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Physics student teachers' reading comprehension skills of science and physics texts

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Abstract

College physics curricula gives less attention to reading comprehension skills. This article reported a critical investigation on physics student teachers reading comprehension skills of science and physics texts. Their performances of reading comprehension of science texts were investigated using reading comprehension test. Science texts used to test their skills of reading comprehension are designed in regard to the TOEFL reading test and translated into Bahasa Indonesia. Eight components of comprehension skills were examined. To assess the reading comprehension skills of physics texts, true-false-unreported tests were used. It was found that the higher reading skills were needed to distinguish the unreported statemet in the basic text. Total of 67 physics student teachers at a college in Bandung participated in the study. It was found that their reading comprehension skills of science and physics texts fell into a low level. These findings supported that training the physics student teachers on reading comprehension strategies of science and physics texts should be integrated into teacher education programs.

Keywords: reading comprehension, physics texts, science text, strategy

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INTRODUCTION

Communication in science requires students to comprehend sience term, information about scientific concepts that expressed in sentences, and also to communicate the science topic with peers and teachers in science class (Koch, 2001). Science texts contain necessary information; each word is important and has specific meaning. Thus, to comprehend overall science concept students have to read all the words and they cannot read most of the words (Draper, 1997). In order to understand a topic in the text of science, students need to understand science term which generally has a specific meaning. Furthermore readers need to actively think about the sentences and paragraphs.

Reading is an active and complex process that involves (1) understanding written text, (2) developing and interpreting meaning, and (3) using meaning as appropriate to type of text, purpose, and situation. (National Assessment Governing Board, 2012, p. iv). In order for knowledge to increase, students must be able to read, understand and interpret written material in various levels of complexity (Baker & Brown, 1984). Reading in the university level is different from reading in school level, where reading at the university level requires deeper analytical skills, engaging in high-level thinking, such as considering author's claims, applying reading information to solve problems, or synthesizing reading information (Afflerbach, Cho, & Kim, 2015). The scope of reading for university student is much wider and scholarly. Academic reading tend to be complex, purpose-ful, and critical, and requires readers to interpret and synthesize dense text that addresses discrete subjects in depth (Sengupta, 2002). Students

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from higher education, especially in physics, are required to be able to build knowledge and meaning through interaction with exposition textbooks on science or mathematics subjects (Mayer, 1996). For student with major subject in science and physics, mastery of domain knowledge, reading skill and reading strategy knowledge importance for science comprehension (O'Reilly & McNamara, 2007).

Difficulties in comprehending scientific and mathematical texts are experienced by science students even though they may have good skills in reading narrative texts (Okanlawon, 2011). This is because the narrative text contains a general theme, like an oral language that is commonly used so that the information is more easily understood by the reader. In narrative text, information is stated explicitly so that the reader more easier to understand the meaning of the text. Narrative text is different with science texts that loaded with important information and detailed logical arguments therefore science text is difficult to understand (Okanlawon, 2011). In science texts, many statements are not explicitly written in the text, therefore the reader have to inference the information implied in the text using the accurate logic. Furthermore if one part of the term is skipped or misunderstood, the sentence becomes incomprehensible and influences the true meaning of the sentence to be conveyed. However, contemporary research in the field of science and physics education gives less attention to reading comprehension skills. The attention of researchers in science education tends to focus on learning methods of learning subject matter, developing problem solving skills and ways to improve the implementation of practical work, (Koch, 2001). Given the limited studies that examine the strategy of reading physics texts at the level of university students (eg. Koch, 1991; 1995), and reading physics texts in higher education requires a deep comprehension, it is necessary to propose strategies to read physics texts which are expected to be an alternative in reading strategies of physics texts. For the need assessment of the proposed strategies, before determining the reading strategy a preliminary study is needed. This study aimed at investigating students' reading comprehension to show the need of training reading comprehension strategies Phyof science and physics text in curricula of undergraduate physics. There were two research questions that present in this study: (1) How did students perform in reading comprehension on science texts? (2) How did students perform in reading comprehension on physics texts?

METHOD

This is a preliminary research with the intention to find reading strategy, that sufficient to apply, especially in reading physisc texts. *Method*. Descriptive method was empoyled to explore students' reading comprehension skills on science and physics texts on physics students teacher.

Participants. The participants of the study are 67 physics students teacher who attended in second year of physics education ranging in age from 19 to 22 years. This study was conducted at Physics Education of a college in Bandung. The sample of the study was selected through convenience sampling method. Convenience sampling is a non-probability sampling technique where subjects are selected because of their convenient accessibility to the researcher.

Instrument. Students' reading comprehension of science texts are tested on three complex science texts about Earth and Universe adapted from several TOEFL reading comprehension that have been translated into Bahasa Indonesia. The type of tests are already available in large numbers and variations. In addition, the results can be relied upon to know the competencies of the participants-test. Models of such standardized test use have the advantage of being seen from their practicality and usefulness. In this study, types of questions that are used in reading comprehension test refer to the formulation developed by Sharpe (2001) in the Baron's TOEFL. Sharpe (2001) identifies eight types of questions commonly used in reading tests. The eight types are: (1) previewing, (2) reading for main ideas, (3) using context for vocabulary, (4) scanning for details, (5) making inferences, (6) identifying exceptions, (7) locating references, and (8) referring to the passage. In reading comprehension tests there are 30 reading comprehension questions of science text about earth and universe. The reliability of the instrument was tested with KR21. Coeffisient reliability of the instrument is 0.8.

To examine students' reading comprehension skills on physics texts instrument was adopted from Koch & Eckstein (1991) that is a short physics text about circular motion. Short physics text (basic text) is included with list of 20 statements about basic text which are interpret the basic text. Type of statement which are

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interpret the basic text are contradict the text, implied in the text, explained in the text, and not explain in the text. In this test, students were asked to decide whether statements about a text are true, false or unreported. The students were instructed not to solve the problems, but rather to decide whether each of a list of interpret text is True (T), False (F) or Unreported (U). The interpret text are to be considered true (T) if the sentences are made in the text or are implied by the text; they are to be considered false (F) if they are inconsistent with the basic text; and they are considered to be unreported (U) if they are consistent with the text but not reported in it. The reliability of the instrument was tested with KR21. Coeffisient reliability of the instrument is 0.9. In each reading comprehension tests there are 30 reading comprehension questions of science text and 20 questions reading physics text, that students should complete it within 45 minutes. Although time is limited, reading fluency are not considered as a component of reading comprehension skills in this study. Reading fluency is the ability to read text aloud with accuracy, speed, and proper expression (Shanahan, 2005).

FINDING AND DISCUSSION

Students' Reading Comprehension on Science Texts

The result of students' reading comprehension test on the science texts is shown in Table 1. The average score achieved by 67 students are 59,6% and the lowest performance was in "making inferences". Score for this skill was 50.4%. Questions in "making inferences". require logical thinking. Students must read the question carefully and understand what being asked so that readers must understand the main idea of the whole paragraph. Based on PISA 2012 (Organisation for Economic Co-operation and Development, 2014), about Descriptions for the Seven Levels of Proficiency in Reading, "making inferences" related to highest level of reading proficiency (Level 6), tasks at this level typically require the reader to make inferences and multiple inference.

Reading comprehension was grouped into literal comprehension, inferential comprehension, and critical comprehension. Lower level reading comprehension group is also called literal reading. Higher level reading comprehension groups are also called critical reading, and consist of three categories: interpretive understanding, critical understanding, and creative understanding (Solikhah, 2015). Linking new knowledge relationships with prior knowledge, drawing inferences and linking coherent ideas is also higher reading comprehension skills (Clarke, Truelove, Hulme, Snowling, & Chesher, 2014). Based on these point of view, it could be say that students in this study are in lower level reading comprehension. Influent by theoretical model of reading comprehension, it could say that students are unable to build an adequate text base (direct representation of the semantic structures of text) and situational model (integrated reordering of text content with prior knowledge) (Clarke et al., 2014), which represent readers' constructive understanding of the meaning of text.

Making inferences in science text, for some cases, need the readers to identify the information because mostly the information is not explicitly stated in the text that is implied in the text so that usually student need paraphrasing. Paraphrasing is rewording some portion of the text by using different words that are more familiar to the reader. It fosters the text-based comprehension (McNamara, Ozuru, Best, & O'Reilly, 2007). Students with poor comprehension in reading show inaccurate in paraphrasing (McNamara, 2004). It can be conclude that students in this study are less capable of performing the task of text-based questions with paraphrase. This finding align with Perin (2013) that found many students have difficulty with identifying main ideas in text, identifying a global idea in text, and composing summaries of text with paraphrase.

The highest score was in "using context for vocabulary" (67,5%). To select the correct answer for vocabulary questions, readers just make sure the context around the sentence, scan the answer choices to see which one makes the most make sense in this context and plug it back into the sentence and see if the sentence still makes sense. Based on PISA 2012 (Organisation for Economic Co-operation and Development, 2014), about Descriptions for the Seven Levels of Proficiency in Reading, reading skills "using context for vocabulary" related to lower level of reading profisiency (Level 1) that stated, "...students can answer questions involving familiar contexts where all relevant information is present...". Students majoring in physics, during their studies at the university, will always be involved in comprehending science reading. They must read with an in-depth comprehending

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so as to be able to make inferences, connect ideas in sentences and paragraphs in a coherent manner, test the validity of claims submitted by the author with a critical attitude, and sometimes understand the motives of the author (Graesser, 2007).

Students' Reading Comprehension on Physics Texts

Instrument that use to examine students' reading comprehension skills on physics texts is shown in Figure 1. This test promt students more analytical and interpretive thinking.

Table 2 presents the mean percentages of correct answers in each of the categories T, F, and U on the test for the entire sample of 67 students. Overall reading comprehension of students to physical text is 46%.

Based on Table 2, it can be said it is most difficult for students to identify unreported items (not explain in the text), less difficult to identify false items (55.4%), and easiest to identify true items (62.2% & 55.2%).

Based on the entirety test results it can be explained that: first, student's comprehension of "basic text" that is represented in the text form in "interpreting text" only reaches 37%. These results show that the students' skill in interpreting the basic text was in low performance. In this task to consider the interpreting text is True, False or Unreported, students have to make inference about basic text.

Second, students' comprehension of the "basic text" that was represented in the form of mathematical equations in "interpreting text", reach 63%. The result implied that the students were familiar with the problem-solving task.

Third, the students' skill in identifying statements about text that were contradict the basic text reach 55%. These results indicated that students have difficulty in seeing the contradictions between the basic text and the statements about text.

Fourth, the students' skill in comprehend the meaning of text implicitly, reach 62%. It is easiest to identify true items.

Fifth, the students' skill in identifying statements about text that were expressed clearly in the text base, reach 55%. It can be said that students difficulty in inference and not reading whole base-text.

Sixth, the students' skill in identifying the statements about text that were not explained in the basic text, reaches 19 %.

Tabel 1. Students' Reading Comprehension of Science Text

No.	Types of Questions that are Used in Reading Comprehension	Overall performance of Reading Comprehension on Science Texts (%)
1.	Previewing	57.5
2.	Reading for main ideas	54.5
3.	Using context for vocabulary	67.5
4.	Scanning for details	63.2
5.	Making inferences	50.4
6.	Identifying exception	54.9
7.	Locating references	66.2
8.	Refering to the passage	53.7

Tabel 2. Students' Reading Comprehension of Physics Text

No.	Types of Statement about Basic Text	Mean Percentages of Correct Answer (%)
1.	Contradict the text (Need to answer "F")	55.4
2.	Implied in the text (Need to answer "T")	62.2
3.	Explain in the text (Need to answer "T")	55.2
4.	Not explain in the text (Need to answer "U")	19.4

A stone of mass *m* is attached to the end of a weightless string and rotates in a circle in a vertical plane. In this case, the tension T_1 in the string at the bottom of the circle is larger than the tension T_2 at the top of the circle by six times the stone's weight.

(a)

7. $T_1 = T_2 + 6mg$
8. $T_2 = T_1 + 6mg$
9. The tension of the string is zero at the bottom
10. The tension of the string is zero at top
11. The tension in the string at the top is greater than stone's weight

(b)

Figure 1. (a) Basic text, (b) Interpreting text

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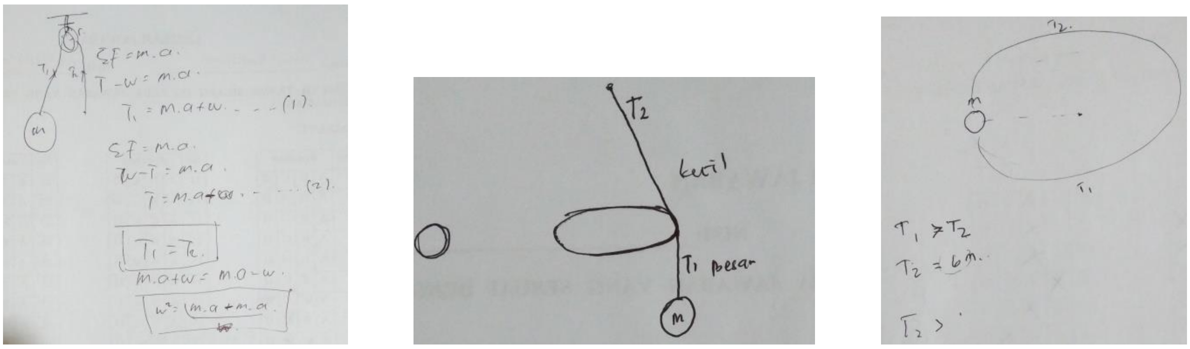

(a) Student #1 (b) Student #2 (c) Student #3

Figure 2. Incorrect free-body diagram representation of basic text (a) Student #1, (b) Student #2 and (c) Student #3

Statement about text that were not explained in the basic text demand students to answer with unreported (U), but 38% student answer false (F) and 43% answer true (T). The results show that it is difficult for students to decide if the statement "Unreported" in the basic text, but it is more-easy to decide if the state-mant statement is "True" or "False". In this reading reading test "Unreported" are intended to stimulate students' curiosity and inspire them to think about information beyond of the text written in the basic text (Koch & Eckstein, 1991). Asked students to think about infor-mation beyond the text that that written on the basic text stimulate students to connect the text with their prior knowledge and experiences with the world (McNamara et al., 2007). Results of this study shows that students lack of prior knowledge and confusion of thinking. Based on interviews with students it can be noted that while doing the task of reading, students try to solve the problem rather than reading. In the reading assignment, students should be always refer to the text instead of trying to solve the problem.

Comprehending of physics texts requires the reader to understand unique lexicon, semantic, syntactic, and unique logic commonly used in physical text. Moreover physics text contains compound sentences with logical connectives to illustrate cause and effect of two ideas, propositions, or sentences often caused cognitive difficulties for the readers (Yore & Shymansky, 1991). Therefore, a special strategy is needed so that the physics text readers have a better comprehension. There are many strategies that can help the readers to improve their com-prehension among others using charts, graphs, diagrams, pictures, symbols, and equations for better comprehension (Yore & Shymansky, 1991). Related to the physics texts that tested in this study, students should make a sketch of the situation by using the diagram namely free-body diagrams representation so that can help the readers determine the correct, wrong or un-identified answer. In fact, only 12% of students used free-body diagram representation but no one students involved in this study who used free-body diagrams representation correctly. Incorrect images representation were used by students are shown in Figure 2. This situation indicates that students are not accustomed to use free-body diagrams in reading strategies or in problem solving. As we know usage of free-body diagrams representation frequently applied in almost all existing physics text-book to solve problem. Successful readers of scientific texts usually using some strategies in reading, such as making diagram, table, graph and examining pictures and captions, and moving back and forth in the text.

Students' attitudes regarding the purpose for reading influence their skills to read, they have to learn to read critically if they want to get entirety all of the materials they are assigned. Good readers are actively involved with the text, and they are aware of the processes they use to comprehend what they read. Students who have better reading comprehension do not occur automatically. There needs to be directed cog-nitive efforts that include cognitive process knowledge and cognitive processing (Pressley & Afflerbach, 1995). During reading, the cognitive effort is expressed through strategies, which are pro-cedural, purposeful, effortful, willful, essential, and facilitative in nature (Alexander & Jetton, 2000). The strategies are applied by the readers must purposefully or intentionally or willfully to monitor comprehension and enhance learning (Alexander & Jetton, 2000).

Comprehending reading in the texts of science and physics is a challenge, because

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readers must comprehend symbols, terms, words and comprehend the sequence of words so that they are connected into a sentence that is dense with ideas. Readers must develop sufficient skills to comprehend the deep meaning of sentences, paragraphs, and the entire text. When the reader manages constructive and integrative processes for making inferences from a dense information from some sentences or analyze the text into a unit idea to understand the text meaning, the readers required higher-level thinking skills (Afflerbach et al., 2015). However for the need to identifies written words and compare them to the meaning of the word from prior knowledge and comprehend a simple sentences of the text, simple skills are sufficient.

The lack of students' reading comprehension in science texts at university level most likely due to low of reading comprehension skills when student were at the secondary school level. Data that gathered from the PISA 2012 results show that for Organisation for Economic Co-operation and Development (OECD) countries were investigated according to math, science, and reading performances, Indonesia's students together with Turkey, Brazil, Colombia, Qatar, stand in position lower performer, at level 1, for reading performance. Tasks at level 1 include a simple task such as: first, finding one piece of information that is explicitly stated in a prominent position in short text and simple syntax using context and known types of text, namely simple narration or list. Second, determining the information easily recognized by readers, such as repeated information, images or symbols. Third, making interpretations, which generally have to be done by making simple connections between adjacent pieces of information (Organisation for Economic Co-operation and Development, 2014). Based on the PISA 2012 results data, especially for OECD countries although there weren't any significant relation found but it appears that students who have low math and science scores are also low reading scores. Students from developed countries have high math and science scores and high reading scores. in developed countries it has been observed that there is a strong reltionship between high math and science scores and high reading scores (Akbaşlı, Şahin, & Yaykiran, 2016).

According to NRP Report 2005 (Shanahan, 2005) reading skills consists of phonemic awareness, phonic, oral reading fluency, vocabulary and reading comprehension strategies. Although there are some factors that influence to reading skill, inference making and reading strategy knowledge are two key attributes that are of particular significant of skilled readers (O'Reilly & McNamara, 2007). When sciense readers face any number of obstacle in reading science text, reading strategies is one of the most effective ways to help science readers overcome obstacles in reading comprehension science text. Reading comprehension strategy need to be taught to students at all level science education.

Strategy instructions that are built on various domains are based on the idea that less skilled students must learn imitating strategies that are shown by skilled students or that compensate for the process shown by skilled students (McNamara, 2009). Other strategies can also be used to help students who struggle with understanding. Many variables are worth considering before applying a reading comprehension strategy that influences the efficacy of the strategy: type of text, prior knowledge, preferred learning style and number of repetitions needed for mastery. When students have the chance to learn, practice, and apply reading comprehension strategies that are deeply coupled to domain learning goals and domain practice, content learning will increase along with students' ability to independently read to learn (Herman, Perkins, Hansen, Gomez, & Gomez, 2010). Science readers should have a corpus of strategies they can use prior to, during, and after reading to learn from science text. The strategies should be applied when students read sience text and when internalized and used frequently, student have benefit when using the strategy, it can lead to large positive effects on text comprehension (Collins, 1991). In addition, for the needs of comprehend and communication, the strategy will help students know how to reflect, analyze, organize, examine, and criticize (Herman, Gomez, Gomez, Williams, & Perkins, 2008). The most important of the use of reading strategies is that students can make inferences so that they can integrate new and prior knowledge into a comprehensive representation of their understanding.

Sullivan (1978) compared comprehension strategies used by good and poor readers and stated that: (1) good readers are more flexible in interpreting and transposing information than poor readers are, (2) good readers had less difficulty in relating past knowledge to reading material, (3) good readers, when making judg-

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ments, show little difficulty in identifying supporting examples. Recommended further research might focus on comprehension strategies that might be tied to certain text structure.

CONCLUSION

The main research goals of the study is examine students' reading comprehension skills on science and physics texts. Both in test of reading science texts and reading physic text, making inferences is the lowest score achieved by students. Making inferences is the highest level of reading skills where tasks at this level typically require the reader to make multiple inferences but vice versa using context for vocabulary related to lower level of reading profisiency.

In test of reading physics texts, result showed that it is difficult for students to decide if the statement "Unreported" in the basic text, but it is more easy to decide if the statement statement is "True" or "False". While doing the task of reading students try to solve the problem rather than reading. The importance of teaching undergraduate science students how to interact effectively with a scientific text has been realized by physics educators (Becker, 1995; Kalman & Kalman, 1996; Mullin, 1989). Nevertheless, college physics education curricula gives less attention in reading comprehension skills. The curricula of undergraduate physics generally prioritize the problem-solving and mathematical aspects of the subject matter. Whereas science text reading skills have important roles and benefits when students are required to read textbooks and laboratory manuals.

When students read science texts, they need a process of understanding because often the information relevant to the understanding in a given sentence, or the relationship between sentences, is not often easily accessed in long-term memory therefore students need greater effort. When the conceptual knowledge is inadequate and when the familiarity with the text is low, reading strategies are particularly important for reading comprehension. In implementing any of the selected comprehension strategy for the purpose of improving reading comprehension skills the following teaching strategies are recommended: (1) Direct explanation. In this strategy, teacher explains to students to apply the strategy so that will help them to comprehend in reading the text; (2) Modeling. In this strategy the teacher models, or demonstrates, how to apply the strategy, usually by "thinking aloud" while reading the text that the students are using; (3) Guided practice. In this strategy the teacher guides and assists as they learn how and when to apply the strategy; (4) Application. In this strategy the teacher helps the students practice the strategy until they can apply it independently.

REFERENCES

Afflerbach, P., Cho, B.-Y., & Kim, J.-Y. (2015). Conceptualizing and assessing higher-order thinking in reading. *Theory Into Practice*, *54*(3), 203–212. https://doi.org/10.1080/00405841.2015.1044367

Akbaşlı, S., Şahin, M., & Yaykiran, Z. (2016). The effect of reading comprehension on the performance in science and mathematics. *Journal of Education and Practice*, *7*(16), 108–121. Retrieved from https://iiste.org/Journals/index.php/JEP/article/view/31539

Alexander, P. A., & Jetton, T. L. (2000). Learning from text: A multidimensional and developmental perspective. In *Handbook of Reading Research* (pp. 285–310). Mahwah, NJ: Routledge Handbooks Online. https://doi.org/10.4324/9781410605023.ch19

Baker, L., & Brown, A. L. (1984). Metacognitive skills and reading. In P. D. Pearson, R. Barr, M. L. Kamil, & P. Mosenthal (Eds.), *Handbook of Reading Research* (Vol. 1, pp. 353–394). New York, N.Y.: Longman.

Becker, S. F. (1995). Guest comment: Teaching writing to teach physics. *American Journal of Physics*, *63*(7), 587.

Clarke, P. J., Truelove, E., Hulme, C., Snowling, M. J., & Chesher, D. (2014). *Developing reading comprehension*. Wiley-Blackwell.

Collins, C. (1991). Reading instruction that increases thinking abilities. *Journal of Reading*, *34*(7), 510–516.

Draper, R. J. (1997). Jigsaw: Because reading your math book shouldn't be a puzzle. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *71*(1), 33–36. https://doi.org/10.1080/00098659709599319

Graesser, A. C. (2007). An introduction to strategic reading comprehension. In D.S.

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

McNamara (Ed.), *Reading Comprehension Strategies: Theories, Interventions, and Technologies* (pp. 3–26). New York, NY.: Lawrence Erlbaum Associates.

Herman, P., Gomez, L. M., Gomez, K., Williams, A., & Perkins, K. (2008). Metacognitive support for reading in science classrooms. In *Proceedings of the 8th international conference on International conference for the learning sciences-Volume 1* (pp. 342–349). International Society of the Learning Sciences.

Herman, P., Perkins, K., Hansen, M., Gomez, L. M., & Gomez, K. (2010). The effectiveness of reading comprehension strategies in high school science classrooms. In *Proceedings of the 9th International Conference of the Learning Sciences-Volume 1* (pp. 857–864). International Society of the Learning Sciences.

Kalman, J., & Kalman, C. (1996). Writing to learn. *American Journal of Physics*, *64*(7), 954–955. https://doi.org/10.1119/1.18279

Koch, A. (2001). Training in metacognition and comprehension of physics texts. *Science Education*, *85*(6), 758–768. https://doi.org/10.1002/sce.1037

Koch, A., & Eckstein, S. G. (1991). Improvement of reading comprehension of physics texts by students' question formulation. *International Journal of Science Education*, *13*(4), 473–485. https://doi.org/10.1080/0950069910130410

Mayer, R. E. (1996). Learning strategies for making sense out of expository text: The SOI model for guiding three cognitive processes in knowledge construction. *Educational Psychology Review*, *8*(4), 357–371. https://doi.org/10.1007/BF01463939

McNamara, D. S. (2004). SERT: Self-explanation reading training. *Discourse Processes*, *38*(1), 1–30. https://doi.org/10.1207/s15326950dp3801_1

McNamara, D. S. (2009). The importance of teaching reading strategies. *Perspectives on Language and Literacy*, *35*(2), 34.

McNamara, D. S., Ozuru, Y., Best, R., & O'Reilly, T. (2007). The 4-pronged comprehension strategy framework. In D.A. McNamara (Ed.), *Reading comprehension strategies: Theories, interventions, and technologies* (pp. 465–496). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Mullin, W. J. (1989). Writing in physics. *The Physics Teacher*, *27*(5), 342–347.

National Assessment Governing Board. (2012). *Reading framework for the 2013 national assessment of educational progress*. Washington, DC.

O'Reilly, T., & McNamara, D. S. (2007). The impact of science knowledge, reading skill, and reading strategy knowledge on more traditional "high-stakes" measures of high school students' science achievement. *American Educational Research Journal*, *44*(1), 161–196. https://doi.org/10.3102/0002831206298171

Okanlawon, A. (2011). Using appropriate strategies to improve students' comprehension of chemistry texts: A guide for chemistry teachers. *African Research Review*, *5*(4). https://doi.org/10.4314/afrrev.v5i4.69278

Organisation for Economic Co-operation and Development. (2014). *PISA 2012 results: What students know and can do (Volume I, Revised edition, February 2014)*. Pisa: OECD Publishing. https://doi.org/10.1787/9789264208780-en

Perin, D. (2013). Literacy skills among academically underprepared students. Retrieved January 14, 2019, from https://ccrc.tc.columbia.edu/publications/literacy-skills-among-academically-underprepared-students.html

Pressley, M., & Afflerbach, P. (1995). *Verbal protocols of reading : the nature of constructively responsive reading*. Lawrence Erlbaum Associates.

Sengupta, S. (2002). Developing academic reading at tertiary level: A longitudinal study tracing conceptual change. *The Reading Matrix*, *2*(1).

Shanahan, T. (2005). *The national reading panel report. Practical advice for teachers*. Learning Point Associates/North Central Regional Educational Laboratory (NCREL).

Sharpe, P. J. (2001). *How to prepare for the TOEFL test: Test of English as a foreign language*. Barron’s Educational Series.

Solikhah, I. (2015). Pengembangan tes reading for academic purposes untuk program EAP di IAIN Surakarta. *CENDEKIA: Journal of Education and Teaching*, *9*(2), 177. https://doi.org/10.30957/cendekia.v9i2.332

Sullivan, J. (1978). Comparing strategies of good and poor comprehenders. *Journal of Reading*, *21*(8), 710–715.

Yore, L. D., & Shymansky, J. A. (1991). Reading in science: Developing an operational conception to guide instruction. *Journal of Science Teacher Education*, *2*(2), 29–36. https://doi.org/10.1007/BF02962849

ISSN 2406-9205 (print), ISSN 2477-4820 (online)