improving competence better than conventional learning methods (Kim *et al*., 2006).

The quality of education can also be improved by the values obtained by students (Rosidin, 2017, p. 4). So, a good and unusual scoring system is needed. The assessment of 2013 is known as authentic assessment, which is defined as a real mirror of the student's learning conditions. The activity of authentic assessment involves 3 domains of Bloom's taxonomy, namely cognitive, psychomotor, and affective. Therefore, to measure collaboration and responsibility skills, an appropriate instrument is needed.

Based on preliminary research conducted by physics teachers at SMAN 1, SMAN 10, and SMAN 16 Bandar Lampung, it was found that the teacher has not implemented an objective assessment to measure students' collaboration and responsibility skills because there were no easy, practical, and appropriate assessment instruments at the time of the learning process. In addition, the results of the questionnaire that have been conducted reveal that 45% of the teachers use collaboration and 40% of the teachers use responsibility skills in instrument assessment.

This is also supported by previous research, which states that: (1) 53% of teachers still have not revised the assessment instrument appropriately at the SMA/MA levels (Haryati, 2018); (2) 21st-century skills measurement instruments available in school are still limited, so that assessment is needed that can improve students' collaboration skills (Hermawan *et al*., 2017); and (3) affective assessment instruments are rarely used during the learning process because teachers only focus on cognitive aspects compared to affective and psychomotor aspects (Anggraheni *et al*., 2015). Furthermore, because there is no effective assessment instrument in school, teachers must rely on observation to assess their affective (Kurniawati & Mawardi, 2021); the affective of a responsibility assessment instrument is rarely used in the learning process because 13.3% of teachers do not know how to use an assessment, 13.3% of teachers have not implemented practical assessment, and 80% of teachers struggle to use an affective assessment instrument (Wardani *et al*., 2021).

Based on the statement above, as a step to provide solutions in the process of assessing students' collaboration and responsibility skills in learning physics, especially at SMAN 1, SMAN 10, and SMAN 16 Bandar Lampung, the teacher 100% agrees that the development of assessment instruments measures students' collaboration and responsibility skills. Therefore, the researcher conducted development research entitled "Development of Assessment Instruments to Measure Students' Collaboration and Responsibility Skills in Physics Learning on the Case Method-Based".

Method

This is a research and development (R & D). The method used is based on the development model of Borg & Gall (1989). The Borg and Gall model consists of 10 development stages. However, this development research only uses seven stages, namely: (1) research and information collection; (2) planning; (3) developing a preliminary form of product; (4) preliminary field testing; (5) main product revision; (6) main field testing; and (7) operational product revision.

Research Subject

This development research uses two subjects, namely: research subjects and test subjects. The research subjects are an instrument for assessing student collaboration and responsibility skills. Meanwhile, the test subjects consisted of three groups. The first group is the subject used to conduct a needs analysis consisting of physics teachers. The second group is the subject used to test the validity of the product to be developed, namely expert lecturers and a teacher. Furthermore, the third group is a test subject to determine the practicality of the product, namely the physics teacher.

Product Development Procedures

The stages of product development are described as follows:

(1) Research and information collection were carried out based on needs analysis and relevant study literature;

(2) Planning was by formulating product designs in the initial, content, and final content sections. The design in the initial content consists of cover, preface, table of contents, and rationale. The design of the content consists of a grid, instrument form, rubric, and instrument scoring guidelines. Meanwhile, the design of the final content consists of a final score recapitulation, recommendation, and bibliography;

(3) Developing a preliminary form of the product is the preparation of specifications tailored to each indicator of

collaboration and responsibility skills when solving the cases;
(4) Preliminary field testing is carried out by expert validation tests on the results of the assessment instrument design seen from the substance, language, and construct to know the location of the error in the product;
(5) Main product revision is done by continuing the expert validity test. Based on the results of the previous expert validation test. The stages of ability indicators in the instruments that are not good will be revised again, while the stages of indicators that are not feasible will be replaced with new indicator stages;
(6) Main field testing is done by revising the assessment instrument that has been made. Furthermore, the assessment instrument was tested on 30 students at SMAN 16 Bandar Lampung, especially XI IPA 1. This field test aims to determine the validity and reliability of the instrument for assessing students' collaboration and responsibility skills;
(7) Operational product revision is done by perfecting the final product that has previously been tested by students.

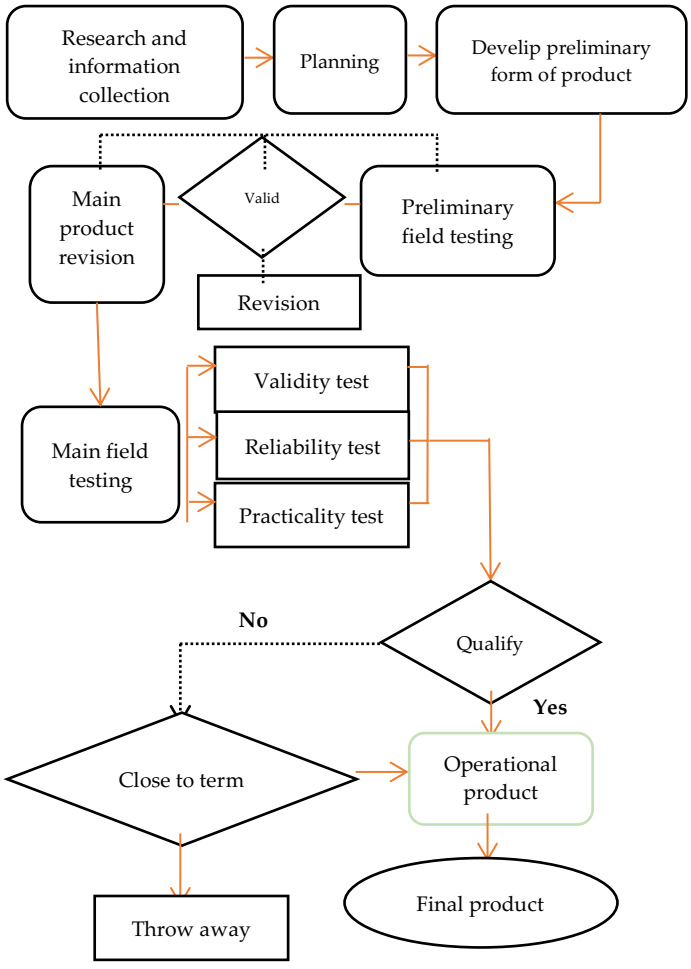

Figure 1. Product development procedures According to Borg & Gall (1989)

Data Analysis Techniques

The questionnaire data analysis technique on the feasibility and practicality analysis of the assessment instrument consisted of testing the validity of the substance, language, and construct. The expert validation test data uses score based on a *Likert scale* with 4 levels, namely 4, 3, 2, and 1, which is then analyzed through calculations as:

$$P = \frac{total\ score\ obtaine}{highest\ score\ count}\ x\ 100\% \quad (1)$$

The result average value of the validity of the assessment instrument are then categorized according to the criteria for the feasibility results in Table 1.

Table 1. Eligibility percentage results criteria

Percentage	Criteria
0 – 20	Invalid
21 – 40	Less
41 – 60	Quite valid
61 – 80	Valid
81 – 100	Very valid

(Yusuf, 2016)

The empirical validity test in this development research uses the Rasch model assisted by Ministep software, the parameters used are as shown in Table 2.

Table 2. Parameters of logit value

Outfit mean square value (MNSQ)	0.5 < MNSQ < 1.5.	Accepted
Outfit Z-standars value (ZSTD)	-2.0 < MNSQ < +2.0	Accepted
Outfit Point Measure Correlation Value (Pt Mean Corr)	0.4 < Pt Measure Corr < 0.85	Accepted

(Sumintono & Widhiarso, 201

The reliability test using the Rasch model with the help of Ministep 4.5.1 software obtained two results of reliability analysis, namely item reliability and person reliability, as shown in Table 3.

Table 3. Cronbach's alpha criteria

Score	Criteria
> 0.8	Very good
0.7 – 0.8	Good
0.6 – 0.7	Enough
0.5 – 0.6	Bad
< 0.5	Very Bad

(Sumintono & Widhiarso, 2015, p. 85)

The item reliability measures the quality of the items in the instrument and person reliability concludes with the consistency of answers from the respondents, the item criteria are presented in Table 4.

Table 4. Criteria for item reliability and person reliability

Score	Criteria
> 0.94	Special
0.91 – 0.94	Very Good
0,.1 – 0.90	Good
0.67 – 0.80	Enough
< 0.67	Weak

(Sumintono & Widhiarso, 2015, p. 85)

Other data that can be used as a reference for the assessment parameters of the Rasch modelling analysis are the INFIT MNSQ and OUTFIT MNSQ values for the person table; if the value obtained is closer to 1.00, it means the better. Meanwhile, the INFIT ZSTD and OUTFIT ZSTD values are getting closer to perfect if the ideal value of 0.0. This means that the quality of the person is getting better.

Analysis of practicality criteria refers to the interval of practicality criteria in terms of teacher response questionnaires presented in Table 5.

Table 5. Practical criteria for learning devices

Score	Criteria
81 – 100	Very high
60 – 80	High
40 – 60	Enough
20 – 40	Low
0 – 20	Very Low

(Riduwan, 2012).

Results and Discussion

This product development is an assessment instrument to measure students' collaboration and responsibility skills in physics learning on a case-method basis. The products resulting from this research development can be seen in Figure 2.

Figure 2. The cover of assessment instrument measure student' collaboration and responsibility skills

Validity. The product validation test consists of expert and empirical tests. The expert validity test consists of substance, language, and construct. The collaboration skill assessment instrument obtained a value of 88.72% with very valid criteria, while the responsibility assessment instrument obtained a value of 85,43% with very valid criteria. The results obtained from the expert validation test are presented in Table 6 and 7.

Table 6. The result of validation test of the student' collaboration and responsibility skills assessment instrument

Collaboration skill

Aspect	Expert			Max score	%	Criteria
	1	2	3			
Construction	26	27	30	32	86,45%	Very valid
Substance	34	37	38	40	90,83%	Very valid
Language	9	11	12	12	88,89%	Very valid
Average percentage					88,72%	Very valid

Responsibility

Aspect	Expert			Max score	%	Criteria
	1	2	3			
Construction	25	27	30	32	85,41%	Very valid
Substance	41	43	46	48	90,31%	Very valid
Language	9	10	10	12	80,56%	Very valid
Average percentage					85,43%	Very valid

Table 7. The result of validation test of student worksheet (LTS)

Aspect	Expert			Max score	%	Criteria
	1	2	3			
Construction	10	12	11	12	91.67%	Very valid
Substance	13	14	15	16	87.50%	Very valid
Language	11	12	12	12	97.22%	Very valid
Average percentage					92.13%	Very valid

The empirical validity test (item fit) is used to identify whether the items function normally or not. There are 15 items question for the instrument of collaboration skill instrument, while they are 10 items question for the instrument of responsibility. As for the results of the analysis of the Ministep 4.5.1 software, the results are presented in Table 8 and 9.

Table 8. Item fit analysis on the collaboration skill assessment instrument

MEASURE	OUTFIT		PT-MEAS-URE	Item
	MNSQ	ZSTD		
-2.96	9.90	5.13	45	A13
-1.29	1.25	.56	52	A14
-1.67	.91	.27	55	A2
-.24	1.00	.16	49	A7
.74	1.03	.20	46	A15
-1.29	.72	-.05	56	A3
.17	1.03	.20	48	A6
.55	.97	.01	49	A4
2.77	.83	-.08	48	A12
1.52	.84	-.40	51	A5
.55	.98	.05	54	A9
1.95	.70	-.71	56	A10
-.98	.59	-.40	63	A8
-2.96	.17	-.47	73	A1
3.12	.34	-.91	60	A11

Table 9. Item fit analysis on the responsibility assessment instrument

MEAS-URE	OUTFIT		PT-MEAS-URE	Item
	MNSQ	ZSTD	CORR	
.44	6.98	4.87	15	A5
-.58	.97	.23	46	A9
-.80	.61	-.23	55	A4
-.80	.61	-.23	55	A6
-1.30	.51	-.34	54	A3
-.130	.51	-.34	54	A10
-2.29	.57	-.21	48	A2
5.22	.09	-.69	73	A7
-2.76	.43	-.28	45	A1
4.18	.07	-.76	81	A8

Based on Table 8 dan 9 that 14 of the 15 items of the collaboration skill assessment instrument have been declared the valid criteria according to (Boone *et al.*, 2014), while 1 item is invalid, which is located at number A13. Table 8 states that 9 of the 10 items of the responsibility assessment instrument have been declared the valid criteria according to (Boone *et al.*, 2014), while 1 item is invalid, which is located at number A5. According to (Wijayanti & Mundilarto, 2015) that, the requirements of a good instrument are valid in terms of content and valid constructs.

Reliability. In the analysis of the reliability of the instrument for assessing collaboration ability and responsibility, Cronbach's alpha values were obtained at 0.82 and 0.71 in the very good and good criteria (Sumintono & Wudhiarso, 2015: 85). The higher the reliability value of the assessment instrument, the better the data obtained from the assessment results (Rosidin, 2017, p. 31). This means that the assessment instrument developed to measure student' collaboration and responsibility skills have a good reliability coefficient value.

Cronbach's alpha value in reliability is the value of the interaction between person reliability and overall item reliability. The value of person reliability and item reliability used is REAL RMSE, because this value is the worst condition of lower limit reliability based on the instrument used (Sumintono & Widhiarso, 2015).

The average value of INFIT MNSQ and OUTFIT MNSQ to measure collaboration skill of instrument assessment, respectively, namely 1.01 and 1.12 mean that the value is getting better because the value is close to the ideal of 1.00. The average values of INFIT ZSTD and OUTFIT ZSTD, respectively, are 0.02 and 0.17, meaning that the quality of the person is getting better because the value is close to the ideal, which is 0.0. The value of person reliability is 0.79, which indicates that the consistency of the answers from the respondents is enough.

The average value of INFIT MNSQ and OUTFIT MNSQ to responsibility respectively of instrument assessment are 0.95 and 1.13, meaning that the value is getting better because the value is close to the ideal, which is 1.00. The average values of INFIT ZSTD and OUTFIT ZSTD, respectively, namely 0.05 and 0.24 mean that the quality of the person is getting better because the value is close to ideal, which is 0.0. The value of person reliability is 0.74 which indicates that the consistency of the answers from the respondents is enough.

The average value of INFIT MNSQ and OUTFIT MNSQ to measure collaboration skill of instrument assessment, respectively, namely 0.99 and 1.42, meaning that the value is getting better because the value is close to the ideal, which is 1.00. The average value of INFIT

ZSTD and OUTFIT ZSTD, respectively, are 0.08 and 0.24, meaning that the quality of the items is getting better because the value is close to ideal, which is 0.0. The value of item reliability is 0.87, which indicates that the quality of the items is very good, meaning that the items on the collaboration assessment instrument can measure what they want to measure.

The average value of INFIT MNSQ and OUTFIT MNSQ to measure the responsibility of instrument assessment, respectively, namely 0.86 and 1.13, meaning that the value is getting better because the value is close to the ideal, which is 1.00. The average value of INFIT ZSTD and OUTFIT ZSTD, respectively, are -0.11 and 0.2, meaning that the quality of the items is getting better because the value is close to ideal, which is 0.0. The value of item reliability is 0.93, which indicates that the quality of the items is special, meaning that the items on the responsibility assessment instrument can measure what they want to measure.

Practicality. In the practical test, the instrument for assessing students' collaboration and responsibility skills was seen in the three aspects, namely convenience, attractiveness, and usefulness. The result of the average score of the practicality instrument assessment of students' collaboration and responsibility skills is presented in Table 10.

Table 10. The result of the average score of the practicality instrument assessment of students' collaboration and responsibility skills

Aspect	Collaboration Practitioner		∑	Responsibility Practitioner		∑
	1	2		1	2	
Convenience	96.87	93.75	95.31	93.75	93.75	93.75
Attractiveness	81.25	87.50	84.38	93.75	87.50	90.63
Usefulness	92.48	92.48	92.48	89.28	92.85	91.01
Total Score			90.72	Total Score		91.80

The score result obtained an average score of the practicality assessment instrument of the collaboration skills is 90.72, while the practicality assessment instrument of the responsibility is 91.80 in very high criteria. This is also in line with research by (Suparmin *et al*., 2012) that the practicality of an instrument is meaningful if there are easinesses in the evaluation instrument both in prepare, use, interpret, obtain the result, and convenience in storing.

Then, this is supported based on the statement from the teacher that the assessment instrument can be said to be practical because: (1) the statement from aspect and indicator of collaboration and responsibility skills in process learning is easy to understand; (2) the assessment instrument is equipped with illustrations in the form of pictures, graphics, and video links according to the material. Thus, this instrument can assist students in understanding the physics concepts for solving the cases; (3) the assessment instrument can replace student learning notes during the activity by applying the AfL approach. Thus, this instrument can help and facilitate teacher in maximizing the assessment of students by adjusting the stages of learning based on the case method (Arifin, 2014)(Arifin, 2017), (Hodri & Rijanto, 2013) & (Viyanti *et al*., 2022) that the criteria of a good instruments are valid, reliable, and practical

Conclusion

The conclusion is based from the result and discussion that: (1) final product of an assessment instrument to measure collaboration and responsibility skills consisting of the initial, content, and final content. The description of student activities in each statement item on the assessment instrument developed refers to indicators from the aspect of collaboration dan responsibility skill and are adjusted through the step of case-based learning; (2) the collaboration assessment instrument was declared valid and reliable with the validity standard in the very valid criteria, while the reliability standard was in the perfect criteria. Meanwhile, the responsibility assessment instrument was declared valid and reliable with the validity in the very valid criteria, while the reliability standard was good criteria; (3) the instrument for assessing collaboration and responsibility skills are also stated practical with very high criteria. The suggestion is based on this research that: (1) in the next research, teacher should use products in the form of an instrument for assessing students' collaboration and responsibility skills in the classroom; (2) it is suggested for the next research add statement items to each aspect of the observations contained in the indicators of the responsibility; (3) the further research is suggested to explain and provide examples on each aspect of observing the indicators of collaboration and responsibility skills in detail.

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