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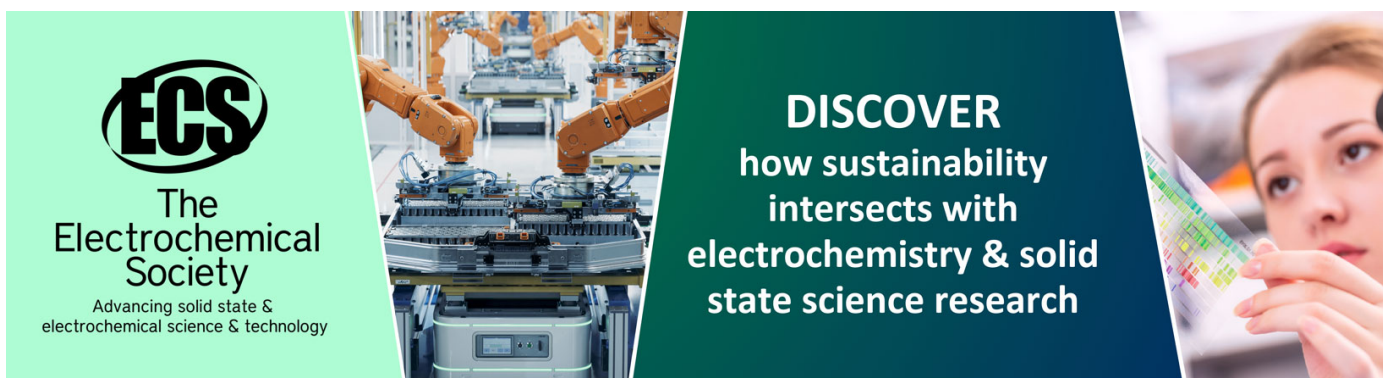
Development of high school physics class XI book, based on concept map to enhance the high-level thinking skills (HOTS)

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Development of high school physics class XI book, based on concept map to enhance the high-level thinking skills (HOTS)

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Abstract Low high-level thinking skills (HOTS) of students, especially in physics can not be separated from the process of learning activities of students in schools that have not emphasized the student-centered. One problem is the books or reading material that is used by high school physics students and teachers have not led to the aspects of cognitive domains that are part of high-level thinking skills. Based on those developed for high school physics textbook using concept maps in both the material and the exposure to examples and exercises for students. The study aims to gain if the book is worth to be used in schools. Development model used in this study is a model of Plomp. ModelPlomp consists of three stages of development that preliminary research (initial investigation), prototyping phase (phase prototypes) and assessment phase (phase assessment). To assess the feasibility of this book used some experts consisting of several professors of physics and school physics teacher. The results of the feasibility test of power obtained an average score of 3.65 with very good category. Feasibility in terms of the depth of material, kesesuaian with the development of the students thought patterns and linkage map concept with high-level thinking skills. While the results of feasibility assessment of conformity with the curriculum, the ease of understanding the text, the feasibility of the exercise presented by the teachers obtained a score of 3.80. The results of the feasibility test of power obtained an average score of 3.65 with very good category. Feasibility in terms of the depth of material, kesesuaian with the development of the students thought patterns and linkage map concept with high-level thinking skills. While the results of feasibility assessment of conformity with the curriculum, the ease of understanding the text, the feasibility of the exercise presented by the teachers obtained a score of 3.80. The results of the feasibility test of power obtained an average score of 3.65 with very good category. Feasibility in terms of the depth of material, kesesuaian with the development of the students thought patterns and linkage map concept with high-level thinking skills. While the results of feasibility assessment of conformity with the curriculum, the ease of understanding the text, the feasibility of the exercise presented by the teachers obtained a score of 3.80.

1. Introduction

Reflecting on the results of an international study into the cognitive abilities of the students are TIMSS (Trends in Mathematics and Science Study) conducted by the IEA (2012). (International Association for the Evaluation of Educational Achievement). The results of the TIMSS 2011 on Physics shows Indonesia scored 397 where this value is below the international average of 500. Berdasarkan percentage of correct answers to the content on the domain of cognitive science about the application and the application is always higher than the problems associated with reasoning. Where the implementation



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and application of thinking abilities including the ability of low-level domain. From these results it can be said that the high-level thinking skills (HOTS) learners Indonesia is still low.

The curriculum 2013 emphasizes the development of high-level intelligence capability that is framed by the attitude of divinity and social values are integrated in the learning process. Habits teachers only give all the information on the students were unusual anymore to apply. Students should be guided to the students must find their own concept. This requires intelligent and creative thinking processes. Smart and creative thinking means thinking high level (HOTS). Students are learning a subject, not an object. He should be dynamic and stimulus membelajarkan himself with the teacher as a "friend" learning in the classroom and outside kelas. Ending of the curriculum of 2013 is terlahirnya learners who are competent in accordance with the graduation standards set.

Physics lesson presentation as part of the science should be implemented as products and processes with balanced. This means that in the physics learning activities of students not only receive the product knowledge of the teacher but also must undergo a process to acquire that knowledge.

From the analysis of reading materials that are used by students and teachers in teaching physics in high school, aspects of cognitive domains that are part of the level of critical thinking has not been as high as aspects of the analysis, evaluation aspects and facets creates (Anderson & Krathwohl, 2001) looks very minimal, Reading materials of physics used by students focus more on delivering information procedural rather than how the information was obtained. The ability to think critically not just to analyze, synthesize and create, but also includes the process of discovering (inquiry), critical thinking (critical thinking), as well as problem solving (problem solving).

For this heading that students have a high level thinking skills is the indispensable book for the book physics students and teachers who can guide students to develop the ability to critically befikir. In this book dikembangkan how a scientist working in finding a concept of physics and students are also invited to find any connection or relationship concepts that they get with the concept sebelumnya. Peta concept was first developed by Novak in 1972 (Novak and Musonda, D, 1991). The ability to think critically can be developed menerapkan concept maps in learning. (Alberto J. Cañas et al, 2017). Concept maps are used create meaningful learning than just learning to memorize. Therefore, a concept map is the most ideal way to mengembangkan high level thinking skills (HOTS) (Kinchin, 2008). Research result *Jukka Väisänen and Kaarle Kurki-Suonio* shows that the learning and teaching of physics using concept maps have a very positive effect (Jukka Väisänen and Kaarle Kurki-Suonio, 2000). One powerful use of a concept map not only as a learning tool but also as an evaluation tool, thus encouraging students to use meaningful learning patterns (Mintzes et al, 2000; Novak, 1990; Novak & Gowin, 1984). Mapping concept is really designed to promote meaningful learning rather than rote learning support. Therefore, following the concept mapping is the ideal tool to support the development of Thinking Skills High level (HOTS) (Kinchin, IM, Lygo-Baker, S. and Hay, DB, 2008)

An important characteristic of concept maps is the inclusion of cross-connections between concepts. This relates to the concepts in a segment or domain of a different concept map. Crosslinking is very helpful to see how a concept in one domain of knowledge represented on the map associated with a concept in another domain shown on the map. In the creation of new knowledge, crosslinking often represent creative leaps on the results of the knowledge. There are two features of concept maps that are important in the facilitation of creative thinking: the hierarchical structure that is represented in a good map and the ability to search for and characterize new crosslinking.

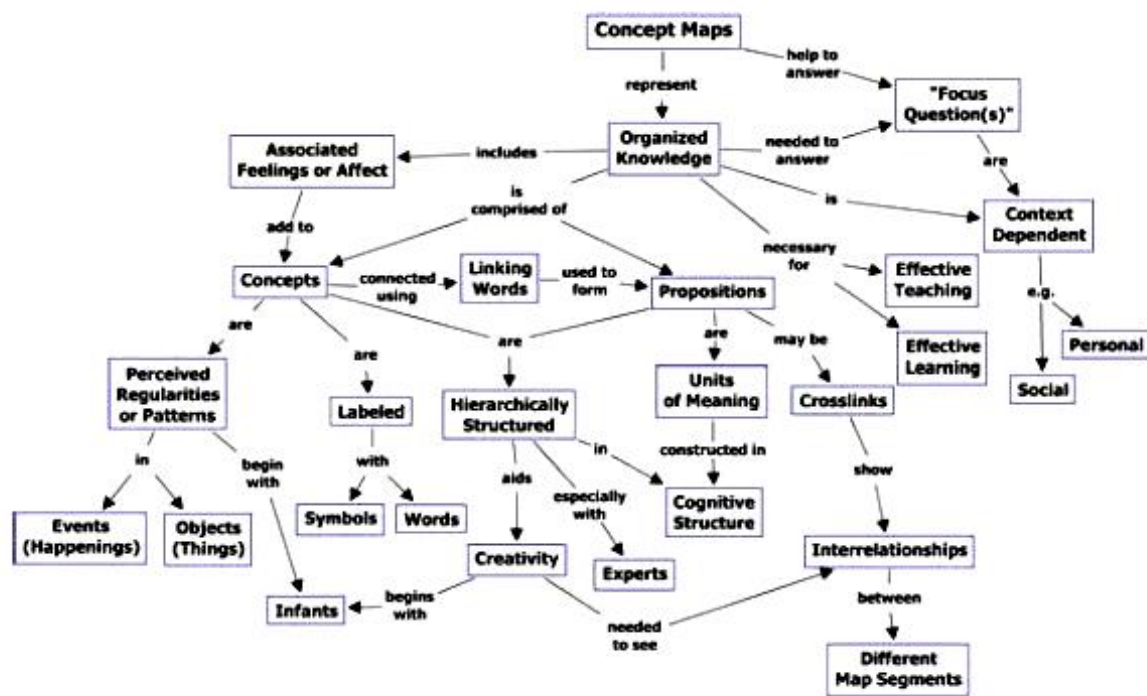


Figure 1. Overview of the concept maps that tend to be read from top to bottom (Novak D.J ,2006)

By training students learn physics is expected that students will be trained in the critical thinking that can eventually construct knowledge by both high-level thinking skills and develop into better.

2. Research Methods

Type of research is the study of research and development (Research and Development, R & D) The model development used is Model Plomp with three stages, namely the preliminary research (initial investigation), prototyping phase (phase prototypes) and assessment phase (phase assessment).

Table 1. Model Plomp Phase

phase	Criteria	Description of Activity
<i>Preliminary Research</i>	Identifying the need for a Product departing from the identification of problems that do	Problem analysis and review of the literature (past or present). The result is a framework for intervention
<i>prototyping Phase</i>	Originally: consistency (construct validity) and practicalities, then put the practicalities and gradually leads to effectiveness	<i>prototype</i> will be tested and revised based formative evaluation. The initial prototypes formative evaluation sheet based only done through expert assessment of the practicality expected to generate.
<i>Assessment Phase</i>	Practicalities and effectiveness	Assess whether the user can work with these products and can apply to learning (relevant and sustainable), and also whether the product is effective.

In the development of this physics book material discussed is a matter of secondary school physics class XI SMA which is material in the 1st half.

To test the feasibility of pruduk produced is used questionnaires with respondents appraisal experts ie Be some lecturers physicists and Upper secondary school physics teacher.

3. Result

Here is an example of a concept map that is trained to the students after they learn the concept Enterprises on rotational motion

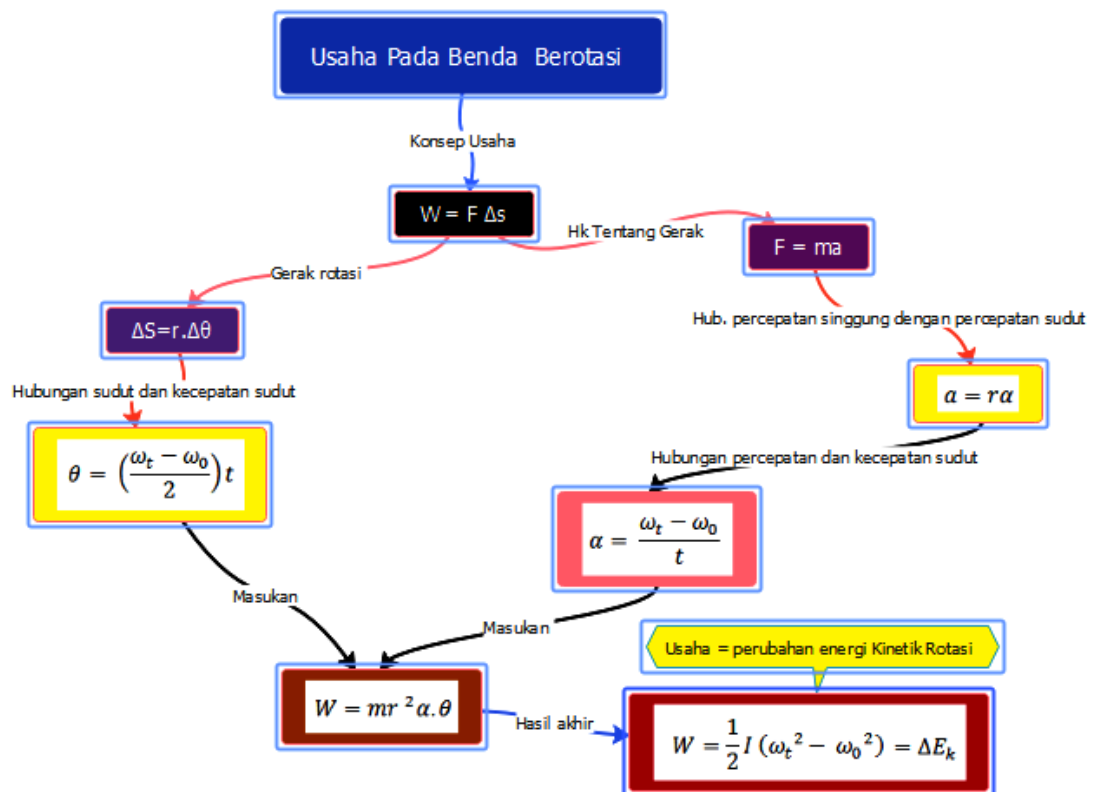


Figure 2. Map of the concept to operations on the motion of rotation

The results of the feasibility test of power obtained an average score of 3.65 with very good category. Feasibility in terms of the depth of material, kesesuai with the development of the students thought patterns and linkage map concept with high-level thinking skills. While the results of feasibility assessment of conformity with the curriculum, the ease of understanding the text, the feasibility of the exercise presented by the teachers obtained a score of 3.80. This means that the book is worth to use.

4. Conclusion

The middle school physics book for this impropriety to use. The use of concept maps in learning physics concepts will provide a very positive effect, especially in constructing knowledge and will ultimately increase the power of creative thinking and increased high-level thinking skills of their own.

References

- [1] Alberto J. Cañas, Priit Reiska AET Möllits (2017). Developing higher-order thinking skills with concept mapping: A case of pedagogic Frailty, *Knowledge Management & E-Learning*, Vol.9, No.3. Sep 2017.

- [2] Alice Thomas, Glenda Thorne, (2009), How to Increase Higher Order Thinking, <https://www.cdl.org/articles/how-to-increase-high-order-thinking/>
- [3] Anderson, LW & Krathmohl, DR (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. New York: Addison Wesley Longman Inc.
- [4] Brookhart, S., M. (2010). How to asses higher order thinking skills in your classroom. Virginia: ASCD.
- [5] Kaarle Kurki-Suonio (2000) .The Use of Concept Maps in the Physics Teacher Education: <https://www.researchgate.net/publication/276288886>
- [6] Kemdikbud, (2018). Buku Pegangan Pembelajaran Berorientasi Pada Keterampilan Berpikir Tingkat Tinggi, *Direktorat Jenderal Guru dan Tenaga Kependidikan Kementerian Pendidikan dan Kebudayaan*
- [7] Kinchin, IM, Lygo-Baker, S. and Hay, DB (2008) Universities as centers of nonlearning. *Studies in Higher Education*, 33 (1): 89-103.
- [8] Krulik, S., & Rudnick, JA (1999). Innovative tasks to improve critical- and creative- thinking kills. *Developing Mathematical Reasoning in Grades K-12*
- [9] Plomp et al (1999), *Design Approaches and Tools in Education and Training*, Kluwer Academic Publishers
- [10] Novak, JD, & Gowin, DB (1984). *Learning how to learn*. New York, NY: Cambridge University Press
- [11] Novak, JD (1990). Concept maps and Vee diagrams: Two metacognitive tools for science and mathematics education. *Instructional Science*, 19, 29-52.
- [12] Novak, JD (1991). Clarify with concept maps: A tool for students and teachers alike. *The Science Teacher*, 58, 45-49.
- [13] Novak, JD, & Musonda, D. (1991). A twelve-year longitudinal study of science concept learning. *American Educational Research Journal*, 28 (1), 117-153.
- [14] Novak J .D (2006)., The Theory Underlying Concept Maps and How to Construct Them : <https://www.researchgate.net/publication/215439441>
- [15] Mintzes, JJ, Wandersee, JH, & Novak, JD (2000). *Assessing science understanding: A human constructivist view*, San Diego: Academic Press.
- [16] TIMSS & PIRLS (2012), *TIMSS 2011 International Results in Science* TIMSS & PIRLS International Study Center.
- [17] May Yee Heong et al, (2011), The Level of Marzano Higher Order Thinking Skills Technical Education among Students, *International Journal of Social Science and Humanity*, Vol. 1, No. 2, July 2011