ISSN 2964-4291
https://proceeding.unnes.ac.id/index.php/iset

The Analysis Of Test Instrument And The Leaners' Responses On Acidity Material With The Uses From Environment As The Learning Source

Riyanti Riyanti*, Edy Cahyono, Sri Haryani, Budi Naini Mindyarto

Universitas Negeri Semarang, Indonesia
*Coresponding Author: riyantiyanti024@gmail.com

Abstract. This research analyzes the test instrument and the learners' responses to acidity material using an environment as the learning source. This quantitative research collected the data with observation, tests, and questionnaires. The researchers used valid and reliable measuring tools to find out the learning achievements of some aspects. The experts' judgments involved six experts and question item analyses with classical test theory (CTT) assisted by SPSS 21. The researchers conducted the trial run test and collected the learners' responses in XI IPA1 of Public SHS 1 Bangsri Jepara, consisting of 35 learners. The data analysis used V Aiken which consisted of question items and learners' responses. The results were 0.91 and 0.91. The content validity consisted of 40 objective question items in the test material about acidity. The reliability was observable from Cronbach's Alpha score, 0.945. The results indicated the question items were reliable and valid. The test analysis results of acidity material included validity and reliability. The analysis was useful to ensure that the instrument would be suitable for learners with various skills. The researchers also found positive responses toward the learning.

Keywords: Instrument Test; Learners' Responses; Acidity; Environment; Learning Source.

How to cite: Riyanti, R., Cahyono, E., Haryani, S., Mindyarto, B.N. (2022). The Analysis of Test Instrument and the Leaners' Responses on Acidity Material with the Usesfrom Environment as the Learning Source. *.ISET: International Conference on Science, Education, and Technology* (2022), 428-434.

INTRODUCTION

Science, technology, and information development in the 21st century last quickly and competitively. Thus, Indonesian people must prepare, anticipate, and win the competition by developing and building various competencies (Suardana et al., 2018). This situation may bring a competitive atmosphere in various life aspects. Learning is an interactive process between the learners and the environment to make positive attitudes and behaviors. Amri (2010) states that learning with an environmental approach could decrease boredom and make learners aware of the environment. The learners' awareness or love of the learners toward the material and environment could make them love and preserve the Earth. Environment refers to any external circumstances of learners and teachers, both physically and non-physically. Environment moderates the learning message so that learners study maximally. Generally, environment refers to integrating objects, powers, situations, and living creatures, including humans, and their behaviors to influence the sustainability and well-being of human life and other creatures (Musfiqon, 2012). The environment includes two primary components. The first component requires learners' placements in the learning system. Then, the second component includes interfaces that represent the selected features by the learners(King & Smith, 2018).

Environmental-based learning process as a learning strategy will lose boredom. This learning process can make learners learn meaningfully. In this learning, teachers use environmental learning as learning targets, learning sources, and learning media to create a meaningful learning atmosphere (Hariyanto & Suyono, 2015). This learning will be more effective if the environment is close to the learners' lives. Scholars have been studying learning environments in science classes extensively in the recent thirty years. They aimed to find the correlation between teaching strategy and social interactions of teachers-learners, learners-learners, and learning materials-learners during learning processes. Scholars found learning environment influenced teaching methods. The learning environment could enhance the teaching and pedagogy aspects of a science lesson taught at schools (Hofstein, 2001). CTL is an approach by using wetlands as the learning source. It excellently improves learners' knowledge (Michou et al., 2013). Learning resources improve learners' learning productivity (Irwandi & Fajeriadi, 2020). Learning resources in chemical lessons refers to understanding chemical concepts by observing their daily lives (contextual learning). Thus, it makes learning interesting and challenging for learners(Sutrisno et al., 2020).

The selection of acidity liquid as learning material was what the learners could reach in their daily lives. Learning about acidity is acceptable in many life sectors. However, the learners' skills should not only recognize and understand acidity (Haroen *et al*., 2016). Test about acidity material is effective if the percentage of classical accomplishment reaches at least 85% of learners that could reach the applied minimum mastery standard. Researchers must evaluate the question items if the learners cannot reach the criteria. The researchers adjusted the minimum mastery standard with the applied minimum mastery standard and formula in the research site. The use of various learning strategies to obtain qualitative and quantitative data are important to ensure the fairness of the assessment and support the learning (Izci & Caliskan, 2017). This research has five points for teachers to reach. Thus, teachers can support learning via assessment. They are: 1) providing objectives and clear learning expectations, 2) collecting learning evidence of learners from formal and informal tasks, 3) providing feedback, 4) collaborating during the assessment, and 5) involving learners in the self-assessment (Black & Wiliam, 2009).

The researchers analyzed some previous research findings on the cognitive aspect. They found a method that could be developed for cognitive assessment in written tests, such as multiple choices or essays. Azwar (2019) explains that a test is a measuring instrument. It consists of questions requiring answers or responses to measure an individual's skill or reveal a certain aspect of the test taker (Mardapi, 2008). Suranata (2007) explains that test is useful to improve learning achievements. A test is useful to measure certain aspects of human behaviors such as cognition, affection, and psychomotor. The use of test and evaluation instruments during the learning process can guide, direct, and monitor the learning and progress of the learners to reach the objective (Kolawole, 2010). In this research, the researchers developed an objective test. A test should meet both contents and construct validities. They are measurable from logical and empirical analyses. Thus, test developers know how the developed test could accommodate the three aspects and the relevance of the test with the interpretation of the obtained scores. Then, the following process requires question item analysis to determine the quality of the developed test. The researchers used classical test theory (CTT) or modern test theory (IRT) to analyze the test. Fitriani et al. (2018) explain that the theory of question item refers to the analytical theory of each revised question item toward the classical theory.

This research analyzed and validated the test of acidity material. Then, the researchers analyzed the findings with CTT. The scope of the research was to analyze the test about the uses of an environment as a learning source without considering the applied models or approaches in classroom learning.

METHODS

This quantitative research collected and analyzed the structured data. Thus, the researchers could interpret the data numerically (Goertzen, 2017). Then, the researchers used classical test theory (CTT) to validate the question item analysis results. Classical Test Theory (CTT) describes how errors could influence the observed scores or measurements (Eleje *et al*., 2018).

RESULTS AND DISCUSSION

The participants of this research were 35 eleventh graders of Public SHS 1 Bangsri, Jepara, in the fourth semester., consisting of 13 male and 22 female learners. The researchers selected them with *purposive sampling*. Sugiyono (2010) explains that purposive sampling is a technique to determine a sample with some considerations. For example, the learners had to be SHS learners who received acidity material.

The applied instruments were test and non-test, consisting of a validity test sheet, objective test instrument sheet, a sheet of learners' response validity, and an instrument of learners' responses about the uses of an environment as a learning source of acidity learning material. The validation sheet is to find out the test validity based on the expert's judgment. Validity is an index to indicate whether an instrument measures the intended elements (Sugiyono, 2003).

It includes five aspects, consisting of four indicators for the test validity sheet on each question item. The indicators are 1) objective appropriateness, 2) communicative language, 3) correct grammar, 4) unbiased item indicators and 4) clear and easy scoring criteria. Then, on the experts' validation, all experts shared their opinions toward question items by providing scales from 1 to five based on the assessment rubrics. The researchers also asked experts to provide notes for further revisions. In this research, a test was the important part. The test consisted of 40 objective question items with

scoring guidelines for acidity material. If the questions were correct, the score would be 1. However, if the questions were incorrect, the score would be 0.

The indicators of learners' response validity sheet consisted of 9 indicators. They were 1) unbiased questions, 2) appropriateness of the statement and the objective of the responses, 3) communicative language, 4) correct grammar, 5) unbiased statement item, 6) interesting instrument format to read, 7) clear guidelines to answer and fill in the instrument, 8) correct question item numbers, and 10) readable sentence length. The instrument sheet of learners' responses was useful for collecting learners' opinions toward using an environment as a learning source per acidity material.

The quantitative data of this research included expert judgment, test results of acidity material, and learners' responses. Then, the researchers analyzed the data further. The expert judgment involved six experts' analyses in determining the test validity and learners' responses after being constructed. The validity test analysis used the content validity coefficient (Aiken, 1985) and item response theory with EFA and CFA models assisted with SPSS software.

Results

The results of the item response theory included validity and reliability parameters. The output analysis was observable from the SPSS output table. Then, the researchers compared the output with the applied criteria to interpret each question item. The researchers estimated the reliability based on the item response theory with *Cronbach's Alpha in this research.*

The constructed test instrument was useful to measure the validity and reliability of the test about acidity material with the uses of an environment as the learning source and the learners' responses. The researchers used acidity as the material and the context for the constructed test instrument. The research focuses were the validity and reliability of constructed instruments in the form of objective questions with forty question items. Table 1 shows the test indicators of this research.

Table 1. Objective Test Question Indicators

Core Competence	Question Item Indicators	Question Item Numbers
3.8 Explaining acidity, acid strength, and ionic balance in solution.	Explaining the natures of acid and base substances in daily lives.	1
	Explaining various concepts of acid and base	8
4.10 Analyzing the pH trajectory changes on some extracted indicators from natural ingredients via experiments	Explaining the indicator changes in various solutions	2
	Explaining the applicable natural ingredients as indicators	1
	Analyzing the acid-base indicators from natural and artificial indicators	2
	Identifying some acid-base solutions with some indicators	1
	Predicting pH solution with some indicators	2
	Calculating pH of strong acid and strong base solutions, and weak acid and weak base solutions	16
	Analyzing pH of strong acid and strong base solutions, and weak acid and weak base solutions	4
	Calculating K_a weak acid solution or K_b of weak acid solution based on the given concentration or pH	1
	Calculating the ionization degree of acid-base solutions	1
	Explaining the reactions of a strong and weak acid, and strong and weak base	1

The validity stage included test question reviews by six experts as their judgment. The

quantitative data included scores from the experts on each aspect of the question items. The researchers analyzed the quantitative data from the content validity, V Aiken's, and item response theory (IRT).

Most scholars used the validation process with content and construct validities. The researchers used Lawshe's CVR (*Content Validity Ratio*) or Aiken's V for content validity in this research. Then, the researchers used multivariate with a multi-method approach or factorial analysis for construct validity. In this research, the researchers used *Explanatory Factor Analysis* (EFA) and *Confirmatory Factorial Analysis* (CFA) (Suseno, 2014). Table 2 shows the reading results of Total Variance Explained.

Table 2. Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	20.362	50.904	50.904	20.362	50.904	50.904	18.872	47.181	47.181
2	8.383	20.958	71.862	8.383	20.958	71.862	5.454	13.635	60.816
3	2.915	7.288	79.151	2.915	7.288	79.151	3.757	9.394	70.210
4	1.601	4.002	83.152	1.601	4.002	83.152	2.983	7.458	77.667
5	1.224	3.059	86.211	1.224	3.059	86.211	2.580	6.450	84.117
6	1.164	2.911	89.122	1.164	2.911	89.122	2.002	5.005	89.122
7	.882	2.205	91.328						
8	.716	1.790	93.118						
9	.573	1.433	94.550						
10	.478	1.194	95.744						

On the component column of the table, ten components out of 40 components represent the variables. On the column of Initial Eigenvalues, calculated with SPSS, the determined value is 1. Thus, researchers took total scores that were higher than 1. They were components numbered 1, 2, 3, 4, 5, and 6. The following Total Variance Explained values are useful to determine possible formation factors. The researchers determined the factors by observing the highest correlation values. The following Rotated Component Matrix, table 3, is useful to determine the included variables as the factors.

Table 3. Rotated Component Matrix

	Component							Component					
No	1	2	3	4	5	6	No	1	2	3	4	5	6
s_1			.615		.606		s_21		.479				.715
s_2	.989						s_22				.360	.305	.532
s_3	.989						s_23	.989					
s_4		.324			.782		s_24	.989					
s_5	.989						s_25						.734
s_6	.989						s_26	.989					
s_7					.745		s_27		.329			.576	.425
s_8	.989						s_28	.989					
s_9	.657		.503				s_29				.769		
s_10			.571	.653		.319	s_30		.547	.495	.355	.480	
s_11		.960					s_31	.989					
s_12	.989						s_32	.989					
s_13		.429	.404	.565			s_33		.960				
s_14		.517	.348				s_34	.989					
s_15	.989						s_35	.989					
s_16	.989						s_36	.989					
s_17	.301	.380	.709				s_37			.681		.400	
s_18			.751	.373			s_38		.960				
s_19				.819			s_39	.989					
s_20			.578	.437			s_40		.960				

Table 3 shows the Rotated Component Matrix to determine the highest correlation factor with the components.

Factor 1: s_2, 3, 5, 6, 8, 9, 12, 15, 16, 23, 24, 26, 28, 31, 32. 34, 35, 36, 39
Factor 2 : s_11, 14, 30, 33, 38, 40
Factor 3 : s_1, 14, 17, 18, 20, 37
Factor 4 : s_10, 14, 17, 18, 20, 37 13, 19, 29
Factor 5 : s_4, 14, 17, 7, 20, 27
Factor 6: s_21, 22, 25

The test questions about the acidity or acid-base material received expert judgment. The result indicated the questions were valid. Then, the researchers tested the questions for 35 eleventh graders. The researchers used *Correlation Coefficient Pearson* to test the validity, assisted by the SPSS program. The validity results of 40 questions were valid. The analysis assisted by SPSS showed all questions were valid based on the output of *Pearson Correlation* values. Then, the researchers conducted a reliability test for each valid question item category.

The researchers used the SPSS program to test the instrument's reliability based on *Cronbach's Alpha* value criteria. Reliability estimation with *Cronbach's Alpha* must occur after the question items are valid. A reliability test is useful to check whether the developed instruments are consistent. For example, if the measurement involves a repeated questionnaire. The analysis results of the test instrument showed the reliability estimation obtained *Cronbach's Alpha* score of 0.945 (see table 4).

Table 4. Reliability Statistics of the Objective Test

Cronbach's Alpha	N of Items
0.945	40

The analysis results of reliability estimation show that the obtained *Cronbach's Alpha* is higher than 0.60. Thus, the question items are valid (Sujarweni, 2014). Therefore, based on the current research's reliability result, the developed objective question items for 35 learners were reliable.

The analysis of learners' responses via a closed-questionnaire had some response levels. They are: extremely agree, agree, fair, disagree, and extremely disagree. The researchers distributed the questionnaire via Google Forms. Then, they recapitulated the results. Table 5 shows the recapitulation results.

Table 5. The Recapitulation Percentage of Learners' Responses toward the Learning

No	Statements	Your Opinions				
		EA	A	F	D	ED
1.	Learning chemistry with the uses of the environment could properly facilitate my conceptual understanding of acid-base.	51.4	42.9	5.7	0	0
2.	Learning chemistry using the environment could facilitate my understanding of various conceptual implementations of chemistry in daily life.	65.7	28.6	5.7	0	0
3.	The proposed problems by teachers encourage me to collect information from various resources.	42.9	42.9	14.2	0	0
4.	I think the question can broaden my knowledge about the use of acid-base in daily lives via learning with the uses of the environment.	94.3	5.7	0	0	0
5.	Learning with the environment as the learning sources could be used for the lesson.	68.6	28.6	2.8	0	0
6.	The practices or demonstrations of chemistry with the uses of surrounding material make me interested in studying chemistry.	42.9	42.9	14.2	0	0
7.	I feel joyful to prove what I study in the practices, especially with the uses of the environment.	94.3	5.7	0	0	0
8.	I am interested to find out the content of chemical substances used in daily lives after the practices by using the surrounding materials.	78.1	14.3	7.6		
9.	I am interested in studying chemistry using the environment as a contextual learning source.	94.3	5.7	0	0	0
10.	Material about acid-base with the environment could be useful for contextual learning sources.	68.6	28.6	2.8	0	0

Discussion

This research analyzes the test instrument and the learners' responses to acidity material using an environment as the learning source. The researchers used classical test theory to test the instrument. The reliability of a test within the CTT framework is based on the correlation coefficient between the observed scores of two parallel measurements. If the reliability of the measurement increases, the error variance will be relatively lower (Adedoyin, 2010). This condition indicates that the observed scores by the test takers are close to the actual scores. The validity stage included test question reviews by six experts as their judgment. All experts stated that the question items, 40 items, and the statements in the questionnaire, ten items, were valid based on V Aiken. Thus, the instruments could be tested for the learners. After validating, the researchers conducted a content validity test with SPSS 21.

The content validity with V Aiken showed that each question item validity for all assessed aspects obtained a score of 0.91. Thus, the validity result was higher than V Aiken's score, 0.78. Thus, generally, the constructed test questions were valid. The test results from SPSS for 40 test questions were valid. The obtained *Pearson Correlation* of sig 2-tailed should be lesser than α(0.05). The calculation of 40 question items showed the Sig 2-tailed score was higher than 0.05.

The SPSS analysis result on Rotated Component Matrix obtained six correlated factors with each component. In the first factor, the researchers found 11 members, the second factor with six members, factor 3 with five members, factor 4 with four members, factor 5 with three members, and factor 6 with three members. Thus, the test instrument with 40 question items was correlated.

From the questionnaire analysis, the percentage of each question item of the learners showed positive responses. Consecutively, the positive response percentages of each question are 94.3%, 94.3%, 85.8%, 100%, 97.2%, 85.8%, 100%, 92,4%, 100%, and 97.2%. Thus, the learners provided positive responses on chemistry using an environment as the learning source for acid-base material. Mustami et al. (2018) found that the environment could be a learning source for SHS learners of Public SHS 5 Sinjai with the ecosystem as the material. In their study, the researchers used the discovery learning model to improve the learning motivation and outcomes of the learners. Setyoningsih (2013) used the environment as a learning source to facilitate science conceptual understanding of the learners. The author did it by observing concrete situations. The positive impact of the environmental approach for learners is to build environmental curiosity.

CONCLUSION

From the result, the constructed test instrument, consisting of 40 question items, was valid with a reliability score of 0.945, categorized as reliable. The learners' responses analyzed with V Aiken also obtained a score of 0.91, categorized as valid. The analysis of test instruments for acid-base material using an environment as the contextual learning source showed that the instrument was applicable to measure cognitive aspects. The instrument was suitable to measure low to high cognitive levels. The instrument to measure learners' responses also could measure the responses. The results showed positive responses from the learners.

ACKNOWLEDGEMENT

Thanks to Universitas Negeri Semarang, Indonesia, that had given us the chance to conduct this research to complete this research article. Hopefully, the findings could be used for further researches.

REFERENCES

Adedoyin, C. (2010). Investigating the invariance of persons' parameter estimates based on classical test and item response theories. *An International Journal on EducationScience*, 2(2), 107-113

Amri, S.dan Ahmadi, K.I. (2010). *Proses Pembelajaran Kreatif dan Inovatif dalam kelas*. Jakarta: Prestasi Pustakaraya.

Azwar, S. (2019). *Konstruksi Tes Kemampuan Kognitif*. Yogyakarta: Pustaka Pelajar.

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation, and Accountability*, *21*(1), 5–31. https://doi.org/10.1007/s11092-008-9068-5

Eleje, L. I., Onah, F. E., & Abanobi, C. C. (2018). Comparative study of classical test theory and item response theory using diagnostic quantitative economics skill test item analysis results. *European Journal of Educational & Social Sciences*, *3*(1), 57–75.

Fitriani, H., Asy'ari, M., Zubaidah, S., & Mahanal, S. (2019). Exploring the prospective

teachers' critical thinking and critical analysis skills. *Jurnal Pendidikan IPA Indonesia*, *8*(3), 379–390. https://doi.org/10.15294/jpii.v8i3.19434

Goertzen, M. J. (2017). Applying quantitative methods to research and data. *Library Technology Reports*, *53*(4), 12–18. https://journals.ala.org/index.php/ltr/article/view/6325

Hariyanto & Suyono . (2015). *Implementasi Belajar & Pembelajaran*. Bandung: Remaja Rosdakarya

Haroen, Z. A., Rosa, N. M., & Nursa'adah, F. P. (2016). Pengembangan Perangkat Pembelajaran Kontekstual Kimia SMA untuk Peningkatan Kemampuan Berpikir Kritis. *Prosiding Semnas Pendidikan IPA Pascasarjana UM*, 735-740.

Hofstein A., Tami L. N. and Relly S.. (2001). Assessment Of The Learning Environment Of Inquiry-Type Laboratories High School Chemistry. *Learning Environments Research* 4: 193–207.

Irwandi, I., & Fajeriadi, H. (2020). Pemanfaatan Lingkungan sebagai Sumber Belajar untuk Meningkatkan Minat dan Hasil Belajar Siswa SMA di Kawasan Pesisir, Kalimantan Selatan. *Bio-Inoved : Jurnal Biologi-Inovasi Pendidikan*, *1*(2), 66. https://doi.org/10.20527/binov.v1i2.7859

Izci, K., & Caliskan, G. (2017). Development of prospective teachers' conceptions of assessment and choices of assessment tasks. *International Journal of Research in Education and Science*, *3*(2), 464–474. https://doi.org/10.21890/ijres.327906

Kolawole, E.B. (2010). *Principles of test construction and administration (Revised Edition)*. Lagos: Bolabay Publications.

King, B., & Smith, C. P. (2018). Mixed-reality learning environments: What happens when you move from a laboratory to a classroom? *International Journal of Research in Education and Science*, *4*(2), 577–594. https://doi.org/10.21890/ijres.428961

Mardapi J. (2008). *Teknik Penyusunan Instrument Tes Dan Nontes*. Jogyakarta : Mitra Cendikia.

Michou, A., Mouratidis, A., Lens, W., & Vansteenkiste, M. 2013. Personal and contextual antecedents of achievement goals: Their direct and indirect relations to students' learning strategies. *Learning and Individual Differences*, *23*, 187-194.

Musfiqon, HM. (2012). *Pengembangan Media dan Sumber Pembelajaran*. Jakarta: Prestasi Pustakarya

Setiyoningsih, T. (2013). *Pengelolaan Pembelajaran Ipa Berbasis Lingkungan*. *1*, 1–9.

Suardana, I. N., Redhana, I. W., Sudiatmika, A. A., & Selamat, I. N. (2018). Students' critical thinking skills in chemistry learning using local culture-based 7E learning cycle model. *International Journal of Instruction*, *11*(2), 399-412.

Sugiyono. (2003). *Statistika Untuk Penelitian*. Bandung: Alfabeta.

Sugiyono. (2010). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif dan R&D*. Bandung: Penerbit Alfabeta.

Sujarweni, W. (2014). *Metodologi Penelitian: Lengkap, Praktis, dan Mudah dipahami*. Yogyakarta: Pustaka Baru.

Sutrisno, H., Wahyudiati, D., & Louise, I. S. Y. (2020). Ethnochemistry in the Chemistry Curriculum in Higher Education: Exploring Chemistry Learning Resources in Sasak Local Wisdom. *Universal Journal of Educational Research*, *8*(12A), 7833–7842. https://doi.org/10.13189/ujer.2020.082572

Surapranata, S. (2007). *Panduan Penulisan Tes Tertulis*. Bandung : Remaja Rosda Karya.

Suseno, M.N. (2014). Pengembangan Pengujian Validitas Isi dan Validatas Konstrak: Interpretasi Hasil Pengujian Validitas. *Proceeding Seminar Nasional Psikometri*, 70-83.