



## THE EFFECT OF CROSSWORD PUZZLE ON STUDENTS' LEARNING OUTCOME AND ACADEMIC ENGLISH MASTERY

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### ABSTRACT

The objectives of this study were to find out whether Crossword puzzles significantly affect: (1) students' learning outcome (2) students' ability in answering question based on Bloom's taxonomy of cognitive domain and (3) students' academic English mastery. This quasi experiment was carried out on two classes of Grade eleven students in SMA Negeri 1 Medan. These two classes were randomly assigned based on the cluster random. The data for students' learning outcome was derived from multiple choices test, while essay test was also given to students to measure their academic English mastery. When the data was normally distributed, independent t-test is employed for data analysis, while Mann Whitney U-test is used when the data were not normally distributed. Students who were assigned with Crossword puzzle (90,  $67 \pm 7$ , 14) have significantly higher learning outcome than those who were given with regular assignment 83,  $81 \pm 6$ , 129, ( $t = 3,430$ ;  $P = 0,001$ ). Students also have significantly higher score in C4 to C6 of Bloom Taxonomy when compared to students who did regular assignments, C4 ( $U = 449$ ;  $P = 0,000$ ), C5 ( $U = 374$ ;  $P = 0,002$ ), C6 ( $U = 315$ ;  $P = 0,039$ ). While Students' academic English Mastery was better in three aspects (writing, spelling, and vocabulary use) compared to students who were given with regular assignments.

*Keywords: Crossword Puzzle, Learning Outcome, Academic English*

### INTRODUCTION

It is fundamental to understand that in order to success in school, a student must at least know how to understand, read, speak, and write the language use in classroom. Biology texts were often found to consist of long - complex sentences and it usually contains many technical terms in describing its concepts, principles and theories, and it brings more susceptible to reading difficulty than other natural sciences [1]. Many technical terms were derived from Latin and Greek words which were unfamiliar to students. The information presented may be abstract and unrelated to the students' everyday activities or life experience. The events or topics being described to the students' were not customary and there is little or no opportunity to negotiate shared

meanings [2]. As biology is descriptive in nature, students need to have sufficient language proficiency to constitute meaning of biological concepts [3]. The presence and mastery of English as a medium of science instruction will bring the impact on student's acquisition of science content knowledge. The foundation of this factor was Cummins [4] work on cognitive academic language proficiency, which relates both cognitive and linguistic processes to academic success of students [5].

According to Cummins [4], there were two levels of language proficiency, which relates both cognitive and linguistic process to the academic success of students: the basic interpersonal communication skill (BICS) and the cognitive academic language proficiency (CALP). CALP is the type of language proficiency that needed to read book, to participate in dialogue and debate, and to provide written response to test. Students who have not yet developed CALP were in disadvantage on learning science or other academic subject matter [5]. Students with limited English proficiency seemed to have a weaker knowledge of science and this inevitably affected their achievement test scores in science [6]. Students in bilingual class may have two different problems at the same time. Not only materials being taught were dense and closely packed with less time to construct clear meaning, there are also problems in understanding English text. When 24 RSBI (Rintisan Sekolah Bertaraf Internasional, a bilingual school), students' were directed to read biological text and answer 7 biological question written in English, 37% were able to correctly answer 4 questions, 8, 3% were able to answer 3 questions, 1, 2 % of them were able to answer 2 question, and 41, 60% were answering incorrectly to all of 7 questions being asked. Students have to pay attention for cognitive language proficiency. Fortunately, there were various techniques that can be used to overcome problems in learning for biological topics on Bilingual class.

Academic word knowledge has the potential to increase academic text for all students. Games and activities were effective when used as approaches for building academic word knowledge [7]. Word games were an excellent way to make students read the textbook chapters as they seek to find the answers. Depending on the choice of clues, this active learning activity can foster simple recall, comprehension, or problem solving [8]. Preparation of students Comprehensive Assessment Test in Science can be such an overwhelming task. The review materials give teachers a quick awareness that there is too much information involving multiple areas that student have to master in order to be success on examination [9]. It is evident that the key to answering many of the multiple choice questions is being able to understand the language used in the questions. That vocabulary is a key factor become apparent. If students are able to master the terminology, they were more likely to analyze questions and formulate correct responses [9].

Puzzles were helpful to review, summarize, practice, find out gaps in knowledge, and develop new relationships among concepts (Davis: 2009). Word puzzle had been also used as a review tools prior to exam, improving students' learning as well as motivate them to a better preparation and generally to become more interested in the subject [10]. Crossword solving involves several useful skills for example excess of vocabulary, reasoning, spelling, and word skills. If someone plays any crossword puzzle, they must be able to identify and understand the terms being used. This often involves acquiring new terminology and brings students to intentionally interest in attending the meaning behind new terminology. It can also involve making differentiations between similar words. A crossword also requires exact spelling, which for students may mean practicing dictionary skills. Other important skills required for completing these puzzles include making inferences, evaluating choices, and drawing conclusions [11]. It is a novel tool, especially for group learning, generating much interest and interaction within the group and also between educators and learners. A well planned crossword puzzle is likely to test higher levels of cognition as compared to many other types of assessments tools [12]. Challenging learning activities in form of word puzzle will be able to maintain student's logical operation. In which Piaget said that learning to perform logical operation is acquired largely through an interaction with problems calling for those operations [13].

## METHOD

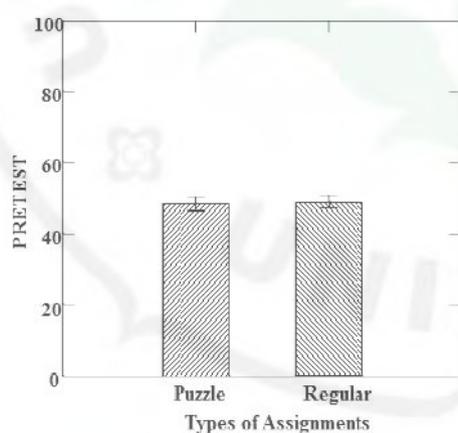
Research was done at SMA Negeri 1 Medan Jalan Teuku Cik Ditiro No. 1 Medan, on second semester of academic year 2011/2012, from January to June 2012. The population of this research was Grade Eleven Science Program, consists of 224 students, which divided into eight parallel classes. Each class consists of approximately 28 students. Grade eleven science students' were RSBI students, in which they use bilingual books. Students show equal ability on pretest (Figure. 1) in which statistical analysis revealed that students' beginning ability was not significantly different. Based on the result of pretest, two classes were taken as research samples which determined randomly using cluster random sampling technique. By using this sampling technique, XI- IPA 1 was selected to be the experiment group, assigned with Crossword Puzzle, and XI- IPA 2 was selected to be the control group, assigned with regular tasks. Crossword puzzle will be used as evaluation tools during 6 sessions of Human Reproductive System for Grade Eleven Science Program. The crossword puzzle is generated using word puzzle generator software, the Crossword Forge 5.5.5. The word questions on crossword puzzle were constructed accurately based on the key words signifying around essential concepts, facts and terms. For control group, the same task will also be given, in form of regular

assignments (multiple choice and essay test) in accordance to learning materials being used in experiment group.

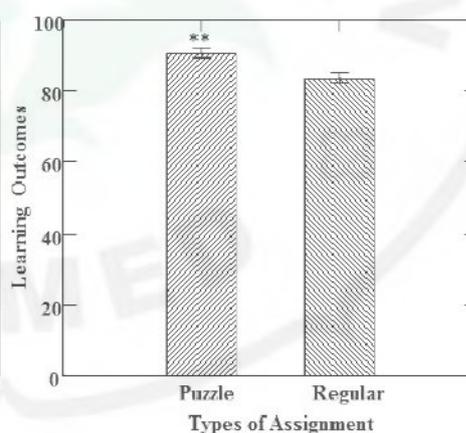
The Instruments for data collection were cognitive tests, in which both multiple choices and essay tests were used. Levels of competence measured were based on Blooms' taxonomy of cognitive domain. Normality tests were used to determine whether a data set is well-modeled by a normal distribution or not. Statistical test of resulted data were done by using SPSS 19 and Mystat 12.

## RESULT AND DISCUSSION

The result of data analysis revealed that students who were assigned with Crossword Puzzle have equal beginning ability  $48,54 \pm 9,432$  ( $\bar{X} \pm SD$ ) to students given with regular assignment,  $49,10 \pm 9,055$ , ( $t = 0,200$ ;  $P = 0,842$ ) (Figure 1). Assigning students with Crossword Puzzles were significantly affecting their learning outcome,  $90,67 \pm 7,142$  ( $\bar{X} \pm SD$ ), compared to giving students with regular assignment,  $83,81 \pm 6,129$ , ( $t = 3,430$ ;  $P = 0,001$ ). Learning with the help of Crossword Puzzle increase students' Learning outcome as much as 10,20% (Figure 2).

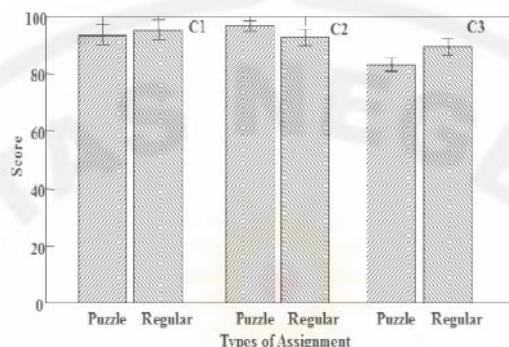


**Figure 1** Result of Pretest of Students' who were assigned with 'crossword puzzle' and those who were given with 'regular' assignment ( $t = 0,200$   $P = 0,842$ ).



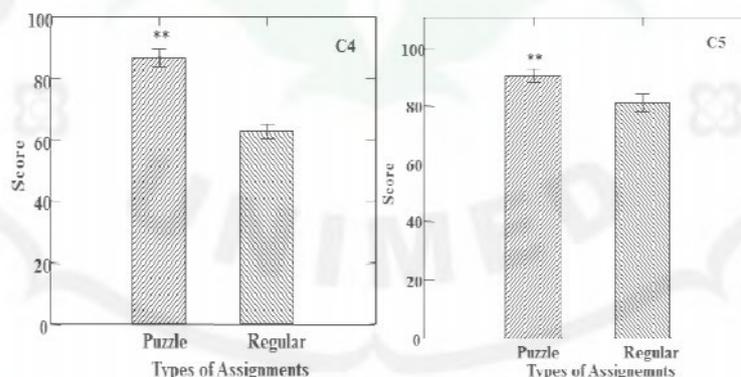
**Figure 2** The effect of types of assignments on students' learning outcome. Asterisks indicates that crossword puzzle have significantly affecting students' learning outcomes ( $t = 3,430$ ;  $P = 0,001$ ).

The analysis of resulted data from students' ability in answering C1 (Knowledge), C2 (Comprehension), and C3 (Application), revealed that students' abilities, who were assigned with crossword puzzle, is not significantly affected by puzzle, compare to the ability in answering C1-C3 question of those who were assigned with regular assignments. The ability in answering question which require knowledge (C1), using nonparametric test, revealed that  $U = 244,500$ ;  $P = 0,754$ , Comprehension (C2)  $U = 282,000$ ;  $P = 0,304$ , Application (C3),  $U = 192,000$ ;  $P = 0,113$  (Figure 3).



**Figure 3** Ability in answering C1, C2, C3 questions between students' who were assigned with 'crossword puzzle' and those who were given with 'regular' assignment, C1 ( $U = 244, 500; P = 0,25$ ), C2 ( $U = 282, 00; P = 0,30$ ), and C3 ( $U = 192, 00; P = 0, 113$ )

Using Mann Whitney U test, to analyze Students' abilities in answering C4 (Analysis-Synthesis) question, their ability were significantly affected when they were assigned with crossword puzzle,  $86, 79 \pm 13, 784$  ( $\bar{X} \pm SD$ ), compared to students, assigned with regular assignment,  $62, 86 \pm 10, 427$ , ( $U = 449, 00; P = 0,000$ ) (Figure 4).

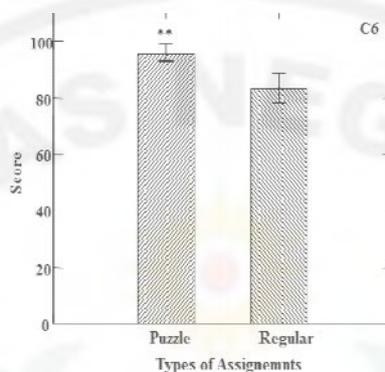


**Figure 4** The effect of types of assignments on students' ability in answering C4 (Analysis-Synthesis) question. Asterisks indicates that crossword puzzle have significantly affecting students' ability in answering Analysis-Synthesis question ( $U = 449; P = 0,000$ ).

**Figure 5** The effect of types of assignments on students' ability in answering C5 (Evaluation) question. Asterisks indicates that crossword puzzle have significantly affecting ability in answering Evaluation question ( $U = 374; P = 0,002$ ).

From the resulted data, non-parametric test were used to determine students' ability in answering question for determining the ability in evaluating (C5). Students' who were assigned with Crossword Puzzle have significantly affected ability in answering, C5 (Evaluation) question,  $90, 50 \pm 10, 966$  ( $\bar{X} \pm SD$ ), compared to those who were assigned with regular task,  $81, 10 \pm 13, 906$ , ( $U = 352, 00; P = 0,014$ ) (Figure 5). Mann Whitney U test used to determine Students' ability in answering, C6 (Creation) question, revealed

that, assigning students with Crossword have significantly affecting their ability in answering C6 question, 95,  $83 \pm 14$ , 116 ( $\bar{X} \pm SD$ ), compared to students assigned regular assignment, 83,  $333 \pm 24$ , 152, ( $U = 315$ , 000;  $P = 0,039$ ) (Figure 6).



**Figure 6** The effect of types of assignments on students' ability in answering C6 (Creation) question. Asterisks indicates that crossword puzzle have significantly affecting ability in answering Creation question ( $U = 315$ ;  $P = 0,039$ ).

In order to hold curiosity and creativity in science learning, students should encounter value as characters of scientific effort, leading to meaningful experience of science learning. This suggests that teacher should help students' curiosity and creativity development using certain tools. Crossword can act as an effective study tools. Students found these tools, when introduced as evaluation tools, to be helpful. Kozma [15] explained that learning with evaluation tools is done as a complementary process within which representations were constructed and procedures performed. A relevant research has shown crosswords to have a positive effect on biology learning [11]. Solving crossword puzzles is as active learning that engages students with the material more than other passive techniques [14].

By the help of Crossword puzzle, students were assisted in identifying areas of understanding as well areas of weakness because when they have problems in solving the key, they will begin ask various question, discussing possible answer with peers as well as re-researching to find correct answer. When students introduced to word 'symptom' on sexual transmitted disease, students began analyzing the presence of bacterial and viral agent leading to the recognition of scientific name of microorganism that causes it. STDs on human body that cause changes on human genital tract were also discussed. Even further discussion can lead STD causing destruction on human nervous system.

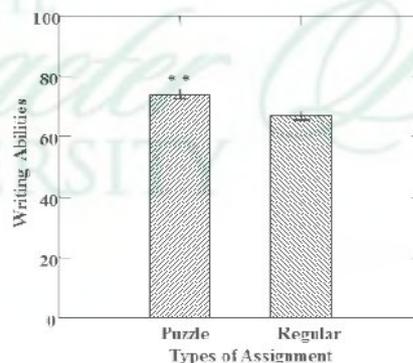
The effects of Crossword puzzle on cognitive domain were also recorded to be higher than those who were assigned with regular assignments. Students introduced with crossword puzzle were shown to have high percentage in correctly answer question in all cognitive domains (knowledge, comprehension, application, analysis, synthesis, evaluation, and creation). This study also shown that students' learning outcome, for

those who were assigned with crossword puzzle tend to have higher percentage of correctly answering question from C4 to C6, indicates that it helps students to actively accommodate their high order thinking skill.

In case of writing ability, it is measured to see how good students implement what they have learned through a written test. The written test can measure students' different style in accommodating their idea as they began transforming their knowledge, one of scientific writing models convey a two different processes; knowledge telling and knowledge transformation. This capability is supported also by learning evaluation tools that better engage students and support activity with the comfortable learning atmosphere [16]. Furthermore, students who have high writing achievement were more easily understand the subject matter presented and able to store it in long term memory.

On evaluating students' writing ability, five components were used; logic and organization, development of ideas, purpose, language, and mechanics. Students who were assigned with Crossword Puzzle have higher writing abilities. The experimental group show higher score after treatment,  $74,92 \pm 8,544$  ( $\bar{X} \pm SD$ ), compared with Control Group, assigned with regular assignment,  $67,05 \pm 6,917$ , ( $t = 3,096$ ;  $P = 0,003$ ). The experimental group using crossword puzzle showed higher abilities in important aspect on science writing such as logic-organization and development of ideas. For example when they asked to answer question about estrogen deficiency, they start first in explaining what estrogen is, its role, action, regulation, possible effect of lacking, and its possible cause. They try to convey understanding even with some limitation in using words.

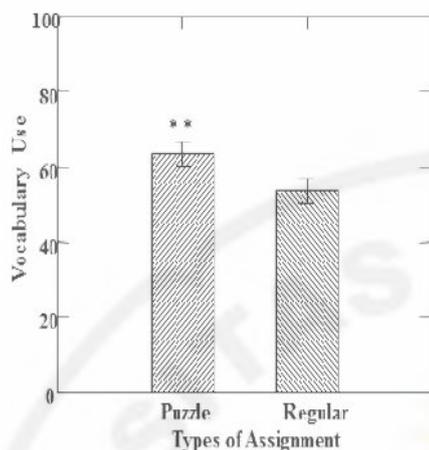
Grabe and Kaplan [18] explain their model of communicative competence applied to writing that embraces listening, speaking, and reading. This model features the writer's ability to use writing as a communication activity and describes skills and processes where the writer's understanding of participants, setting, task, text and topic and performance with textual output were integrated. By having the ability to write, student can obtain a variety of information in relatively short time.



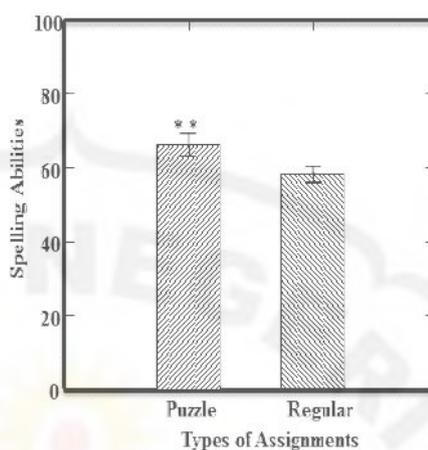
**Figure 7** The effect of types of assignments on students' writing abilities. Asterisks indicates that crossword puzzle have significantly affecting writing abilities ( $t = 3,0966$ ;  $P = 0,003$ ).

The analysis of result of students' vocabulary use revealed that, students who were assigned with Crossword Puzzle affected more when utilizing both biological and non-scientific vocabularies,  $63,04 \pm 15,527$  ( $\bar{X} \pm SD$ ), compared with regular assignment,  $53,76 \pm 12,506$ , ( $t = 2,422$ ;  $P = 0,020$ ). The result of analysis, using independent T-test, based on resulted data of spelling ability, revealed that, students spelling ability for those who were assigned with Crossword Puzzle have significantly affected by puzzle compared to the ability of students' assigned with regular assignments. The experimental group, after treatment show average score,  $66,25 \pm 14,621$  ( $\bar{X} \pm SD$ ), compared to regular assignment,  $58,33 \pm 9,982$ , ( $t = 2,090$ ;  $P = 0,043$ ) (Figure 8). Study found that a multi-approach in vocabulary teaching was more effective than using a single approach. Crossword puzzles have been shown to be effective teaching tools of terminology, definitions, spelling, and pairing key concepts with related names, resulting in greater memorization of facts as explained by Crossman & Crossman, Childers [19]. Especially for Biology in which the rate of new things discovered and understood were gone rapidly and new materials is frequently added, lead to misunderstanding and learning problems.

By using Crossword Puzzle, students were directed to find out key words of the clues that express the main idea. The key words introduced using Crossword puzzle will help them understand the English text used in Biological topics. If they found unknown words later on exam, students can skip the difficult words by continuing reading or predicting the meaning and confirming it by means of the next word they have known. For Human Reproductive System topics, crossword puzzle was created to include major concepts. On written test student can include 45 biological terms of human reproductive system (deficiency, estrogen, progesterone, menstrual cycle, essential, pregnancy, diseases, genital, genital area, skin damage, period, menopause, hormone, ovum, ovaries, fallopian tube, releases, secondary oocyte, mature follicle, fertilization, fertilized, oviduct, fimbriae, sperm, ovulation, egg, ova, family planning, pills, birth control, device, condom, surgical operation, sterilization method, vasectomy, Tubectomy)



**Figure 8** The effect of types of assignments on students' vocabulary use. Asterisks indicates that crossword puzzle have significantly affecting students' vocabulary use ( $t = 2, 119$ ;  $P = 0,040$ ).



**Figure 9** The effect of types of assignments on students' spelling abilities. Asterisks indicates that crossword puzzle have significantly affecting students' spelling abilities ( $t = 2, 096$ ;  $P = 0,043$ ).

In words spelling, crossword puzzle will be helpful because of the need to spell items correctly to complete the puzzle. Students cannot proceed to answering other key words before finishing other words correctly. Later it will result in increased care in studying as well, and when completed, can be used further as a helpful study device. After treatment, some obstacle in measuring spelling abilities is that eventhough biological words were introduced during teaching learning process; students tend to write down words that they sure knew how to spell. The final result revealed that experimental group show higher ability in spelling which means crossword puzzle were significantly affected spelling abilities.

## CONCLUSION

Students' learning outcome, higher order thinking skill, writing abilities, vocabulary use, and spelling abilities, are significantly affected by assigning them with crossword puzzle compare to regular assignments.

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