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TABLE OF CONTENTS

Effectiveness of Concept Cartoons on 7th Grade Students' Understanding of "the Structure and Properties of Matter"

Fuat Serkan SAY, Haluk ÖZMEN

Abstract | Full text: pdf (DOI: 10.12973/tused.10218a)

Argumentation Based Inquiry Applications: Small Group Discussions of Students with Different Levels of Success

Esra Kabataş Memiş, Ebru Ezberci Çevik

Abstract | Full text: pdf (DOI: 10.12973/tused.10219a)

Critical Inquiry Based Learning: A Model of Learning to Promote Critical Thinking Among Prospective Teachers of Physic

Saiful PRAYOGI, Leny YUANITA WASIS

Abstract | Full text: pdf (DOI: 10.12973/tused.10220a)

Analysis of the forms of argumentation of teachers in training in the context of a socio-scientific issue

Nidia TORRES, Jose Gabriel CRISTANCHO

Abstract | Full text: pdf (DOI: 10.12973/tused.10221a)

Contribution of Mind Mapping, Summarizing, and Questioning in the RQA Learning Model to Genetic Learning Outcomes

Slamet HARIYADI, Aloysius Duran COREBIMA, Siti ZUBAIDAH, IBROHIM

Abstract | Full text: pdf (DOI: 10.12973/tused.10222a)

Impacts of the Use of a Digital Simulation in Learning Earth Sciences (the Case of Relative Dating in High School)

Youssef NAFIDI, Anouar ALAMI, Moncef ZAKI, Bouchta EL BATRI, Hanane AFKAR

Abstract | Full text: pdf (DOI: 10.12973/tused.10223a)

Grid Analysis Display System (GrADS) and Multi Modus Visualization in Earth Science Learning Mastery and Spiritual Aspect to Enhance Concept

Henny JOHAN, Andi SUHANDI, Ana Ratna WULAN, SIPRIYADI

Abstract | Full text: pdf (DOI: 10.12973/tused.10224a)

Scientific Inquiry Perception and Ability of Pre-service Teachers

Z. Zulfiani, Yanti Herlanti

Abstract | Full text: pdf (DOI: 10.12973/tused.10225a)



Contribution of Mind Mapping, Summarizing, and Questioning in the RQA Learning Model to Genetic Learning Outcomes

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ABSTRACT

This study aimed to measure the contribution of summarizing and questioning in the Reading-Questioning-Answering (RQA) learning model integrated with mind mapping on the genetic learning outcomes. This study was a correlational research and has been analyzed using multiple regressions. Mind mapping, summarizing, and questioning were positioned as predictors, and genetic learning outcomes were positioned as a criterion. The research sample comprised 33 students. There was a strong correlation (97.4%) between mind mapping, summarizing, and questioning with the learning outcomes. The value of the relative contribution of each predictor (questioning, mind mapping, and summarizing) was 58.74%, 39.76%, and 1.50%, respectively. The value of the effective contribution of questioning, mind mapping, and summarizing was 57.21%, 38.73%, and 1.46% respectively. Thus, the contribution of questioning was higher than that of mind mapping and summarizing on the genetic learning outcomes. Future studies need to be conducted in order to confirm these research results.

Keywords: Learning model, mind mapping, questioning, reading-questioning-answering, summarizing.

INTRODUCTION

The Reading, Questioning, and Answering (RQA) learning model is a learning model that has been widely studied in all levels of schools and universities (Zunaidah, 2015; Bahtiar, 2013; Rahmawati, 2014). The syntax of this learning model has three steps, namely Reading (the students summarize the learning material), Questioning (the students make questions based on the summary), and Answering (the students answer those questions). The three syntaxes were performed prior to the classical teaching and learning processes (Corebima & Bahri, 2011).

Studies conducted on learning models such as RQA are usually related to learning model on learning outcomes as a unity. For example, the effect of RQA as a whole on metacognitive skills (Hasanuddin, 2013), learning activities (Rahmawati, 2014), thinking empowerment (Mulyadi *et al.*, 2014), critical thinking (Priantari, 2014), higher order thinking,



science process skills, and retention (Sumampouw, 2011). According to our research, no study has investigated the contribution of each element, such as of reading, questioning, or answering, to the learning outcomes separately. This study attempts to measure the contribution of summarizing and questioning separately to the learning outcomes.

Research on RQA has not been widely developed in other countries outside of Indonesia because the dissemination of the research results did not spread enough. In fact, this learning model is very good to be implemented considering its syntax that is needed by educators in all types and levels of education. RQA is designed on the assumption that every student should have sufficient knowledge before entering the classroom. This knowledge can make a major contribution to learning interactions because the students already have knowledge about the learning material that will be taught by the teachers. This initial knowledge is further enriched during the learning process and is also confirmed by other concepts.

The initial knowledge of students gained during composing a resume during the phase of “reading” is obtained from the reference that has been recommended to be read. Based on the reading results, questions will arise as a result of the cognitive interaction between students’ new knowledge and previous knowledge. The students then answer these questions on the basis of the depth of their knowledge.

In this study, new syntax was added in previous RQA, namely the phase of mind mapping as a preliminary research outcome obtained before the genetic learning. The preliminary research was conducted for three semesters before the main study was carried out at the State University of Malang and the University of Jember, (Hariyadi, 2015a). The results of the preliminary research showed that the implementation of RQA by the students had not been optimal. The students’ ability of summarizing the initial syntax of RQA had not met the standards. They only took some phrases or sentences in the articles and rearranged them into paragraphs during the summarizing process. In fact, a summarizing should be original (using the writer’s own language and expression), concise (much shorter than the text), accurate (reveal the main idea), objective (exclude the opinion of the author), and complete (convey the whole idea) (Kirsznner & Mandell, 2013).

In relation to these results, the researcher considered using a certain technique as a mediator to make the summary. The technique was mind mapping. According to Buzan (2015) this technique provided the students a space to capture the essence of the concept and to write the key words and concepts that interconnect between one another in the form of associations and connections. Moreover, according to Hariyadi (2015b) mind mapping contains the key words of a discussion that is arranged in the links from the main concept, branching into the related sub-concepts. Solas & Wilson (2015) stated that mind mapping was helpful for enhancing the artistic and creative abilities of students and it required limited language use in order to force students for organizing information by making associations between concepts; this resulted in the student engagement increase and helped to retain student focus. Based on the mind mapping patterns, the students can summarize the learning material easily and coherently. Thus, in this study mind mapping technique was integrated with RQA.

Importance of the study

Genetics is a very important course for understanding the biological phenomena comprehensively, in accordance with the opinion of Theodosius Dobzhansky who said that it is impossible to understand Biology without the enlightenment of Genetics (Ayala, *et al.*, 1984). The understanding of the concepts of Genetics will greatly help in the understanding and development of other branches of Biology. Thus, it is imperative to design a research related to learning models that can trigger a comprehensive understanding of Genetics. Moreover, in this study, each part of the learning model is partially examined in terms of its

effect on the learning results. Thus, the most influential of the syntax can be found. This information will give contribution greatly to the research on other learning models, such as Think-Pair-Share and Two Stray-Two Stay.

Aim

This study aimed to measure the contribution of summarizing and questioning in the RQA learning model integrated with mind mapping to the genetic learning outcomes, using a quasi-experimental research design. These research results are very important to improve this integrated learning model further.

METHODS

This study was conducted as a part of dissertation research regarding the effect of the RQA learning model and Project Based Learning on the critical thinking skill, metacognitive skill, and cognitive learning outcomes in different academic abilities. This research is a quasi-experimental research conducted in two Genetics classes using pretest posttest nonequivalent control group design of 2 x 2 factorial design. The participants of this research were the students of Biology Education, Faculty of Teacher Training and Education, University of Jember, 2015/2016 academic year. In this connection, there were two classes of which one class was taught with RQA learning and the other was taught with conventional learning. In the two classes, there were students of high as well as of low academic ability. The two classes were previously tested for an equality test. The instruments used in the quasi-experimental research were learning media, essay test (to measure the cognitive learning result, critical thinking skills, and metacognitive skills), including its rubrics related observation sheet as well as a questionnaire to uncover the responses of teacher and students. All the instruments have been validated. Related to the essay test, a reliability test was conducted as well. However, this article was written based only on the data of the RQA learning model, especially related to the contribution of each syntax of RQA on the learning results. Those data used are derived from 33 students (25 females and 8 males).

In this study, the correlation analysis was conducted between mind mapping, summarizing, and questioning and the final value score of the study. The final value score was the total of the scores of the seven components, namely the scores of mind mapping, summarizing, questioning, learning participation (during the process of discussion, presentation, questioning, and answering), lab practicing (classical and independent project), midterm exams, and final exams. The data were analyzed using multiple regressions. Before the hypothesis testing, normality tests (by Kolmogorov-Smirnov) and the homogeneity of variance test (by Levene) was carried out. The analyses were carried out using SPSS version 17 for Windows with a significance level of 0.05 ($p < 0.05$).

FINDINGS

As part of the normality tests, the One-Sample Kolmogorov-Smirnov Test showed that the significance value of mind mapping, summarizing, questioning, (M-S-Q) and the learning outcomes was 0.903, 0.448, 0.588, and 0.758, respectively. These results indicated that the values of mind mapping, summarizing, questioning, and the learning outcomes were normally distributed.

The results of the multiple regression correlation analysis showed that the $F(3, 29) = 368.108$, $p < 0.05$ (Table 1). The value of the multiple regression coefficients (R) was 0.987 with a contribution value (R^2) of 0.974 (Table 2). The R value of 0.987 indicates a strong multiple correlation between mind mapping, summarizing, and questioning at one side and the learning outcomes at the other side. Moreover, the 0.974 value of R^2 showed that mind

mapping, summarizing, and questioning simultaneously gave contributions as much as 97.4%, while the remaining 2.6% was influenced by the other predictors that were not investigated.

Table 1. Multiple Regression Correlation on the Learning Outcomes

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	378.308	3	126.103	368.108	.000 ^a
	residual	9.935	29	.343		
	Total	388.242	32			

Table 2. The Value of Multiple Regression Coefficients

	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.987 ^a	0.974	0.972	0.585	1.759

The results of the multiple regression equation analysis of the correlation between summarizing, questioning, mind mapping and the learning outcomes showed that the regression equation is as follows: $Y=19,529+0,252X_1+0,256X_2-0,239X_3$ (Table 3). The contribution value of each predictor toward the learning outcomes is that mind mapping gives a relative contribution of 39.76%, summarizing gives a relative contribution of 1.5%, and questioning gives a relative contribution of 58.74%. Thus, the total relative contribution is 100%. The effective contribution of mind mapping, summarizing, and questioning is 38.73%, 1.46%, and 57.21%, respectively. Thus, the total effective contribution to the learning outcomes is 97.40% (Table 4). These results indicate that questioning has the biggest contribution in explaining the learning outcomes compared with mind mapping and summarizing.

Table 3. Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tol	VIF
	1 (Constant)	19.529	1.749				11.168
Summarizing	.252	.023	.386	10.815	.000	.692	1.444
Questioning	.256	.026	.358	9.682	.000	.644	1.553
Mind Mapping	.239	.019	.462	12.560	.000	.653	1.532

Dependent Variable: Score

$r_{X1-Y} = 0,784$

$r_{X2-Y} = 0,794$

$r_{X3-Y} = 0,838$

Table 4. Relative Contribution and Effective Contributions of Variables

Variable	RC (%)	EC (%)
X 1 (Mind Mapping)	39.76	38.73
X 2 (Summarizing)	1.50	1.46
X 3 (Questioning)	58.74	57.21
Total	100	97.40

RC = Relative Contribution; **EC** = Effective Contribution

DISCUSSION and CONCLUSION

The correlation between M-S-Q and the learning outcomes

Technically, the implementation of M-S-Q is the first asset to form concepts before students carry out discussions, presentations, and question-answers in the class. In addition, M-S-Q provides prior knowledge before implementing a class practicum or independent project practicum. Any discussions that occurred during the discussion session were closely related to the material from which the students made the summaries, and the question answers. Thus, the students will be more focused on elaborating the material of the results of the personal study prepared before the teaching and learning activities so that it causes the value of M-S-Q simultaneously contribute 97.4% toward the learning outcomes.

On the basis of the results related to mind mapping and RQA, it can be concluded that both lead to an improvement in the learning outcomes. According to Liu, *et al.* (2014), the use of mind mapping gives a good effect in improving teaching and learning activities. Similarly, Whitman (2015) stated that the results of mind mapping strongly supported the test results because the students used visual skills, logical reasoning, and abstract thinking, promoted meaningful learning, and allowed the presentation of new material to build in the existing knowledge. Furthermore, according to Mulyadi *et al.* (2014), the cognitive learning outcomes of students using the RQA model led to a significant increase. This condition is in line with Corebima & Bahri (2011) who stated that the RQA learning model improved students' metacognitive skills, improved their concepts 14.38% higher than those using traditional learning, and even improved the concept gaining ability of the low academic achievers 59.96% better than those of high academic achievers experiencing traditional learning.

The contribution of mind mapping on the learning outcomes

The creation of mind mapping by the students was carried out during the pre-learning activity before summarizing. Each student was required to make up the main points of the concept of the material from various reading sources, which were arranged into a stratified chart, ranging from the main concept and the supporting concepts to the explanatory concepts. By using mind mapping, summarizing becomes more effective because mind mapping is designed to summarize written material (Farrand *et al.*, 2002), to make it easier in writing the main points to be arranged into a short essay, intertwined into one intact concept, and to be the ideal tool to clarify concepts (Peet, 2001).

The process of understanding the concept as a whole is a personal process that plays a role in building knowledge because mind mapping requires the central idea in advance (O'Connor, 2011). Next, the key ideas are developed (Riswanto & Putra, 2012) followed by the development of the related ideas radiating out from the central idea (Aykaç, 2015). Thus, mind mapping requires an understanding of the whole concept, followed by analyzing it into personal concepts, and then representing it into a spider diagram or a hierarchical list (Prunckun, 2015). This way, it is arranged in an exact technique like how the brain functions radiating (Buzan, 2015). It is natural that mind mapping has a significant contribution toward the learning outcomes because it overcomes misunderstandings, supports the understanding of the concepts as a whole (Akinoglu & Yasar, 2007), and increases the long term memory of factual information (D'Antoni *et al.*, 2010).

The contribution of summarizing on the learning outcomes

Summarizing is the second syntax after mind mapping composition. The concept that has been summarized in a mind mapping chart form becomes the main reference in drafting a resume. Summarizing is the process of making the shortest representation of the original information source (Stein *et al.*, 2000). The advantages of a resume as the product of a

summarizing process are that it is concise, accurate, objective, and complete; moreover, it is original because it uses the writer's own words and not the words obtained from the reading source (Kirszner & Mandell, 2013). As a result of using their own words in making the resumes, the students can experience barriers in the interpretation that is different from the original concept. Moreover, many students did not abide by the use of mind mapping while summarizing. This deviation caused the contribution of summarizing on the learning outcomes to be the smallest one.

Based on the results of the research, most of the resumes constructed by the students did not follow the guidelines of mind mapping. Their works did not have a coherent understanding. The main ideas did not have explicit meanings. There were some students who copy-pasted from resumes available on the internet. Several models of resumes were found to be very short because they only described the key words in the mind mapping. Some resumes looked like a long essay but did not show any link between concepts. The best resumes were the ones that were brief and yet were able to interconnect the concepts, thus giving a clear understanding. Related to the sentence structure, many students used their own words, especially for **certain** learning materials that were of less information. For the materials that were rich in information and contained many theories, some resume contained students' own words as well as text words, but some resumes seemed to be copy-pasted from the internet. These facts indicate that the students do not experience yet a conceptual change (Duit & Treagust, 2003; Pelamonia & Corebima, 2015) when making a resume. They still made the resume in the same way as before and did not use the guidelines of mind mapping.

In fact, the idea of preparing a resume using mind mapping is an effective way to control the formation of concept maps well and in an integrated manner. The weakness of this solution is the interpretation of foreign text, consistency of ideas when extracting the description of the concept in single or short sentences in mind map, and the interpretation deviation when preparing a resume using their own sentences. This causes a lower contribution of the summarizing than that of mind mapping.

The contribution of questioning on the learning outcomes

The questions raised during the process of summarizing were induced since the construction of mind mapping. To do a mind mapping, the students must understand the main ideas of the assigned reading and then create a resume. During that process, the students experienced the process of reading, processing, understanding, analyzing, and synthesizing the content of the reading. Next, they created a chart containing keywords and placed them into a mind map that was interconnected and intact. These sequences of processes can generate questions related to the unclear concepts, not yet understood concepts, incomplete concepts, or those causing confrontation with other concepts. Based on this phenomenon, a list of the questions and answers was compiled as per the students' mindsets. These questions also become the subject of the question and answer process during the discussion in the classroom so that the learning becomes more dynamic. When only relying on personal awareness to ask questions without the preparation related to prior knowledge, it will take a long time and the students will be less responsive. According to Zee *et al.* (2001), many students wanted to ask questions if their teachers asked them to do so. In fact, many teachers chose not to offer questions, so that students rarely asked questions. In this regard, it appears that the thinking process in the M-S-Q phase is quite essential, causing the students to do learning interaction more easily, due to the fact that the questioning activity has a higher score than those of mind mapping and summarizing.

Questioning is an important aspect that will trigger further curiosity (Calaprice, 2011), will develop creativeness and criticism ability (Ali, 2005), will result in students learning

more things, will induce an alternative answer in understanding a concept (Walsh & Sattes, 2011), and will increase the students' involvement in the learning interactions (Campbell & Mayer, 2009). Furthermore, questioning is an indicator of a self-concept mastery about science if students understand scientific questions (Çoban, 2011). Questions can be used as techniques in cross-culture studies in science education (Ali, 2016). In questioning, the elements that appear are derived from the cognitive conflict between the received concept and the prior experience, as well as between the prior knowledge and the personal beliefs (Hariyadi, 2014). If there is a good synergy between these elements, there will be a good process of understanding of the material. If there is a cognitive polarization, there will be divergence of concept leading to problems, that will induce the emergence of questions. Thus, questions are an important force in exploring knowledge compared with simply reading factual information provided in books. Questions can also be a medium to realize ideas or opinions, which can affect the learning outcomes. In this regard, it is shown that the thinking process in the MRQ phase is significantly important and makes the students able to do learning interaction more easily; hence, in this research the questioning phase has higher value than the mind mapping and the resume phase.

Suggestions

Mind mapping, summarizing, and questioning (M-S-Q) during the pre-learning process gives a significant contribution (97.4%) to the learning outcomes. Questioning gives the highest contribution because in this phase, the students find the sources of the problems during the pre-learning process. The second highest contribution is that of mind mapping because it extracts the main points of reading that requires extensive knowledge. The lowest contribution is that of summarizing because it only paraphrases the main concepts that have been developed; the students did not experience the process of deepening and widening of thinking. On the contrary, the students have not experienced a conceptual change from what has been believed so far; due to which they do not take advantage of the mind mapping charts to summarize, and instead, they summarize the text in their own way, which is by taking parts of the paragraphs that are considered important and arranging them into a summarizing product.

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