Influence of Virtual Chemistry Laboratory Utilization (V-Lab) toward Self-Regulated Learning

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Abstract. Various barriers in implementation of chemistry practicum activity rise as well as limitations of laboratory room, laboratory tools, chemical substance, tools and substance storage, safety equipment, operational cost, laboratory staff and time. Those barriers are solved by researchers through Virtual Chemistry Laboratory utilization (V-Lab) integrated in hybrid learning. By hybrid learning, researchers were encouraged to research the influence of V-Lab utilization remotely toward self-regulated learning through quasi-experiment. Research subject involved is 163 eleventh class learners in senior high school in Central Java Indonesia. The subject was divided into three independent samples namely control class, experiment 1 class, and experiment 2 class. The control class conducted a conventional laboratory activity, the first experiment class carried on V-Lab, and the second class combined the conventional laboratory and V-Lab. Self-regulated learning data of learners was collected through Likert scale questionnaires with five choices. Next, those data were analyzed through ANOVA. The result was shown by the absence of V-Lab influence integrated by hybrid learning toward self-regulated learning learners.

1. Introduction

Virtual Chemistry Laboratory (V-Lab) is chemistry laboratory based computer, where practicum activity is done by virtual which tools and substance interaction are not involved physical directly [1]. Virtual Laboratory occurrences are started by rapid information technology development. Operational cost, lack of facilities and infrastructure and technical skill in the laboratory can be solved through Virtual laboratory utilization [2]. Experiments’ repeating done in the conventional laboratory also can be done through virtual laboratory access in the web [3]. Advantages of virtual laboratory above are believed that it can also be used to solve limited facilities and infrastructure in the conventional laboratory on Senior high school in Central Java Province of Indonesia. That is supported by chemistry teacher questionnaires’ result (N=13), where it can be got average where it was obtained average score in the amount of 3.23. It means qualitatively, teacher agree that lack of laboratory room, laboratory staff, safety work and equipment, time, tool and substance can be solved by presence of virtual laboratory. Those things become strong reason to use V-Lab in this research.

V-Lab used in the research has been tested that it has good quality from material expert review, learning design, and information technology along very good quality from chemistry teacher assessment result. V-Lab which is tested its quality, and then it is implemented in chemistry hybrid
learning helped by social media such as WhatsApp. Hybrid learning is meant as a combination of two learning methods between LBL (Lecture Based Learning) and TBL (Team Based Learning) in order to reach complete knowledge understanding [4]. However, in this research, hybrid learning meant is a learning combination of interface and long distance session. Long distance combination session is considered necessary when interface class learning does not run maximally yet because of limitation of time and teacher. It is supported by learners’ questionnaires’ result (N=100), where it is obtained average score in the amount of 2.26. It means qualitatively learners disagree if practicum activity can be finished on time, while, combination with interface session is also considered necessary when learners are not sure if they can follow long distance practicum activity because of internet access barriers. Instructors’ presence in interface is very useful, so choosing hybrid learning is felt fearful [5].

Hybrid learning is effective as interaction tools and collaboration between language learners and foreigner become wide [6]. Then, motivation, learning discipline, and self-regulated learning also can be increased after using hybrid learning in molecular dynamical subject [7].

V-Lab based computer and hybrid learning so chemistry learning completed by long distance practicum activity can be done. Learning activity and long distance practicum internet mediated are really identical with self-regulated learning growing, because learners have a role as a planner, a monitor and self-learning regulator [8]. Self-regulated can also be interpreted as private initiative, perseverance, adoptive skill, and focus on establish learning activity [9]. Self-regulated learning is important to be owned by learners in other that involvement and learning interest can be enhanced [10]. In this research context, self-regulated learning meant relates to learning process choices (what, when, and where). Choices process was believed in harmony with V-Lab advantages which is no limitation in time, tool, or place. Choice process is one of three categories to grow self-regulated learning, two of them relate to metacognition based learning and learning environment creation which is appropriate with learners’ characteristic [11].

Besides, self-regulated learning growing can also be influenced by internet as complete information facilitator to finish task [12]. There is various information in internet that makes learners more careful in sorting out relevant information with tasks. Relevant information choice is one of self-regulated learning indicator [13]. Next, various information in internet can also be used to check the truth of the concept. Truth searching process is self-regulated learning indicator [14]. Covering self-regulated learning indicator in learning helping internet, researchers are motivated to test V-Lab influence integrated hybrid learning toward learners’ self-regulated learning growing.

2. Material and methods

V-Lab influence testing toward self-regulated learning was done through quasi-experiment. Research was started by instrument development of need analysis and self-regulated learning. Next, both developed instruments were reviewed by instrument expert. However, self-regulated learning instrument was specially reviewed by education physiology expert. In this context, every expert’s review result was in the form of judgement given and completed by criticism and suggestion as guidance to do revision. Detail development and validation result of instrument can be seen in Table 1.

| Instrument               | Likert scale | Aspect                        | Amount statement | Validation result                                      |
|--------------------------|--------------|-------------------------------|------------------|-------------------------------------------------------|
| Chemistry teachers’ need | 4 choices    | Indonesia education standard  | 16               | Additions’ statement of Chemistry technology need.     |
| Learners’ need           | 5 choices    | Selectivity, monitoring, planning [15] | 18               | Sintesis theory in order to see slice between theories clearly. |
| Self-regulated learning   | 5 choices    |                               | 28               |                                                       |

After it had been reviewed by experts, self-regulated learning instruments need to be validated empirically. Its purpose is to judge practice utilization from items in instrument [16]. Through
empirical validation such as relevant assessment and implementation, a tool was declared potentially effective as supported cure practice [17]. Empirical validation was done by filling self-regulated learning questionnaires by learners outside research sample (N=280). Next, questionnaires filling data was processed with Quest application, so it was obtained coefficient reliability of estimate and item fit (Table 2).

Table 2. Reliability of estimate and item from Quest application

| Instrument                   | Coefficient Reliability of Estimate | Item Amount (initial) | Item Fit (end) |
|------------------------------|-------------------------------------|-----------------------|---------------|
| Self-regulated learning      | 0.72                                | 28                    | 25            |

Reliability was consistent, while coefficient reliability was ratio from real variant score toward variant score observed. Coefficient reliability zero had weak reliability, because variant score observed almost error variant score [18]. While coefficient reliability one had strong reliability, because variant score observed were almost the same with real variant score. As an example, if instrument with coefficient reliability under 0.70, it was declared not maximal in separating low and high learners’ ability [19]. On Table 2, it was obtained coefficient reliability 0.72, it meant item in self-regulated learning instrument reliable enough in differencing every learner’s learning independence. Next, on Table 2 could also be known the amount of fit item i.e. 25, it meant that there are three invalid items because of differences with amount of starting items. It is declared again that fit item with model about one mark for INFIT MNSQ and OUTFIT MNSQ, as well zero mark for INFIT t and OUTFIT t [20]. In this research, it was obtained INFIT MNSQ value and OUTFIT MNSQ in range one along INFIT t value and OUTFIT t not in range zero (too small). So, it was indicated that it was not all fit item with model. It was proved in fit item map. There were three items (number 26, 27, and 28) outside range 0.7-1.3 so, it consistently was not appropriate with average box. While, the other 25 item was in range, so it was considered consistent with average box. Next, it is delivered that item in critic point 0.7-1.3 was indicated as fit item and can be used to take research data; while item outside critic point was mentioned misfit and cannot be used in research [21].

Figure 1. INFIT and OUTFIT value mean square.  
Figure 2. INFIT Value and OUTFIT t

At the beginning, the research subject involved consists of 178 learners, but there were only 163 learners who were active until the end of research. About 15 learners were eliminated because of absence in taking research data. Next, about 163 learners were divided into three independent samples, where every sample was given different acknowledgement. Acknowledgement description on every independent sample was shown on Table 3.
Table 3. Acknowledgement description in every independent sample

| Independent Sample | Amount | Before | Interface Activity | Long Distance Activity | After |
|--------------------|--------|--------|--------------------|------------------------|-------|
| Control class      | 59     | -      | Searching reading resources about crude oil material in school library, wet practicum in group, material discussion, task consultation, collecting practicum report. | - | Learners’ self-regulated learning measure through questionnaires. |
| Experiment 1 class | 51     | -      | Virtual practicum, animation video access, 3D object can be done in group or personal. | Virtual practicum repetition, animation video access, 3D object, searching various reading resources about crude oil material in internet, material discussion and task consultation through group in WhatsApp, collecting practicum report through teachers email. | |
| Experiment 2 class | 53     | -      | Searching reading resources about crude oil material in school library, wet practicum in group, material discussion, task consultation, collecting practicum report. | Wet practicum repetition through virtual, animation video access, 3D object, searching various reading resources about crude oil in internet, material discussion and tasks consultation through group in WhatsApp, collecting practicum report through teachers’ email. | |

V-Lab influence toward self-regulated learning was tested through ANOVA (Analysis of Variance) SPSS 21 helping. However, before test was done by some ANOVA assumptions with parametric data (ratio or interval), it must be filled such as every independent sample distributed normally, there was homogenities variant for every independent sample and observation result of every subject doesn’t not depend on other observation [22]. At the beginning, self-regulated learning collected data is ordinal data, and then it was changed to be interval data in successive method help. Interval successive method is respondent perception scale data procedure which is grouped into interval scale based on levels [23]. In this research, the first and second ANOVA assumptions had been fulfilled where every independent sample was distributed normally (Table 4) and there was homogenities variants from every independent sample (Table 5) because significant value bigger than 0.05. It was added that the third ANOVA assumption had been fulfilled where observation of every subject was done independently with different instruments (Table 1).

Table 4. Normality test result for every independent sample

| Independent Sample | Amount (N) | Significance Shapiro-Wilk | Significance Lillifors |
|--------------------|------------|---------------------------|------------------------|
| Control class      | 59         | 0.190                     | 0.076                  |
| Experiment 1 class | 51         | 0.121                     | 0.200                  |
| Experiment 2 class | 53         | 0.208                     | 0.200                  |
Table 5. Homogeneities variants

| Levene Statistic | df1 | df2 | Significance |
|------------------|-----|-----|--------------|
| 2.189            | 2   | 160 | .115         |

On the whole, it can be concluded that three assumptions above have been fulfilled, so influence of V-Lab utilization hybrid learning integrated toward self-regulated learning can be analyzed through ANOVA.

3. Result and discussion

ANOVA test result shows that there is no different average of self-regulated learning value on three independent samples (Table 6). That is proven by comparison value of F arithmetic and F table, where it is obtained F arithmetic about 1.762 and F table about 3.053, so F arithmetic < F table and H0 is accepted, beside, it is proven by significance result bigger than 0.05 i.e. 0.175, and it impacts on H0 assumption.

Table 6. Not significant difference among independent sample

| Sum of Squares | df | Mean Square | F     | Significance |
|----------------|----|-------------|-------|--------------|
| Between groups | 393.817 | 2 | 196.908 | 1.762 | .175 |
| Within groups  | 17884.685 | 160 | 111.779 |
| Total          | 18278.502 | 162 |

Figure 3. Self-regulated learning average value every independent sample

Although, it is declared that there is no difference, it does not mean that three independent samples of self-regulated learning average result become exactly same. However, there is difference average value even though it is too small (Figure 3). In this context, it can be known that the highest self-regulated learning average result was obtained in experiment 1 class. Some speculations arise reason related the highest average value result namely because of computer and information technology utilization. Technology is the best platform to support self-regulated learning development because it can pull learners’ interest and imagination, it can be used as practice facilities to practice theory, and it is surrounded by rich learning environment because it is available various information to develop and to check learners’ knowledge [24]. Technology is also useful to expand and to deepen information [25].

Availability of various features is also believed to be influential toward self-regulated learning accretion. Feature as activeness support makes learners helped in finding their own knowledge [26]. Meant Features are in the form of virtual activity, where long distance practicum can be done by learners independently, without worries of time, place, and substance limitation, tools availability or self-safety. Other features such as practicum procedure, learners’ sheet, information about tool usefulness, physical characteristic and chemistry substance and also animation video become support self-regulated learning growing. Research result before presents that learners are really helped in independent learning after using video because it can be rewinded as need [27].
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One of online learning from hybrid learning is also believed to be able in pushing self-regulated learning growing because various information is available in internet. Learners more often do searching information through in internet. Learners only need to be careful in sorting out relevant information with task being done. It is known that relevant information choice is one of self-regulated learning indicator [28]. Concept truth knowledge searching process is one of self-regulated learning indicator [29]. Although learners are being trained to study independently, but consultation in online learning is believed important especially when learners find difficulty which cannot be solved by them. It is supported by research result before which declared that understanding enhancement, revision and learning arrangement can happen after consultation [30]. Combination of interface and online learning supported self-regulated learning feature such as web is believed that it can help rightness of tasks collecting, presence enhancement and learners’ activeness in learning [31].

On Figure 2 is also be known that self-regulated learning average result in experiment 2 class lower than control class. Even though, in experiment 2 class there are two practicum activities done in conventional laboratory and V-Lab integrated hybrid learning. A research shows that enhancement of understanding and learning achievement happen because of combination of practicum activity in virtual laboratory and real laboratory [32]. Then, enhancement of learning achievement also result virtual laboratory utilization completed multimedia [33]. In this context, multimedia is from practicum activity in conventional laboratory including tools utilization, chemistry substance characteristic identification, while multimedia from V-Lab is in the form of animation videos, virtual practicum, and 3D object. So, it indicates that learning activity in experiment 2 class was believed that it impacts toward learning achievement.

Learning achievement can be predicted through covered self-regulated learning stages [34]. Self-regulated learning which tends to be used by smart learners impact on enhancement of learning achievement [35]. Self-regulated learning relationship with learning achievement is shown through research result, in which learners with web enabled SRL intervention have higher mark significantly than learners without intervention [36]. Finally, it can be concluded that there is close connection between how high self-regulated learning with learning achievements. In this research, experiment 2 class should have higher self-regulated learning than other class because there are various activities and activeness support features. But, research result obtained has not been showed yet.

That is why, further research needs to be done. Some matters needs to be fixed on further research as well as practice session before system used, because there are many learners feel difficult when system is used for the first time [37]. It is supported by statements which stated that demonstration activity consisted of virtual laboratory and the ways to use it needs to be done [38]. The other things which need to be fixed are amount of meetings to measure self-regulated learning, where in this research measuring are done three times after learning. Those meeting felt too few to observe learners’ self-regulated learning growing. Even though growing of self-regulated learning in learners’ self cannot happen spontaneously, but appropriate study and practice are needed [39]. To be independent learner, learners need to study gradually as time in order that all component in learning can be arranged [40]. Less appropriate research result relate possibe with questionnaires distribution to the learners which is only three times learning. It is worried that it would be influenced questionnaires filling. It is really possibly that learners find difficulties in filling questionnaires because they forgot all things happened when they studied [41]. As a result, learners’ totality of mind and action in self-
regulated learning is not reflected. In further research, it is better if the behaviors study was noted in journal and course site every week [42].

4. Conclusion

Statically, it is declared that there is no significant difference of average result of every independent sample. It can be concluded that there is no influence of V-Lab utilization integrated hybrid learning toward self-regulated learning. Even though, this research can be a reference of further research that measure was not done and it was only done three times after learning, but, it needs to be done gradually and continually.

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