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Integrating Entrepreneurial Practice in Contextual Learning of Biotechnology for Senior High School Students

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ABSTRACT

This research aimed to describe the implementation of entrepreneurial practice integrated in Contextual Teaching and Learning (CTL) and its impact on the conceptual test score and total motivation scale of senior high-school students toward biotechnology learning in two classrooms that were treated with randomized pretest-posttest control group design. Participants were 58 students who have non significantly different background scores in biology. They were divided in two groups and randomly picked up for a control and an experiment classes (group). The CTL pillars were applied for both classes but in the experimental class students experienced doing simple research in market demand-supply for existing-traditional biotechnology goods. They modified them and calculated of the production cost, selling new goods and took risk to return loan and experienced in gain profit and lost. Then after intervention, conceptual test score and total motivation scale increased significantly in both classes but students at the experimental class where entrepreneurial practice as part of their experience have higher conceptual test score and total motivation scale than their peers in control class treated with CTL only. Statistically, t-test methods confirmed that those data are significantly different at confident level of $p \leq 0.05$. There is a moderate positive correlation ($r2 = 0.369$) between conceptual score test and total motivation scale. Neither has it correlation between entrepreneurial attitude scale and total motivation scale of the students in both groups, nor has it correlation between entrepreneurial attitudes and conceptual test score.

Keywords: Contextual Teaching and Learning (CTL), Entrepreneurship, Motivation, Biotechnology.

INTRODUCTION

Many academic instructions' syllabi give very much emphasize on content base and theoretical aspect of science but seldom practically connected with problems in real life (Labov & Huddleston, 2008; Holbrook, 2005). Therefore some students felt science is boring, difficult, and not relevant to people's life; science is more attractive to boys and less interesting to older students (Prokop, Prokop & Tunnicliffe, 2007). Although this conclusion could not be generalized for all the science.

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Primary school pupils have lower interest in biology and their interest have been declined during a generation from 1983 to 2011 as reported by Randler, Osti and Hummel (2012). Therefore science including biology should be taught in context of daily life so students will know the connection between biological concepts learnt in classroom and the real life issue (Chamany, Allen & Tanner, 2008).

Contextual Teaching and Learning (CTL) has been introduced as learning approach to fill the gap of science theory and life context (Berns & Erikson, 2001). Students are guided to learn science in context of life and motivating students to find the relevance of their learning with real life. CTL process is emphasized on *making meaningful connection*, *constructivism*, *inquiry*, *critical and creative thinking*, *learning community*, *authentic assessment* (Johnson, 2002; Glynn & Winter, 2004; Klassen, 2006).

The CTL affectivity on students' academic performances in science was reported by Deen and Smith (2006) and the applications of CTL in Indonesian have been studied by Komalasari (2012) and Oka (2011). Typically, CTL in biology teaching in high school was published by Puspitasari, Raharjo and Isnawati (2012). They reported that CTL approach could help student in problem solving activity of biology at high school.

CTL has been proven as an effective approach to link between science as theoretical basis and the context of real life. However the combination of CTL with entrepreneurial practices to improve of students' comprehension of biotechnology and inspiring them to be entrepreneur is still interesting to study especially for rural high school. Study on rural education has been research interest recently (Adlim et al., 2013; Anderson & Chang, 2011). Scholars have suggested to educate women and youth in rural with entrepreneurial skill as part of reducing poverty program (Mahmood, 2009).

Disputed among experts whether or not entrepreneurship could be taught (Haase & Lautenschläger, 2011) is no longer prominent after several articles between 1985 and 1994 concluded that entrepreneurship can be taught, and that educational programs can positively influence an individual's entrepreneurial attributes (Gorman, Hanlon & King, 1997). Some experts have encouraged school and university to reform their curriculum to insert the entrepreneurial practice (Baumol, 2004; Pihie. 2009 & Singh. 2009). Moreover, some universities and schools have implemented the entrepreneurial practice and it become United Nation programs (Mayhew et al., 2012; Mahmood, 2009; Deakins et al., 2005). Some entrepreneurial education programs in biotechnology have also reported as university agenda however, it has not integrated with biology learning in high school class (Collet & Watt, 2005; Karimi et al., 2010; Kovacs et al., 2010 & Kunert et al., 2012).

The definition of entrepreneurship has been developed since 1700s however, the consensus made that entrepreneurship is positively link to economic growth, by introducing new ideas, new processes, new products, new services and new business opportunities (Mayhew et al., 2012). Activities of selling goods or services creatively to other people after doing some market analysis, organizing team work, willing to take risk, in this study would be considered as an entrepreneurial practice although it was part of the learning agenda.

Integrating entrepreneurial practice in science learning could be a strategic solution for high school to prepare their students to live better in a community. Currently in Indonesia, there is 70% out of 4,135,975 students go general high school and only 30% to the vocational ones while the university enrollment rate was only 29% (www.pdsp.kemdiknas.go.id***)***. More than 71% or 2,055,580 high school graduates back to the community without life skill. Therefore the entrepreneurial practice in high school is essential because it might inspire the students to create job opportunity in community.

Integrating entrepreneurial practice in biotechnology lesson is reasonable since some of traditional home-made biotechnology products have been commercially available in local market. Those products include yeast, soybean fermentation with Indonesian name as

"tempe", "tahu or tofu", "tauco"; rice or cassava fermentation ("tape"), etc. The products are produce with involving microorganism of *Rhizopuz oryzae, Rhizopus oligosporus, Acetobacter xylum,* Saccharomyces *cerevisiae, etc.* Students could learn to improve the value add of the commodities by making a better packing, new tastes, a new appearance or new marketing system.

Thereby the main research questions of this study is what the effect of integrating entrepreneurship-CTL approach on students' academic achievement and motivation toward biotechnology lesson for rural high school students.

This study was to compare the students' academic achievement and learning motivation in both control and experimental classes where CTL and CTL-integrated entrepreneurial practice instructed respectively. The research questions are

(1) How to implement CTL-integrated entrepreneurial practice in biotechnology learning for high school students?
(2) Are there any different student's conceptual test score and learning motivation scale between group of students in experimental class that taught with CTL-integrated entrepreneurial practice and the their peers in control class taught with CTL-only
(3) Is there any correlation between student's conceptual test score, motivation scale entrepreneurial attitudes

METHODOLOGY

a) Participants

There were there parallel science classes available in senior high school of "SMAN 1 Indrapuri"; those were XII-IPA 1; XII-IPA-2 and XII-IPA-3. The biology score tests of each student in each class were analyzed and compared in terms of homogeneity and normality. *F*-test for homogeneity showed all homogeneous classes at statistical confident of 0.05. However the normality test analyzed with "Lilliefors" at significant level (p = 0.05), only XII-IPA 1 and XII-IPA-2 had as normal distribution (L = 0.2083 & 0.195; n = 12). Therefore those groups (classes) were chosen as a sample. The group (not each student) was randomly picked up one for experimental group treatment and another group for the control. The experimental class consists of 28 students and a control one has 30 students.

b) Instrument

This study used three instruments; academic achievement test containing 30 item multiple-choice questions with 5 answer options. It was taken from standardized national examination and the content was validated by experts. The reliability tests were analyzed by using KR-20 formula. The other is Science Motivation Questionnaire that was modified from Glynn et al (2011). It was composed of 20 questions in with each question has Likert-type scale of temporal frequency; Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD). Reliability test for the questionnaire was used alpha formula. The third instruments is entrepreneurial attitude of students that were composed by modifying the rubrics reported previously (Kgagara, 2011; Solymossy, 1998; Timmons & Spinelli, 2009; Shariff & Saud, 2009). The rubrics contained 6 main parameters that were attitude being independence, willing to take risks, leadership, creativity, oriented to action, working hard as previously reported (Kgagara, 2011; Shariff & Saud, 2009; Solymossy,1998).

c) Research Procedures

Research was carried out with Randomized Pretest-Posttest Control Design. Both classes were started by giving pretest and motivation questioners for the students.

Biotechnology learning in both classes was delivered by CTL but in the experimental class was integrated with entrepreneurial practice as illustrated in Figure 1. Students' activity was guided by using students' worksheet for conceptual microbiology and worksheets for entrepreneurial practice. Prior to entrepreneurial practice, the students learnt biotechnology concepts. The entrepreneurial practice was started by doing research at traditional market closed to the school. Each group of students was given worksheets to record biotechnology product as local commodities; the product names, the origin, the price, the packing. The students were offered small loan (Rp. 50.000 ~US$ 5) as revenue to start their business on new product of home-made biotechnology commodity. Some modification, improvement or cost reduction on the existing commodity would be considered a new product. Students had to write the business plan in worksheet as detail as possible including the modification would be made and the profit might be gained. After worksheet was reviewed and endorsed by teachers, then the students carried out the assignment at home so that they had much times and they would be supervised by their parents. In following week, the students brought their new products to school for exhibition and marketing.

The learning activities in school were observed by three observers. The observers monitored the student's activity and did scoring by using observation sheets equipped with active learning rubrics. They also filled up a check list to monitor the syntax of CTL and entrepreneurial practice. At the end of the class, posttest and the motivation questionnaire were given to students to evaluate the impact of treatment (intervention).

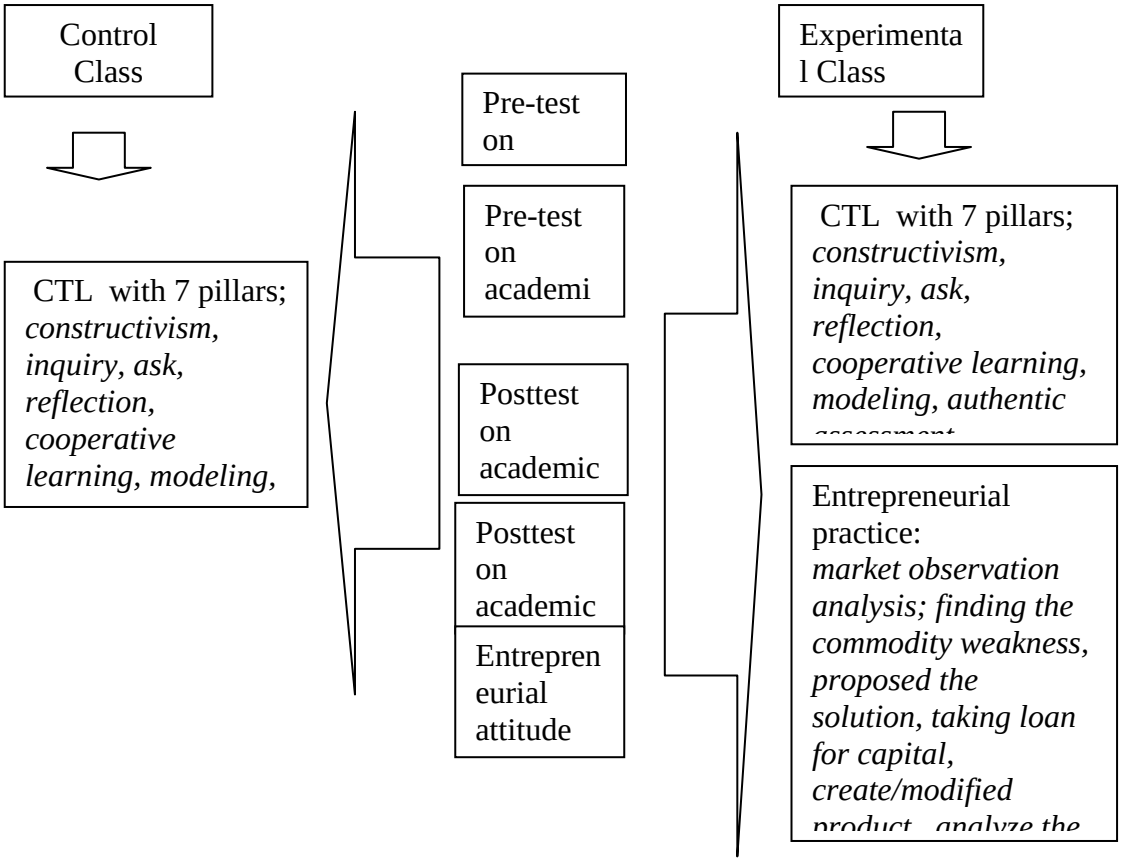

Figure 1. *Comparison Learning Activities Between Control and Experimental Classes*

d) Data Analysis

Some *t*-test was used to analyze the significant difference in learning outcomes and learning motivation between the experimental class and the control class. Each set of data

were analyzed the normality and homogeneity prior to t-test. Correlation between motivation and learning outcomes were analyzed using product moment correlation test.

FINDINGS

How to implement CTL-integrated entrepreneurial practice in biotechnology learning for high school students?

Student Activities

The combination of CTL activities and entrepreneurial activities is shown in Table 1. The CTL were done following the 7 pillars; *making meaningful connection*, *constructivism*, *inquiry*, *critical and creative thinking*, *learning community*, *and using authentic assessment*. The entrepreneurial practice was carried out in to build at least the 6 important values that were expected become students attitude on "*independent, willing to take risks, leadership, creativity, oriented to action, and working hard*".

Table 1. *Biotechnology Topics Learned in CTL and Entrepreneurial Activities*

Topics	CTL activities	Entrepreneurial activities
Traditional biotechnology	a. Students performed group discussions to identify various group of microorganisms that play a role in biotechnological processes. b. Students reviewed literature and classify traditional biotechnology products	a. Students visited traditional market and collected several traditional biotechnology products and then discussed how to increase the value add. b. Selling back the traditional biotechnology products with better packing or appearance c. observations students can classify traditional biotechnology products.
Modern biotechnology	a. Students reviewed the literature to report & presented the steps of genetic engineering b. Students conducted observation of the dairy product and environment issue in their community to find the problems related to modern biotechnology c. Students did group discussion to indentify the link between biotechnology problem in society and the concepts of modern biotechnology	
Role of biotechnology	Students reviewed literature and dairy product of modern biotechnology to report the role Through observation in the a role of biotechnology to humans	a. Students modified the traditional biotechnology products b. Students marketed their modified the biotechnology products

During the entrepreneurial practice, students were enthusiastic to the explanation their business plan especially after they knew it would be provided revenue capital. They started to consider gaining profit, the risk being loss and pay back the debt. Some of the entrepreneurial activities were done by students at home and it was their choices whatever they want to produce as long as involving biotechnology process. In following week, the students brought several goods to be sold in school. Those products that were "tofu" and "tempe" (fermented soybeans); "tape" (fermented cassava or rice); "donat" (fermented wheat-flour). They did not

just modified the new packing and new taste for the common goods but also they created a new one that was "tempe" roll-up with "meatball", tempe was produced by soybean fermentation. Students sold their goods in the class in break time after obtaining permission from their teacher. The products were displayed in tables at school front yard and the group members were looking for buyers to taste and offer to buy. The selling activities were only limited one hour before the following lesson time on.

In presentation, students claimed that they made profit of 80%. However, some students experienced loss. Groups suffered a loss on the first sale were not willing to continue for selling longer because they were worry they could not return the loan. In group discussions, the profit gainers stated that they would like to continue but the time for next lesson was coming.

Students have learnt well conceptual biotechnology and did practice the entrepreneurship as shown in Table 2, although there were less than 10% of student did not actively participated in entrepreneurial practice in their group.

From several entrepreneurial orientation attitudes, it is found that student were independently to chose what they sold, they were willing to take loan, they organized the business activity, they create new goods and they did their business plan and they worked seriously to plan, implemented and analyzed their business. However, those indicators did not reach a maximum as shown in Table 3. The lowest level for the attitude component was in working hard and leadership level due to the anxiety of getting business loss and the class time constraint.

Table 3. *Entrepreneurial Attitude of the Students*

No	Entrepreneurial attitude of students	Score Means	SD	Ratio to max score (%)
1.	Independent	2.68	0.47	67.00
2.	Willing to take risks	2.57	0.50	64.25
3.	Leadership	2.39	0.50	59.00
4.	Creativity	2.68	0.50	67.00
5.	Orientated to action	2.54	0.50	63.50
6.	Working hard	2.32	0.73	58.00

Students wrote in reflection that they enjoyed the class and strongly agreed with the implementation of the integration CTL to entrepreneurship as learning strategy in their school because it can train students to be creative and independent. They also expressed the negative site; that they were worried they did not gain much the conceptual content from their teachers, although they learnt a few from their peer and their experience. Students expected their teacher did conceptual reinforcement especially for the difficult concepts.

Are there different student's conceptual test score and learning motivation when their learning activity associated with entrepreneurial practice?

Conceptual test score

The conceptual of biology test score for experimental and control class displayed in Fig. 1. On the basis of pretest score, 60% of students in control class have test-score in range of 21-40, and 25% of students have score in 41-60 and the rest have lower. After class intervention the majority (60%) of students have score range of 61-80 but less than 5% have score of 81-100.

In experimental class, majority (90%) of students have score-test with range of 21-40 before class intervention. After implementing CTL-entrepreneurial practice, the high

proportion have shifted to higher score range, that is 70% have score between 61-80 and the rest (30%) have test-scores in range of 81-100.

It can be inferred from this data that the number of students with higher test-score increased after class intervention. Majority students in experimental class have higher test score than their peer in control class after the intervention as shown in Figure 2 that curves of student distribution shifted to the right (higher score range).

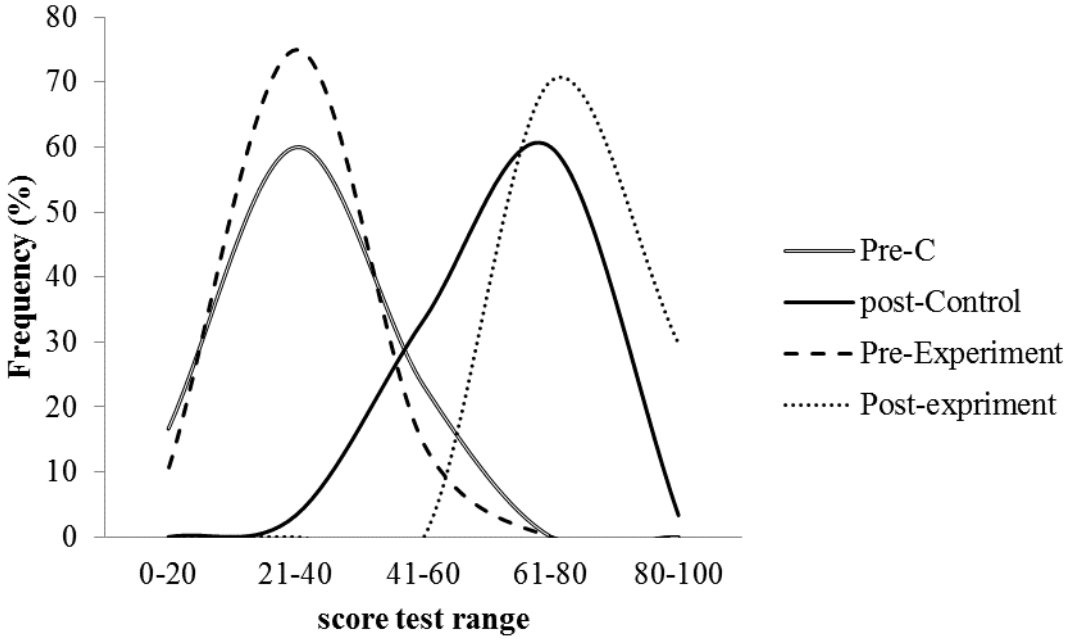

Figure 2. *Distribution of Conceptual Test- Score of Students in Both Control and Experiment Classes; Pre = Pretest; Post = Posttest.*

Statistically, the post hoc pair-wise comparisons using *t*-tests of pretest, posttest for both control and experimental class were all significantly different except the pretest pair. Pretest score in experimental class versus in the control was non significant different ($t = 0.053$, $p = 0.48$; $df = 54$). This also explained that students have statistically similar background in both experimental and control class before class intervention. After intervention, posttest score between experimental and control were significantly different ($t = 4.49$, $p < 0.01$; $df = 54$) and students in experimental group have higher score. Within experimental group, pretest and posttest were also significantly different ($t = 17.41$; $p < 0.01$; $df = 52$) and posttest was higher than pretest score. Similar phenomena was also observed within control class ($t = 11.19$, $p < 0.01$; $df = 56$).

Student learning motivation

Total motivation scale of each student was sum of individual questioner responds and the distribution is displayed in Figure 3. Before intervention (pretest), students' motivation scale toward biotechnology learning in control class was in range of 61-80 for all students (100%). In experimental class however, the student proportion was smaller that is only 94% as shown in Fig. 3. After intervention (posttest), the total scales in control class remained high distribution in range of 61-80 that is 75% and only 25% of which has shifted to highest range that is 80-100. In the experimental class, majority students (65%) had already have total scales in highest range (80-100) and only 35% remained in range of 61-80.

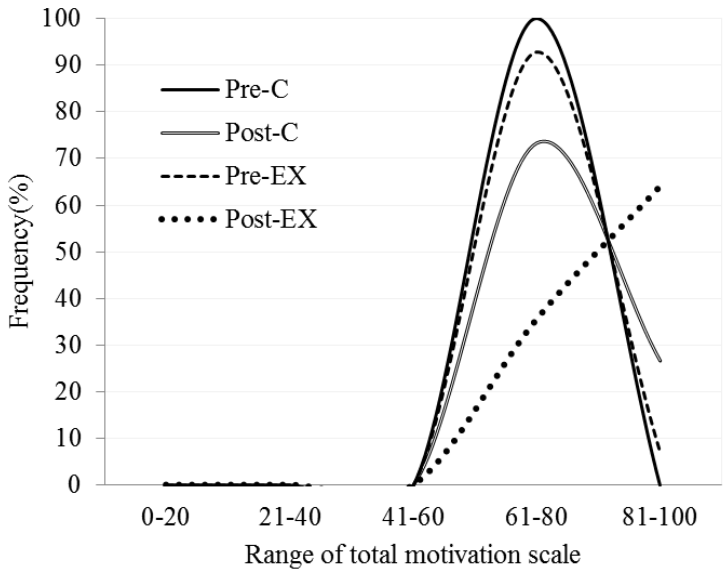

Figure 3. *Distribution Total Motivation Scales; Pre-C (Pretest in Control Class); Post-C (Posttest in Control Class); Pre-X (Pretest in Experimental Class); Post-X (Posttest in Experimental Class).*

Before intervention (pretest) the total motivation scale of the students both in experimental and control class was non significantly different (t = 0.90; p = 0.185; df = 54) and become significantly different (t = 4.32; p < 0.01; df = 54) after classroom intervention; The different total motivation scale between pretest and posttests also significant within both control class (t = 7,90; p < 0.01; df = 52); and experimental class (t = 4.74; p < 0.01; df = 56).

Is there any correlation student's conceptual test score and learning motivation after class intervention?

Using Pearson correlation analyses to determine the association between total motivation total scale and conceptual test score for both control and experimental classes were shown in Figure 4 & 5. A moderate positive correlation between total motivation scale and conceptual test score was only present in experimental class (r^2 = 0.369, p = 0.05) but none for the control one (r^2 = 0.08, p = 0.05). The conceptual test score tended to increase a long with increasing student motivation in experimental class where entrepreneurial practice was introduced.

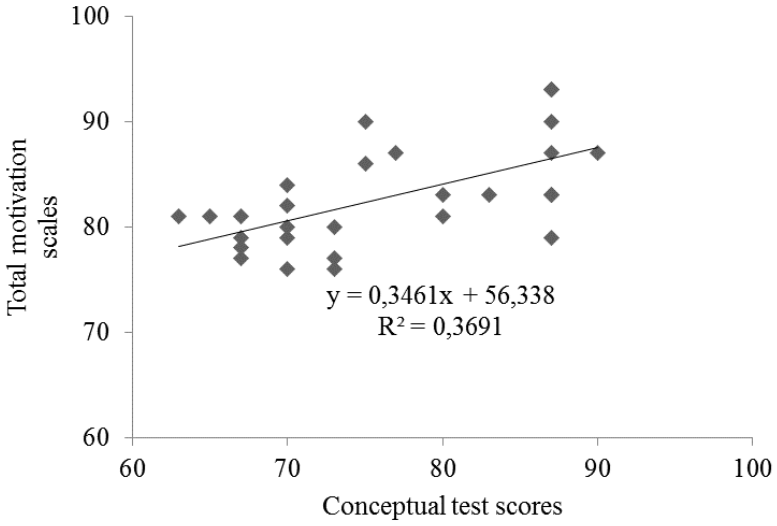

Figure 4. *Correlation between Total Motivation Scale and Conceptual Test Score in Experiment Class*

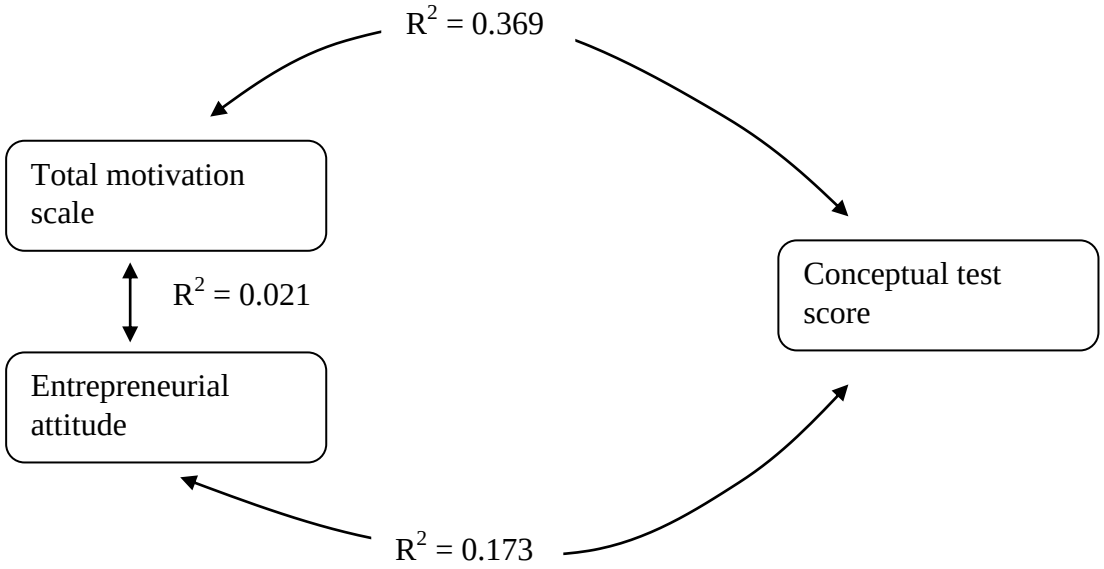

Figure 5. *Correlation Diagram between Total Motivation Scale to Entrepreneurial Attitude and Conceptual Test Score After İntervention in Experimental Class*

DISCUSSION and CONCLUSION

The learning activities lead to improve the proportion of students with higher test score within in both experimental and control classes after intervention as presented in Figure 2 & 3. The means of total score (from pretest to posttest) also increased in both classes; from 34 (SD = 9.16) to 76.21 (SD = 8.5); from 33.93 (SD = 10.7) to 64.57 (SD = 10.2) for experimental and control classes respectively. This finding aligned with the previous study reported by Komalasari (2012), Oka (2011) and Setiawan (2012). Komalasari proved that CTL was considered effective learning approach in civic education and Oka'studies (2011) also confirmed that CTL brought junior high school students to have higher achievement test score in science.

The conceptual test score in experimental class had positive and moderately correlated ($r^2 = 0.369$) with total motivation scale as shown Figure 4 but such case there were not happen in control class ($r^2 = 0.08$, see Figure 5). In experimental class students learnt new things and impressed with the new learning approach which they had not experience before. The students could be more interested doing learning activities which they thought they would have the necessary competence and value as known in theory of motivation belief (Boekaerts, 2002; Black & Deci, 2000). In experimental class also they learnt biotechnology and knew the uses and objective of their learning, which affected to their learning motivation. Students with high academic motivation usually will do better effort to accomplish the conceptual test as reported by Tela (2007).

It is concluded that integration of entrepreneurship in CTL can improve both conceptual score and total motivation scale toward biotechnology concepts at rural, sub-district senior high school, SMA Negeri 1 Indrapuri, Aceh Province. Students in the experimental class have higher conceptual test score and higher total motivation scales than their pairs in control class. There is a positive correlation between the total motivation scale and conceptual score test if entrepreneurial practice applied in biotechnology learning.

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