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# Describing Representation Ability of Prospective Science Teacher Based on Learning Style

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**Abstract.** The ability to represent a phenomenon in various forms either graphically, mathematically, in diagrams, etc. is the ability of multiple representations. This study aims to provide an overview of the multiple representation abilities of prospective science teacher based on their learning styles. The sample was 59 students of the 4th semester of Science Education Study Program, Universitas Negeri Makassar who took course of Fluid. The research instrument used were a learning style test and a representation ability test on dynamic fluid material in the form of multiple choices. The results of the learning style test showed that 21 are auditory learner, 11 are kinesthetic, and 27 are visual. Furthermore, the results of the representation ability test related to image representation, graphic representation, verbal representation and symbolic representation were analysed according to the visual, auditory, and kinesthetic learning styles. The results of data analysis showed that the highest average value of graphic representation ability was owned by students with a visual learning style in the medium category. Furthermore, the highest value of the ability to represent images, symbols, and verbal was had by kinesthetic learner with each category, medium, high, and high. Based on these results it can be concluded that science teacher candidates with kinesthetic learning styles have better representation abilities than the other two learning styles.

**Keywords:** Representation, Symbol, Graph, Verbal, Image, Learning style

## 1. Introduction

The quality of education is dependent on the quality of teachers because teachers are the most important factor in improving the quality of education. Research shows that teachers' knowledge and skills have a significant impact on their student's academic performance [1][2]. Therefore, it is very important to



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ensure adequate abilities of prospective teachers in terms of mastery of knowledge and skills/abilities that support the teaching and learning process.

The experience lecturing in science teacher candidates at Universitas Negeri Makassar, one of the universities in Indonesia, shows the lack of students' ability to understand verbal language and translate it into the form of mathematical equations. In addition, it is found that in the subjects such as fundamental physics, waves, fluids, and others, students have limited skills in linking graphs with mathematical data. Furthermore, they also cannot translate the graphic into verbal language. As an example; For the graph of the relationship between the deviation and the period, students still cannot determine the period of a sinusoidal or longitudinal wave based on the graph presented in the questions. Another example is students only know the deviation symbolized by  $Y$  but they have not been able to describe the deviation in a graph. These facts show that some students do not have sufficient multi-representation on a natural phenomenon.

Multiple representations are a combination of formats used to conclude, process, or display information [3]. The teacher's ability to convey a material of subject will greatly affect the student's representation ability. When teachers can instruct in various ways or various kinds of representations, students will have knowledge of various representations in their minds [4].

Multiple representations are classified into 5, namely concrete, verbal, symbolic, visual, and gesture, and that visualization describes how to produce its meaning based on the representation [3][5]. The representation that is most commonly found today is a visual representation. Why is that, because humans are faster to process the information provided through visual elements. In terms of processing information, humans process image information or visual elements 60000 times faster than text [6]. Therefore, in this millennial era, more information is presented in a visual form in the hope that this information or knowledge can be quickly received by the brain.

Visual representation engages the human sense of sight so that branches of this representation include, image representations, graphs, and diagrams. Furthermore, for symbolic representations related to the use of mathematical symbols and in chemistry the symbolic representation becomes very broad because every chemical element has a symbol and there are chemical reactions that use many symbols [7]. Therefore, in chemistry learning, multiple representations are divided into 3 types, namely macroscopic, microscopic and symbolic representations [8] [9]

On the other hand, in physics learning, Leigh defines multi-representation as a sequential translation of a physics problem given from one language symbol to another, starting with writing a verbal description of the problem, then moving it to an adapted image and diagrammatic representation, and ending (usually) with a mathematical formula that can be used to determine the answer using numbers [10]. In science learning, students must acquire conceptual knowledge and the ability to maximize representation (graphical representations, words, and equations) used for communication and problem solving. The learning process which more often involves students with elements of visual and symbolic representations, completes the words displayed verbally and in writing, can increase their desire to use these representations gradually and reach the advanced stage of using representations. Using multiple representations asks students to be able to combine representations in a meaningful way. To do this, students need to translate between representations and thus learning strategies designed to facilitate this also apply to research findings [11].

Beside teachers must create learning that facilitates multiple representation of students, teachers must also consider how students learn. How to make it easier for them to receive information known as learning styles. In general, students will find difficult to process information if they feel uncomfortable with the way the information or knowledge is presented. Some students have different learning styles, have different way to obtain information and are dominant in one form of learning style [12].

Although each researcher uses different terms, DePorter & Hernacki argues that researchers have agreed that there are two main categories of how we learn, first, how we absorb information easily (modality) and second, how we organize and process the information (brain domination). A person's learning style are combination of how he absorbs, organizes and processes information. Thus everyone has a style of learning in accordance with their own personality. According to Bandler and Grinder that although most people have access to three modalities (visual, auditory, and kinesthetic) and almost

everyone tends to one learning modality which acts as a filter for learning, processing, and communication. [13].

Some students adore to learn when the information is presented with pictures but also there are students who like to learn by listening and some students like to involves physical learning. For example, students with a visual learning style will find it easier to process the information obtained by presenting the information in a visual form, such as pictures, graphics, etc. Therefore, knowing student learning styles is important so that teachers can adjust teaching methods with the majority of students' learning styles because it affects academic performance [14][15][13][16]

Assessing learning styles does not only contributes to students' meta-knowledge and it can create a basis for improving their control mechanisms in regulating their own learning environment. Even before students become involved in the setting of the learning environment, learning styles can be a very important factor [17].

Based on the explanation, it is able to conclude that that people with visual learning styles will easily represent images or visual elements because they are easier to process information if the information is in the form of a visual display. To see whether people with visual learning styles will be able to have better visual representation abilities compared to other learning styles as well as verbal representation abilities, and others, a study was conducted to see how the representation abilities of science teacher prospective students in terms of their learning styles.

## 2. Methods

This research is a quantitative descriptive study that describes the representation ability of science teacher candidates in terms of learning styles. Sampling was carried out by selecting all 59 students of the science education study program who programmed the Fluid course in the even semester of the 2019-2020 academic year.

The research instruments used were a learning style diagnostic test and a multiple choice test of representation ability. Learning style diagnostic tests were adopted from tests that had been developed by experts while the representation ability test was developed in accordance with the courses taken by students, fluid material.

The research data were analysed using descriptive statistics to identify the level of representation ability of science teacher candidates in general. This analysis was also used to determine the level of representation ability of them based on learning styles (visual, audio and kinesthetic).

## 3. Result and Discussion

### 3.1 Research Result

#### 3.1.1 Learning Style

Learning style diagnostic tests are given to all fourth semester students of science education study program who program fluid courses via google form. The test results indicate that there are variations in the learning styles of the students. The results of learning styles can be shown in Table 3.1 as follow.

**Table 1.** Result of Test of Learning Styles

Learning Styles	Count of Learning Style	Percentage of Learning Style
<b>Auditory</b>	21	35.59%
<b>Kinesthetic</b>	11	18.64%
<b>Visual</b>	27	45.76%
<b>Grand Total</b>	<b>59</b>	<b>100.00%</b>

From Table 1, it shows that the largest percentage of learning styles is visual as 45.76% (27 participants). In addition, the smallest number of learning styles is owned by the kinesthetic with 11 out of 59 people or around 18.64%. Furthermore, the auditory learning style is in the middle position with

a percentage of 35.59%. Furthermore, after giving a diagnostic test, the following step is conducting representation ability test after fluid course finished.

### 3.1.2 Representation Ability based on learning style

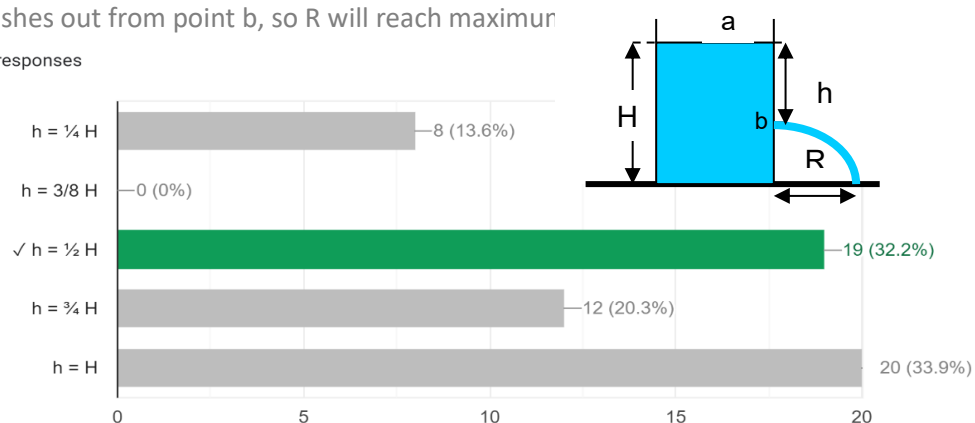
The results of the representation ability test were divided into representations of graphic, pictures, symbols, and verbal. The following table is the average result of the representation ability test. The categories used are five categories, namely very low, low, medium, high, and very high.

**Table 2.** The average value of Multiple Representation Ability

Learning Style	Average Value of Representation Ability							
	Graph (1)	Level	Image (2)	Level	Symbol (3)	Level	Verbal (4)	Level
<b>Auditory</b>	61.90	Medium	52.38	Low	47.62	Low	59.52	Medium
<b>Kinesthetic</b>	59.09	Medium	63.64	Medium	68.18	High	72.73	High
<b>Visual</b>	59.26	Medium	44.44	Low	44.44	Low	59.26	Medium

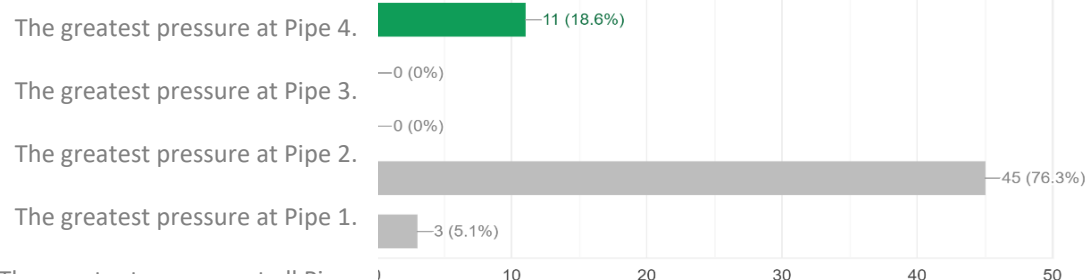
If water gushes out from point b, so R will reach maximum

19 / 59 correct responses



Look at the following picture.  
Choose the best answer related to the picture.

11 / 59 correct responses



(b)

**Figure 1.** (a) Question No 2 and answer percentage, (b) Question No 2 and answer percentage

Table 2 indicates that the graphical representation abilities of all types of learning styles are in the medium category. Furthermore, in the image representation ability, the highest average score was obtained by prospective teachers with a kinesthetic learning style, a value of 63.64, in the medium category and the lowest was owned by the visual learning style with the low category. The next data shows the ability of mathematical symbol representation and it count in term that the highest average score is possessed by prospective teachers with a kinesthetic learning style in a high category. This also applies to the average value of the verbal representation ability which is also the highest owned the kinesthetic learning style.

The results of the test analysis, it was invented that there were two questions in which many of the science teacher candidates chose the wrong answer. These two types of questions are the types of questions made to measure the ability of image representation, question no 2 and question No.5. Question no 2 shows a picture of a container with a hole in the side so that water emits from the container, and based on the picture students are asked to determine how to do it water coverage is maximum (see Figure (a)). Furthermore, question No.5 also shows a picture of pipes arranged with different diameters, participants are asked to choose the greatest pressure on the four tubes (see Figure 1 (b)).

From the number of participants who answered correctly, in question 2, it was found that 19 participant who answered correctly were spread across the three types of learning styles. Furthermore, in question number 5, it can be seen that 6 students with an auditory learning style answered correctly out of 11 participants, and only 2 people who answered correctly from students with a visual learning style (see Table 3.3).

**Table 3.** Two MR test item with More Misunderstanding

Learning Styles	Item number 5		Item number 8	
	frequency	percentage (%)	frequency	percentage (%)
Visual	5	26	2	18
Auditory	7	37	6	55
Kinesthetic	6	32	3	27
Grand Total	19		11	

### 3.2 Discussion

The learning style diagnostic test is intended to detect the type of learning style of science teacher candidate. This is intended so that the results of the test researchers can obtain information on the distribution of learning styles in the research subject and what learning styles are dominant. This test is also intended to get an idea of how the representation ability of each learning style is.

From the results of the study, it was found that the dominant learning style of the 4th semester science teacher candidate was visual, followed by auditory and kinesthetic. This result is in line with the number of visual learning styles worldwide, namely 83% of visual people, although the percentage of visual people in science teacher candidates is less, namely 45%. Research conducted also found that of the 251 students who were given learning style tests, the results showed that the majority of students were visual learning styles [14]. Furthermore, being aware of these results, the teaching style is adjusted to the student's learning style and the results show that there is a significant impact when adjusting the teaching style to the student's learning style [4][18]. These results indicate the importance of knowing students' learning styles so that how to teach adapts to their learning styles.

Although several studies have shown that there is a significant effect when the teaching method is adjusted to the learning styles of students, there are also studies that show the opposite. Some of the results of research indicate that incorporating elements of learning styles to design appropriate learning cannot contribute to the quality of problem solving or increase declarative knowledge. The results

showed a lack of correlation between learning style variables and academic achievement. The results shown are both science and mathematics achievements, both of which show no correlation between learning achievement and learning styles [10]. Other studies have also found that there is no influence on learning styles and the form of teaching on student academic achievement [20] These results indicate that there are other factors that can affect student learning outcomes.

One factor that can play a role in learning outcomes is the implementation of multiple representations in learning. The results show that in science learning, students are able to overcome the concept of science well when they use multiple representations [21][22][23]. Information presented in multiple representations provides supporting data that supports cognitive processes and it can reduce the possibility of misinterpretation of a concept so as to strengthen conceptual understanding [24].

The multiple representation abilities measured in this study are representations of images, graphics, symbols, and verbal in terms of visual, auditory, and kinesthetic learning styles. This research is intended to see the representation ability of students with visual, auditory, and kinesthetic learning styles. From the results of the data analysis of the representation ability test, information was obtained that for the ability of graphical representation, the three learning styles had a medium level of ability, which meant that students with different learning styles had relatively the same graphical representation ability. These results also indicate that the ability to represent graphics still needs to be improved to a high or very high level.

Furthermore, the ability to represent mathematical symbols that shows the highest average score is chosen by students with a kinesthetic learning style, medium level. On the other hand, students with visual and auditory learning styles are at a low level. This result is similar to the ability of verbal representation where students with the kinesthetic learning style who have the highest score are at a high level while the other two learning styles are at the medium level. The results showed that students with kinesthetic learning styles had better cognitive knowledge about fluids than the other two learning styles. Good concept knowledge is influenced by the ability to represent material in various representations so as to minimize misconceptions.

Furthermore, the ability to represent images where the test results show that students with kinesthetic learning styles have better image representation abilities than the other two learning styles, namely at the medium level while the others at low levels. This result is quite surprising because the ability to represent images of students with visual learning styles is quite low. As it is known that students with a visual learning style readily receive and process information presented in the form of visual such as pictures, graphics, etc [13].

Generally, the averages value of the image representation ability of the three types of learning styles are low. Judging from several question items from the image representation, it shows that many students chose the wrong answer. The questions are number 5 and number 8. In question number 5, a picture is presented and students must be able to determine the maximum range of water that comes out of the tube. The problem requires the ability of students to represent images into symbols and requires knowledge to formulate mathematical equations so that there are factors from students' cognitive knowledge to be able to answer this question correctly. Therefore, the choice of answers is not only influenced by the students' image representation abilities but also their cognitive knowledge. Furthermore, question No. 8 shows that many students choose answers that are contrasting with the correct answers. These results indicate a misconception about the concept.

Based on these results, it is very important to apply multiple representation learning in the classroom, teach how to translate image representations into mathematical equations or mathematical symbols, or translate mathematical representations into verbal representations and so on so that understanding of a concept is well developed and misconceptions do not occur [23][25][26].

#### 4. Conclusion

The highest average value of graphic representation ability was owned by students with a visual learning style in the medium category. Furthermore, the highest value of the ability to represent images, symbols, and verbal was had by kinesthetic learner with each category, medium, high, and high. Based on these results it can be concluded that prospective science teacher with kinesthetic learning styles have better representation abilities than the other two learning styles.

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### References

- [1] Nilawati, 2016. Korelasi Kinerja Dan Motivasi Kerja Guru Dengan Prestasi Belajar Siswa Pada SMA Negeri Kota Sigli Kabupaten Pidie. Tesis. 2016. Banda Aceh, Universitas Syiah Kuala.
- [2] Fajri, A., Rahman, K.I., Awaliatul Fajri, Imas Kania Rahman, Santi Lisnawati Awaliatul Fajri, Imas Kania Rahman, Santi Lisnawati. 2019. Hubungan Kinerja Guru Dengan Prestasi Belajar Siswa. Annual Conference on Islamic Education and Social Sains (ACIEDSS 2019) Vol 1 No 2 (2019). Islamisasi Ilmu Pengetahuan di Era Revolusi Industri 4.0 | 260
- [3] Gilbert, J. K. (2004). Models and Modelling: Routes to more authentic science education. *International Journal of Science and Mathematics Education*, 2, 16.
- [4] Nurrahmawati, Cholis Sa'dijah, Sudirman, Makbul Muksar. 2019. Multiple Representations' Ability in Solving Word Problem. *International Journal of Recent Technology and Engineering (IJRTE)*. ISSN: 2277-3878, Volume-8, Issue- 1C2, May 2019.
- [5] Hwang, W.-Y., Chen, N.-S., Dung, J.-J., & Yang, Y.-L. (2007). Multiple Representation Skills and Creativity Effects on Mathematical Problem Solving using a Multimedia Whiteboard System. *Educational Technology & Society*, 10 (2), 191-212)
- [6] Lynch, Matthew. 2012. Looks Do Matter: How Visuals Shape Elearning <https://www.thetechedvocate.org/looks-do-matter-how-visuals-shape-elearning/>. Accessed September 28<sup>th</sup>, 2019.
- [7] Gilbert, J. K . 2010. The role of visual representations in the learning and teaching of science: An introduction. *Asia-Pacific Forum on Science Learning and Teaching*, Volume 11, Issue 1, Foreword, p.2.
- [8] Chittleborough, G and Treagust. D. F. 2007. *The modelling ability of non-major chemistry students and their understanding of the sub-microscopic level*. *Chemistry Education Research and Practice*, 8 (3), 274-292.
- [9] Gilbert, J. K. dan Treagust, D, 2009. Multiple Representations in Chemical Education. Springer.
- [10] Leigh, Gregor. 2004. Developing Multi-representational Problem Solving Skills in Large, Mixed-ability Physics Classes. University of Cape Town Department of Physics: Thesis. (online). ([http://www.phy.uct.ac.za/people/bufler/ Leigh\\_MSc.Pdf](http://www.phy.uct.ac.za/people/bufler/Leigh_MSc.Pdf), accessed October 2020).
- [11] Hill, M., & Sharma, M. D., 2015. Students' Representational Fluency at University: A CrossSectional Measure of How Multiple Representations are Used by Physics Students Using the Representational Fluency Survey. *Eurasia Journal of Mathematics, Science & Technology Education*, 2015, 11(6), 1633-1655.
- [12] Rovai, A. P., & Grooms, L.D. 2004. The relationship of personality-based learning style preferences and learning among online graduate students. *Journal of Computing in Higher Education*, 16(1), 30-47
- [13] DePorter & Hernacki. 2006. *Quantum Learning*. PT. Mizan Pustaka. Bandung.
- [14] Chetty. N. D. S, Sahabuddin, N. A., Ali, Z., Hamzah N., Abdul Rahman, N., Kasim, S. Nithya. 2019. Learning styles and teaching styles determine students' academic performances. *International Journal of Evaluation and Research in Education (IJERE)* Vol. 8, No. 3, September 2019, pp. 610~615
- [15] Hawk, T. F. & Shah, A.J. 2007. Using learning style instruments to enhance student learning. *Decision Sciences. Journal of Innovative Education*, 5, 1-19
- [16] Angela Abu-Asba, Hazita Azman, Rosniah Mustaffa, 2012. Learning Styles Of Yemeni Undergraduate Science Students. *GEMA Online™ Journal of Language Studies* Volume 12(2), May 2012.



- [17] Lehmann, T and Ifenthaler, D . 2012. Influence of Students' Learning Styles on The Effectiveness of Instructional Interventions. *IADIS International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2012)*
- [18] Azfaal, S, Noor Zainah Siau and Wida Susanty Hj. Suhali, 2019. Evaluating Students' Personality and Learning Styles in Higher Education: *Pedagogical Considerations*. *International Journal of Learning, Teaching and Educational Research* Vol. 18, No. 7, pp. 145-164, July 2019
- [19] Wilson, M. 2012. Student's learning style and preferences and teachers' instructional strategies: Correlation between matched styles and academic achievement. *STRATE Journal*. Fall-winter 2012, vol 22 number 1. Pg-36
- [20] Cimermanová, I. (2018). The Effect of Learning Styles on Academic Achievement in Different Forms of Teaching. *International Journal of Instruction*, 11(3), 219-232. <https://doi.org/10.12973/iji.2018.11316a>
- [21] Marpaung, N., Liliyasi, L., & Setiawan, A. (2016, November). Identifikasi Kemampuan Multipel Representasi Mahasiswa Calon Guru Fisika. In *Prosiding Seminar Biologi* (Vol. 13, No. 1, pp. 445-449)
- [22] Abdurrahman, R. A. 2016. Limitation of representation mode in learning gravitational concept and its influence toward student skill problem solving. In *Proceeding of The 2nd International Seminar on Science Education* (pp. 373-377).
- [23] Wati, Mustika, Mahtari, Saiyidah, Ramlah dan Misbah. (2020). Studi Kemampuan Representasi Siswa Pada Pokok Bahasan Hukum Newton. *Jurnal Inovasi dan Pembelajaran Fisika*, Vol 7 (1) 1-6
- [24] Ainsworth, S. (1999). The functions of multiple representations. *Computers & education*, 33(2-3), 131-152.
- [25] Fatimah, S. (2016). Analisis multirepresentasi mahasiswa PGSD pada konsep gelombang dan bunyi. *Premiere Educandum: Jurnal Pendidikan Dasar dan Pembelajaran*, 6(02).
- [26] Kohl, P.B. & Finkelstein, (2004). Representational Format, Student Choice, and Problem Solving in Physics. *Physics Educational Research Conference. (PER)* Sacramento, California. 790: 121 -124.