VALIDITY AND RELIABILITY OF CONCEPTION DIAGNOSTIC TEST USING FIVE-TIER FORMAT FOR ELASTICITY CONCEPTS

[1)]Fadhilah Nur Salsabila and [2)]Frida U. Ermawati
Physics Department, Faculty of Mathematics and Natural Science, Universitas Negeri Surabaya
Email: [2)]frida.ermawati@unesa.ac.id

Abstract

Physics is one of subjects taught in secondary high school that potentially causes misconceptions on students. One of them occurs in Elasticity concepts as found by the authors. For example, students assumed that butter, wax and wet clay are elastic objects since it can be shaped easily. This assumption is wrong because those objects are plastic (non-elastic) materials, i.e. when the objects are given an attraction force, the objects will not return to its original form. Therefore, students were considered to experience misconceptions. Such misconceptions should be overcome soon, one of them is by multi-tier diagnostic test. This article aims to develop a conception diagnostic test in five-tier format for Elasticity concepts and to determine the validity (both internal and external aspects) and reliability. Two groups of students were involved: 21 students to gain common reasons (i.e. third-tier questions) and 32 students to collect the validity and reliability data. The internal validity was assessed by a pointed Physics lecturer in UNESA. The external validity covers content and construct aspects. The content validity was determined by false positives (FP) and false negatives (FN) data (each <10%). The construct validity was analyzed using the *Pearson Product Moment* correlation(r_{xy}). The Reliability (r_{11}) was determined using the *Cronbach's Alpha* with r_{11} = 0.42 and 5% significance level. The internal validity data is 91.33%; the FP and FN values are 5.9 and 2.6%, respectively meaning that the developed instrument is valid. The r_{xy} is 0.600> r_{11}. Therefore this instrument is valid and reliable for use.

Keywords: Five-tier diagnostic test, Elasticity concepts, Validity, Reliability

Abstrak

Fisika merupakan salah satu mata pelajaran yang diajarkan di sekolah menengah atas yang berpotensi menimbulkan miskonsepsi pada peserta didik (PD). Salah satunya terjadi pada konsep Elastisitas seperti yang ditemukan oleh Penulis. Sebagai contoh, PD menyebutkan bahwa mentega, lilin dan tanah liat basah adalah contoh benda-benda yang bersifat elastis sebab ketiga benda tersebut dapat dibentuk dengan mudah. Anggapan tersebut keliru sebab ketiganya tergolong benda plastis (non elastis), yaitu apabila kepada benda-benda tersebut diberi gaya tarik, maka benda tersebut tidak akan kembali ke bentuk semula. Oleh karena itu PD mengalami miskonsepsi. Miskonsepsi seperti itu harus segera diatasi, salah satunya dengan tes diagnostik multi-tier. Artikel ini bertujuan untuk mengembangkan tes diagnostik konsepsi berformat lima tingkat untuk materi Elastisitas dan menentukan validitas (baik aspek internal maupun eksternal) dan reliabilitas tes. Dua kelompok PD terlibat dalam penelitian ini, yaitu 21 PD untuk menjaring alasan yang umum disebutkan oleh PD (pertanyaan *three-tier*) dan 32 PD untuk memperoleh data validitas (baik aspek internal maupun eksternal) dan reliabilitas tes. Validitas diuji oleh seorang dosen Jurusan Fisika UNESA. Validitas eksternal mencakup aspek konten dan konstruk. Validitas konten ditentukan berdasarkan nilai positif palsu (*false positive*, FP) dan negatif palsu (*false negative*, FN), masing-masing harus < 10 %. Validitas konstruk dianalisis menggunakan persamaan korelasi *Pearson Product Moment* (r_{xy}). Reliabilitas (r_{11}) ditentukan menggunakan *Alpha Cronbach* dengan r_{11} = 0,42 dan taraf signifikan 5%. Data validitas internal = 91,33 %; nilai FP dan FN masing-masing sebesar 5,9 dan 2,6 % yang berarti bahwa tes yang dikembangkan valid. Nilai r_{xy} = 0,600 > r_{11}. Dengan demikian, tes yang telah dikembangakan ini telah valid dan reliabel untuk digunakan.

Kata Kunci: *Five-tier diagnostic test*, Konsep Elastisitas, Validitas, Reliabilitas

INTRODUCTION

Mechanics is one of branches taught in Physics subject in senior high school that reported causes students' misconceptions. Recently, misconceptions on the Mechanics branch was detected in Work and Energy concepts (Anggrayni & Ermawati, 2019), Dynamic Rotation and Rigid Body Equilibrium (Jannah & Ermawati, 2020) and in Dynamic Fluid (Kurniawati & Ermawati, 2020). As an example, Anggrayni & Ermawati (2019) reported that about 50 % of the 11th grade students

in science class in senior high school 4 Sidoarjo, East Java experienced misconceptions in Energy Change concepts. The students assumed that: (a) when someone walks forward from one location to another with displacement **s** while carrying a backpack, or (b) when someone push a wall with a certain force **F**, or (c) when two persons are pulling a rob oppositely at the same force **F**, they all do work. However, according to Physics concept (Giancoli, 2001) in Equation (1), they all do not do the work at all. The reason is because in (a) the angle θ between the displacement and the force is a right angle; in (b) the displacement **s** is zero, and in (c) the total force **F** is zero.

$$W = \mathbf{F} \cdot \mathbf{s} = |\mathbf{F}||\mathbf{s}|\cos\theta \quad (1)$$

Where W = work (scalar), **F** is a force (vector), **s** = a displacement (vector) and θ = the angle between the force and the displacement of an object.

Misconceptions were also detected by the authors in Elasticity concepts when the first author was carrying out a practical teaching work at senior high school 11 Surabaya. On that occasion, the author did a survey by asking 70 science-class students in 11th grade to do a test comprises of 15 multiple choice questions on that concepts. The results showed that 35.7% of the total students achieved 50 out of 100. Those students cannot distinguish between elastic and plastic objects so they cannot set a correct example for each object. For example, the students mentioned that butter, wax and wet clay are elastic objects. They argued that these objects can be shaped easily. However, their claims was wrong. Butter, wax and wet clay are plastic (non-elastic) objects since those objects will not return to its original shape when they are given an attraction force (Giancoli, 2001). Ballons, nylon threads and bicycle nipples are the correct elastic objects because those objects return to their original shape when a force is acting on those object. The students are therefore suffered misconceptions on elastic and plastic objects. Such misconceptions should be detected soon, otherwise it could affect student's understanding on the following concepts (Jannah & Ermawati, 2020).

Misconception can be identified by providing diagnostic tests to students (Jauhariyah, et al. 2018). Diagnostic tests are the favourite solution to identify misconceptions and the level of students conception (Adodo, 2013). Lately, the commonly used multi-tiers conception diagnostic test is a four-tier format of diagnostic test (Ermawati, et al. 2019). Such diagnostic test consists of 1st-tier question (i.e. several answer options), 2nd-tier question (level of confidence in choosing the correct answer), 3rd-tier question (several options of reasons in choosing the correct answer on the 1st-tier) and 4th-tier question (the level of confidence in choosing the correct reason on the 3rd-tier) (Rohmanasari & Ermawati, 2020) and (Kurniawati & Ermawati, 2020).

However, Anam, et al. (2019) and Bayuni et al. (2018) argued that the four-tier format of diagnostic test is not the finest choice to justify students' conceptions. One of the reasons is that the students could provide the answers of the 1st-and 3rd-questions just by guessing it. From the test examiner (in this case the teacher) point a view, the four-tier format test also does not provide sufficient data to justify whether the students have understood the concepts being tested or not. Considering this argument, a 5th-tier question in the form of an open question should be added into the four-tier test. The aim is to give an opportunity for the examiner to confirm himself on the students' understanding on the tested concepts. For the students, the 5th-tier question will also facilitate them to express their understanding both on the chosen answers (the 1st-) and the chosen reasons (the 3rd-tier).

Given that typical of each question in the four-tier diagnostic test vary, the additional confirmation question (i.e. the 5th-tier question) can also vary. For example, when the intended confirmation requires a deeper explanation on a certain concept, the 5th-tier question should be a concluding question. When the confirmation requires an illustration, the 5th-tier question should be a drawing question. That is the idea in developing a five-tier format of conception diagnostic test.

Further, in a four-tier format of conception diagnostic test, a student is categorised understand a concept when the answer pattern is ″correct-sure-correct-sure″, each representing the answer of the 1st-, 2nd-, 3rd-and 4th-tier questions. In a five-tier format test, the 5th-tier answer should be included to the above answer pattern as an extra consideration to justify students' conception level. **Table 1** lists possible combination patterns of students' answers and the conception levels proposed in a five-tier test format.

Table 1. The combination of student's answer in five-tier format of diagnostic tests and the conception levels (Anam et al., 2019)

No.	1st tier	2nd tier	3rd tier	4th tier	5th tier	Conception level
1	Correct	Sure	Correct	Sure	SD / SC	SC
					PD /PC	PU
					MD / MC	UC
					UD / UC	
					ND / NC	UnC
2	Correct	Sure	Correct	Not sure	PD /PC or MD/MC or UD/UC or ND/NC	LK
3	Correct	Not sure	Correct	Sure		
4	Correct	Not sure	Correct	Not sure		

5	Correct	Sure	Wrong	Not sure		
6	Correct	Sure	Wrong	Sure		
7	Correct	Not sure	Wrong	Sure		
8	Correct	Not sure	Wrong	Not sure		
9	Wrong	Sure	Correct	Sure		
10	Wrong	Sure	Correct	Not sure		
11	Wrong	Not sure	Correct	Sure		
12	Wrong	Not sure	Correct	Not sure		
13	Wrong	Sure	Wrong	Not sure	PD/PC or MD/MC or UD/UC or ND/NC	NU
14	Wrong	Not sure	Wrong	Sure		
15	Wrong	Not sure	Wrong	Not sure		
16	Wrong	Sure	Wrong	Sure	MD/MC	MSC
17	When there is a tier question that is not answered by a student, or when a student choose more than one answers					UnC

SD/SC= Scientific Drawing/Conclusion, PD/PC= Partial Drawing/Conclusion, MD/MC= Misconception Drawing/Conclusion, UD/UC= Undefined Drawing/Conclusion, ND/NC= No Drawing/Conclusion, SC= Scientific Conception, PU= Partial Understanding, UC= Unconfirmed Conception, UnC= Un-code, LK= Lack of Knowledge, NU= No Understand a Concept, MSC= Misconception.

Table 2 lists the categories, the description and the score of student's answers on the 5th-tier question based on the five combination answers in No. 1 of Table 1.

Table 2. Student's answer categories to the fifth-tier question, description, and score % (Dikmenli, 2010)

No.	*Category*	*Description*	*Score (%)*
1	*Scientific Drawing / Conclusion (SD /SC)*	When a student can provide comprehensive visualizations / conclusions according to the answer key.	100
2	*Partial Drawing / Conclusion (PD / PC)*	When a student can provide visualizations / conclusions that are not 100% like the answer key (with a light error).	70 - 99
3	*Undefined Drawing / Conclusion (UD / UC)*	When a student can provide visualizations / conclusions that cannot be understood.	40 - 69
4	*Misconception Drawing / Conclusion (MD / MC)*	When a student can provide a visualization that is incorrect or different from the answer key.	1 - 39
5	*No Drawing / Conclusion (ND / C)*	When a student can not provide visualization / conclusions at all	0

Based on the fact that students' misconceptions is truly happend and need to be detected as soon as possible, this paper is therefore devoted to report the development of a five-tier conception diagnostic test on Elasticity concepts and to determine the validity and reliability.

METHOD

This research was started by developing a three-tier format of diagnostic test questions on Elasticity concepts. The developed test that consists of 19 questions was written based on the literature studies.The instrument was tested on 21 new students (Year 2019) in Physics Department, Surabaya State University in order to collect common reasons, i.e. the answers on the 3th-tier questions. Using the collected common reasons, a 19-questions of five-tier format of diagnostic test on Elasticity concepts was developed. The resulting instrument was then validated internally by a pointed lecturer at the Department. The aim was to gain a critical feedback, both on the content, the construct and the language aspects. There are four indicators to assess the content validity of the developed five-tier diagnostic test, i.e. (1) the conformity between the item test and the Vector concepts, (2) the suitability of the item test with the question indicators, (3) the suitability between the item test and the order of the content, and (4) Clarity of questions, answers and reasons for answers.

The indicators of construct validity covers six aspects, namely: (1) clarity of the instruction for students doing this test, (2) the suitability between the test items, the Bloom's taxonomy and the basic competencies, (3) the effectiveness of the test items for identifying students' conception, (4) the choice of answer reasons (the 4th-tier) can reveal the causes of misconceptions originated from students, (5) the distractor's choices in the 4th-tier are rational and homogeneous with the answers in the 1st-tier, and (6) tables, graphs and other illustrations are all suitable to the problems.

There are three indicators in language aspects, i.e. (1) the test is well written in Indonesian language, (2) the questions should be precise, clearly stated and free of multiple interpretation contents, and (3) the questions should be communicative. The % of internal validity is justified using Equation 2 (Sugiyono, 2015).

$$P = \frac{S_R}{N.P_A.R} . 100\ \% \qquad (2)$$

Where P is % internal validity; S_R is the total score given by each validator; N is the maximum score in test; P_A is total questions in test and R is the numbers of validators. **Table 3** provides the interpretation of the internal validity values of this developed diagnostic test and the criteria.

Tabel 3. Distribution of internal validity score in Equation (1) and the criteria. (Riduwan & Akdon, 2013)

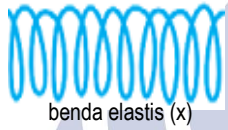
Score (%)	Criteria
0 - 20	Not valid
21 - 40	Less valid
41 - 60	Quite valid
61 - 80	Valid

81 - 100	Very valid

Feedback given by the internal validator was then used to revise the developed test, becoming a five-tier format test. The developed five-tier test comprises of 19 questions. **Table 4** shows one of the 19 questions on the Elasticity concepts written in the five-tier format by the authors.

Table 4. One of 19 diagnostic questions in five-tier format on Elasticity concepts developed by the authors

Tier	Question
1st tier	**Problem and the available answers** Dalam kehidupan sehari-hari banyak ditemukan benda-benda dan berbagai sifatnya, seperti sifat benda yang keras, kuat, dapat berubah bentuk, lunak, tidak elastis, hingga elastis. Berdasarkan elastisitasnya, benda dibedakan menjadi benda elastis dan tidak elastis. Pilihlah 5 benda elastis dari ke-11 benda dibawah ini!  Tanah Liat  Slinki  Ban dalam motor  Balon  Plastisin  Benang Nilon Pegas Baja   Pentil Sepeda    Kayu Kertas Karet Gelang a. tanah liat, ban dalam motor, balon, kayu, karet gelang b. tanah liat, plastisin, nilon, kertas, kayu c. tanah liat, plastisin, pegas baja, kertas, kayu d. slinki, ban dalam motor, balon, pegas baja, pentil sepeda e. slinki, ban dalam motor, pentil sepeda, kayu, karet gelang In daily life, we found many objects with various properties, such as hard, strong, deformable, soft, not elastic, until elastic. Based on the elasticity, objects can be divided into elastic and inelastic objects. Choose 5 elastic objects from the 11 items below!  Clay  Slinki  Motorcycle Tire  Balloon  Plasticine  Nylon  Spring Steel  Bicycle Nipples  Wood  Paper  Rubber bracelet
2nd tier	**The confidence level in choosing the correct answer** Apakah kamu yakin dengan jawabanmu? a. Yakin b. Tidak Yakin Are you sure with your answer? a. Yakin b. Tidak Yakin
3rd tier	**Possible reason in choosing the correct answer** Alasan Pilihan Jawaban: a. Benda dikatakan elastis apabila benda tersebut diberi tarikan akan kembali seperti semula. b. Semua benda memiliki sifat elastis. c. Benda dikatakan elastis bila benda tersebut dapat kembali ke bentuk semula setelah gaya yang mengubah bentuk tersebut ditiadakan. d. Benda elastis merupakan benda yang sifatnya lentur. e. Semua benda yang diberi gaya sebesar F akan berubah bentuk dan benda dapat kembali ke bentuk semula apabila diberikan gaya yang sama sebesar F f. Benda dengan massa yang ringan adalah benda elastis . g. …… …… Reasons for the Answer: a. The object is said to be elastic if the object is given a pull will return to normal. b. All objects have elastic properties. c. The object is said to be elastic if the object can return to its original shape after the force that changed the shape is removed. d. Elastic objects are objects that are flexible.

	e. All objects with a force of F will change shape and objects can return to their original shape if given the same force as F f. Objects with light mass are elastic objects. g. …… ……
4th tier	**The confidence level in choosing the correct reason** Apakah kamu yakin dengan alasanmu? a. Yakin b. Tidak Yakin Are you sure with your reason? a. Yakin b. Tidak Yakin
5th tier	**A drawing or concluding question** Berdasarkan alasan yang telah Anda pilih, bagaimana menggambar kondisi dari benda elastis (x) saat a. benda elastis (x) diberi tarikan b. setelah benda elastis (x) dilepas tarikannya  benda elastis (x) a. Gambar benda elastis (x) diberi tarikan b. Gambar benda elastis (x) setelah tarikan dilepas Based on the reason you choose, how to draw the condition of the elastic object (x) when a. elastic objects (x) are given a pull b. after the elastic object (x) is pulled off  elastic object (x) a. Draw elastic object (x) that given a pull b. Draw elastic object (x) after the pull is released

The 19-conceptual questions in Table 4 was then tested to 32 students in science class in senior high school 11 Surabaya, East Java in order to gain the data on external validity (contents and construct aspects) and reliability. The content aspect was evaluated by calculating the score % of false positives (FP) and false negatives (FN). FP is the five-tier answer combination in No. 6 in Table 1 (correct-sure-wrong-sure-wrong), while FN is the answer combination in No. 9 (wrong-sure-correct-sure-wrong); and the scores were calculated using Equation 3 and Equation 4 below (Jannah, 2020).

$$\% FP = \frac{\sum FP}{\sum items \; x \; \sum PD} \; x \; 100 \; \% \qquad (3)$$

$$\% FN = \frac{\sum FN}{\sum items \; x \; \sum PD} \; x \; 100 \; \% \qquad (4)$$

$\sum$FP is the total combination of students' answers (correct-sure-wrong-sure-wrong); $\sum$FN is the total combination of students' answers (wrong-sure-correct-sure-wrong); $\sum$items is numbers of questions (= 19) and $\sum$PD is number of students (= 32). Kirbulut & Geban (2014) suggested that these content aspect (i.e. FP and FN) should be < 10 %.

The construct aspect of validity was determined using the Pearson Product Moment (Equation 5). The instrument is valid when the value of $r_{xy} > r_{theoretic}$ (Arikunto, 2013).

$$r_{xy} = \frac{\sum xy}{\sqrt{(\sum x^2)(\sum y^2)}} \qquad (5)$$

Where r_{xy} is a correlation between *x* and *y*; *x* is the difference between the number of correct answer scores on the 1st- and 3rd-tier, *y* is the difference between the total scores of confidence on the 2nd- and 4th-tier. The correlation values are listed in **Table 5**.

Table 5. The correlation coefficients r_{xy} (Sugiyono, 2015)

No.	Correlation Figures ($\mathbf{r_{xy}}$)	Relationship Level
1	0.000 – 0.199	Very low
2	0.200 – 0.399	Low
3	0.400 – 0.599	Moderate
4	0.600 – 0.799	High
5	0.800 – 1.000	Very high

The reliability of the test was justified using the Alpha Cronbach's (r_{11}) in Equation (6) (Sugiyono, 2015). The instrument is reliable when the value of $r_{11} > r_{theoretic}$. In this work, the $r_{theoretic}$ taken is 0.361 since 32 students were involved in this work, while the significant level taken is 5 %.

$$r_{11} = \frac{k}{k\text{-}1}\left(1 - \frac{\sum \sigma_b^2}{\sigma_t^2}\right) \qquad (6)$$

Where r_{11} is a reliability coefficient of the developed instrument; *k* is the sum of questions; $\Sigma\sigma_b^2$ is the sum of variant in each question (Equation 7), while σ_t^2 is the total variant (Equation 8), (Sugiyono, 2015). **Table 6** shows the reliability index using the Alpha Cronbach's criteria.

$$\sigma_b{}^2 = \frac{\sum X_i{}^2 - \frac{(\sum X_i{}^2)}{n}}{n} \quad (7)$$

$$\sigma_t{}^2 = \frac{\sum X^2 - \frac{(\sum X^2)}{n}}{n} \quad (8)$$

In this case, n is the total numbers of students involved, X_i is the answer of each question and ΣX is the total answers of students on each question.

Tabel 6. The reliability index using Alpha Cronbach's criteria (Arikunto, 2013)

No.	Reliability Index (r)	Criteria
1	0.800-1.000	Very high
2	0.600-0.799	High
3	0.400-0.599	Moderate
4	0.200-0.399	Low
5	-1.000-0.199	Very low

RESULTS AND DISCUSSION

Table 7 shows the internal validity result of the developed five-tier diagnostic test on Elasticity concepts.

Table 7. The internal validity result of the five-tier diagnostic test developed in this work

Validity	Aspects	Validator Score	%	Criteria
Content	a	4	94.00	Very valid
	b	4		
	c	4		
	d	3		
Construct	a	4	88.00	Very valid
	b	3		
	c	3		
	d	4		
	e	3		
	f	4		
Language	a	4	92.00	Very valid
	b	3		
	c	4		
Average			**91.33**	**Very Valid**

Data in Table 7 says that the developed five-tier diagnostic test is very valid because the average score is 91.33. **Table 8** depicts the contents validity (FP and FN) of the developed tests.

Table 8. The content validity (FP and FN) scores of the developed five-tier diagnostic test

Question No.	False Positif (FP)	False Negatif (FN)
1.	0	0
2.	0	0
3.	0	1
4.	1	1
5.	1	1
6.	2	0
7.	4	2
8.	2	1
9.	1	0
10.	2	1
11.	4	1
12.	2	0
13.	5	2
14.	2	0
15.	2	0
16.	1	1
17.	2	2
18.	2	1
19.	3	2
Total	36	16
Total Students	32	
%	**5.9 %**	**2.6 %**

Based on the data in Table 8, the FP and FN of this test is 5.9 and 2.6 % respectively which are much less than 10 %. This means that the developed test has fulfilled the content aspect of validity. **Table 9** shows the construct aspect data of the developed test, while **Table 10** presents the reliability score.

Table 9. The construct aspect score of the external validity of the developed instrument

Question No.	r_{xy}	$r_{theoritic}$	Criteria
1	0.693	0.361	Valid
2	0.571		Valid
3	0823		Valid
4	0.351		Not valid
5	0.853		Valid
6	0.342		Not valid
7	0.578		Valid
8	0.337		Not valid
9	0.487		Valid
10	0.604		Valid
11	0.578		Valid
12	0.528		Valid
13	0.413		Valid
14	0.881		Valid
15	0.887		Valid
16	0901		Valid
17	0.628		Valid
18	0.342		Not valid
19	0.606		Valid

In Table 9 above, among 19 questions, 15 questions are valid since $r_{xy} > r_{theoritic}$, while the rest, i.e. the questions No. 4, 6, 8 and 18 are not valid since they have low correlations (i.e. the $r_{xy} < r_{theoritic}$, see Table 5). The four questions are therefore dropped from the developed test and the authors will edit it by adding details pictures to make the questions are more communicative, for the next research.

Table 10. The reliability score of the developed test

No	Coefficient Correlation (r_{11})	r_{table}	Criteria
1	0.42	0.361	Moderate

Table 10 shows that the reliability coefficient (r_{11}) of the developed five-tier diagnostic test is 0.42 which is moderately reliable since the $r_{11} > r_{tabel}$. The reliability of instrument was in moderate level because the total variant (σ_t^2) was bigger than the sum of variant in each question ($\Sigma\sigma_b^2$). The developed instrument was indeed worthy for further use because of the $r_{11} > r_{tabel}$.

The relevant research to identify misconceptions on the Elasticity concepts was published by Hidayati, et al. (2016). That research focused on identifying students' misconception for each concept in Elasticity by using the CRI *(Certainty of Response Index)* system. The highest misconceptions was on the concept of Modulus Young with a score of 74.29 %. Based on that publication, the authors of this present work were encouraged to develop a diagnostic test on the Elasticity concepts using a five-tier format and check the validity and reliability before the diagnostic test is being carried out to students.

This five-tier diagnostic test has some advantages than CRI *(Certainty of Response Index)* system, namely: 1) the examiners are more sure about the students' level conception, 2) this test can diagnose misconception in more detail, 3) the five-tier diagnostic test can reveal what students' think about the concepts, and 4) the five-tier test can cover students' conception more widely by adding the drawing tier in the diagnostic test (Anam, et al., 2019).

CONCLUSION

Based on the results above, it can be concluded that the five-tier diagnostic test on Elasticity concepts developed in this work has fulfilled all the aspects of validity and reliability. Therefore, the developed test can be used to identify the level of conception of high school students in Elasticity concepts.

REFERENCES

Adodo, S. O. (2013). Effects of Two-Tier Multiple Choice Diagnostic Assessment Items on Student's Learning Outcome in Basic Science Technology (BST). *Academic Journal of Interdisciplinary Studies*, 02 (02), 201-210.

Anam, et al. (2019). Developing a Five-Tier Diagnostic Test to Identify Students' Misconceptions in Science: An Example of the Heat Transfer Concepts. *Elementary Education Online*, 18 (03), 1014-1029.

Anggrayni, S., & Ermawati F. U. (2019). The Validity of Four-Tier's Misconception Diagnostic Test for Work and Energy Concepts. *Journal of Physics: Conference Series, 1171 (2019), 012037.*

Arikunto, Suharsimi. (2014). Prosedur Penelitian. Jakarta: Rineka Cipta.

Bayuni, et al. (2018). Identification Misconception of Primary School Teacher Education Students in Changes of Matters using a Five-Tier Diagnostic Test. *Physics Conference Series, 1031 (01), 012086.*

Dikmenli, M. (2010). Misconceptions of Cell Division held by Student Teachers in Biology: A drawing Analysis. *Scientific Research and Essay*, 05 (02), 235-247.

Ermawati, et al. (2019). Misconception Profile of Students in Senior High School IV Sidoarjo East Java in Work and Energy Concepts and The Causes Evaluated Using Four-Tier Diagnostic Test. *Journal of Physics: Conference Series, 1387 (2019), 012062.*

Giancoli, Douglas. (2001). Fisika Edisi Kelima Jilid 1. Jakarta: Erlangga

Hidayati, et al. (2016). Identifikasi Miskonsepsi Siswa Kelas X pada Materi Elastisitas dan Hukum Hooke di SMA Negeri 1 Indralaya. Jurnal Inovasi Pembelajaran Fisika, 03 (02), 30662.

Jannah, E. M., & Ermawati F. U. (2020). Identify 11th Grade of Senior High School Jogoroto students' misconception on Dynamic Rotation and Rigid Body Equilibrium Concepts using Four-Tier Diagnostic Test. *Journal of Physics: Conference Series, 1491 (2020), 012010.*

Jauhariyah, et al. (2018). The Students' Misconception Profile on Chapter Gas Kinetic Theory. *Journal of Physics: Conference Series, 997 (2018), 012031*.

Kirbulut & Geban. (2014). Using Three-tier Diagnostic Test to Assess Students' Misconceptions of States of Matter. *Eurasia Journal of Mathematics, Science and Technology Education. 509-521.*

Kurniawati, D. M., & Ermawati F. U. (2020). Analysis Students' Conception Using Four-Tier Diagnostic Test for Dynamic Fluid Concepts. *Journal of Physics: Conference Series, 1491 (2020), 012012.*

Riduwan dan Akdon. (2013). Rumus dan Data Dalam Analisis Statistika. Bandung: Alfabeta.

Rohmanasari, F., & Ermawati F. U. (2020). Using Four-Tier Multiple Choice Diagnostic Test to Identify Misconception Profile of 12th Grade Students In

Optical Instrument Concepts. *Journal of Physics: Conference Series, 1491 (2020), 012011*.

Sugiyono. (2015). Metode Penelitian Pendidikan. Bandung: Alfabeta.