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Formative Assessment with Stages of Understanding by Design (UbD) in Improving Habits of Mind

Ria Yulia Gloria^{a,b}, Sudarmin^a, Wiyanto^a, and Dyah Rini Indriyanti^a

^a Graduate Program at UNNES Semarang, Jawa Tengah, INDONESIA.

^b Science Teaching-Biology at IAIN Syekh Nurjati of Cirebon, Jawa Barat, INDONESIA

ABSTRACT

A new trend in the education world is the effort to improve high level thinking skills and smart thinking habits. This is due to a change of the paradigm in teaching: from teacher centered learning to student centered learning. A student centered learning will make students encounter various problems, therefore a learning that can train high thinking skills and smart thinking habits is needed. One way to train and form habits of mind is by applying formative assessment. This study is aimed to know the effect of formative assessment in improving habits of mind. The method used was quasi-experiment design. As many as 31 students were given treatment i.e. by giving them formative assessment through stages of UbD for one semester. The strategies of formative assessment given were discussion and presentation; mind mapping, analysis of scientific articles, and practices. Pre test and posttest were given to measure the students' habits of mind. Observation of activities during teaching and learning process, both theory and practice, was done. Research result with t-test showed there was a significant improvement in habits of mind, and the value of habits of mind per category in each formative assessment strategy has significant differences when using one-way anova test.

KEYWORDS

Formative Assessment, Habits of mind, Understanding by design (UbD)

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Introduction

Smart thinking skill is an important thing that students must have. This is due to the fact that students often have to face problems that they do not know the solutions yet. As mentioned by Costa & Kallick (2000), and Carter *et al.* (2005), if they have good *habits of mind*, it means they have a smart character and behavior (*to behave intelligently*) to face unknown answers. Therefore education should try to develop better and complete intellectual capability of the students (Costa & Kallick, 2004). The question is has the current learning process been directed to form and improve smart thinking skills?

CORRESPONDENCE R.Y. Gloria ✉ riyulgloria@gmail.com

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These days learning activities which do not support the formation of habits of mind still exist. A study conducted by one of the state Islamic institutes in West Java Indonesia (Gloria et al., 2017), found that there were students who still have habits of mind in low category, and the category was quite many (89.5%). These of course do not meet the standard for students who live in this century, as the problems they have to face are more complicated. Lack of a learning process which trains the formation of habits of mind is the problem, one of which is inappropriate assessment given to the students. A study result conducted by Wulan (2007) says that students are not interested in the tasks given by their lecturers because they do not have a chance to get feedback and self assessment. While Ronis (2011), says that today many standard tests used in summative tests are sometimes invalid, unreliable and inconsistent. Based on this we need learning process especially the assessment which can facilitate the formation of students' habits of mind.

Intelligence is not fixed, but flexible, and can be changed to be better or the opposite (Costa & Kallick, 2008). This means in order to build our intelligence we need an exercise that facilitates the formation of habits of mind. Thinking exercise which is done repetitively will facilitate the formation of habits of mind, so that the tasks and assessments given during teaching and learning process will give a real effect. If the exercise is given continuously, the habits of mind will be formed. A study by Sriyati et al (2010), explains that formative assessment gives contribution in the forming of habits of mind. Steinkuehler et al (2008), says that games have the potential to develop habits of mind. Anwar's study (2005), found that habits of mind can be formed through performance assessment learning in teaching the concept of environment. According to Cheung and Hwe (2008), some indicators of habits of mind can be developed and trained through online learning. Gloria (2017), in her study concluded that problem based learning Selecta learning in biology was effective to form the prospective teachers' habits of mind. Steinkuehler & Duncan (2008) presented empirical evidence on the potentials of games in developing habits of mind. From the above description we can conclude that habits of mind can be trained and formed through the learning process or activities. The question is what kind of learning is effective in forming habits of mind.

One important thing in learning is the assessment during the learning process and how we do it, or what is known as the formative assessment. Bell & Cowie (2002) says formative assessment is an important part of teaching which considers students' need in thinking. Thus formative assessment will train students to be active during the learning process such as interacting with other students and discussion as a tool to exchange ideas. (Sadler, 1989; Black and William, 2004; Shavelson, 2006), explain that students' active role or the process experienced by students during learning gives positive impact on them. According to Ronnis (2011), formative assessment is information collected by the educators (teachers or lecturers) during learning process in the classroom, which gives information about students and students' understanding. Another advantage of formative assessment is it can help students understand the concept (Kusairi et al., 2017). It can be concluded that formative assessment is an important part of teaching which considers students' need in thinking.

There have been a lot of studies conducted on formative assessment, and some have proved its advantages. Formative assessment can encourage students to be interested in the topic learned, increase motivation and learning outcome.

Formative assessment can give confidence and optimism, and form habits of mind (Ziman, *et al.*, 2007; Sriyati *et al.*, 2010; Smith, *et al.*, 2011; Saptono, 2015). Formative assessment can make students interested in Biology (Gun dan Pitt, 2003). While a study by Admiral, *et al.* (2014) says that a formative component of self assessment is a valid way to assess students' performance, while peer assessment can be used and valid to explain the difference in the result of students final exam.

In contrast to previous studies, the formative assessment in this study was selected through reversed design (UbD). Through the UbD design, the formative assessment strategy chosen for the learning activities will be adapted to the needs of the students, and in accordance with the given topics. Costa & Kallick (2008) stated that if teachers create a program unit using UbD then the capacity of students in understanding the material will be stronger. In Wiggins (2005), it is said that reversed design is a task analysis that aims to remember the precious task to be fulfilled, in addition we can provide everyone the best stock.

Formative assessment and UbD design are closely related to the habits of mind, especially the active role of the student during the formative assessment that can form the habits of mind. The active role is that formative assessment provides meaningful activity during the learning process (Thin, 2006; Saptono, 2015). Ronnis (2011), states that formative assessments comprised of information compiled by teachers or lecturers during daily meetings within the classroom, indicate the internal processing of student information, the development of students' understanding, interaction among students, and discussion as a tool for exchanging ideas. Lee hang & Bell (2015), formative assessment involves communication between teachers and students, or between students and students to gain meaningful learning together. All of these opinions indicate there is the training that students will receive during the learning process and take place continuously. The positive influence of the formative assessment will apply to all male and female students, Gloria *et al.* (2017), the habits of mind's value is not influenced by sex differences. Therefore Sriyati (2015), concluded that formative assessment contributes to the formation of habits of mind.

Thus this study aims to determine the increase of student's habits of mind after applying formative assessment through the stages of UbD. Formative assessment strategies used were discussions, scientific article analysis presentations, mind mapping, and problem-based inquiry practice.

Research Method

Design

This research used quasi-experiment design, with a one-group pre-test and post-test (Creswell, 2014, Creswell, 2015). One experimental class was given treatment. Before the treatment the class was given pre-test, and then post-test after treatment.

Table 1. Design of Research



Pretest	Treatment	Posttest
0	X1	0

Note : 0 = test to know students' Habits of Mind

X1 = Formative assessment through UbD

Sample

The participants in this study are students majoring in biology education in one of the Islamic universities in west java which is in the lecture period of semester 6. The number of sample was 31 students consisting of 9 men and 22 women. The population of semester 6 students is 133.

Instrument

The instrument used is a questionnaire to assess students' habits of mind. The questionnaire consists of 21 questions consisting of 16 categories of habits of mind from Costa and Kallick (2008). The 16 categories are: 1) Persisting 2) Managing impulsivity, 3) Listening with understanding and empathy, 4) Thinking flexibly, 5) Meta cognition, 6) Striving for accuracy, 7) Questioning and problem posing, 8) Applying past knowledge 9) Thinking and communicating with clarity and precision, 10) Gathering data through all sense, 11) Creating, imagining and innovating, 12) Responding with wonderment and awe, 13) Taking Responsible Risk, 14) Finding humor, 15) Thinking interdependently, 16) Remaining open to continuous learning.

Procedure

Formative assessment with UbD stages is given to 31 students of sixth semester, in 12 meetings that last for one semester (six months). The subject given in this research is Plant Physiology, covering three topics: biophysics, biochemists, and biogrowth.

The formative assessment strategies used are selected through the stages of UbD (Wiggins, 1999; Wiggins 2005; Wiggins, 2011). These are group discussions, presentations, mind mapping, scientific article analysis, practicum activities, and practicum reports. A formative assessment component consisting of feedback, peer assessment, and self assessment is performed on each activity. Formative assessment strategies applied to theoretical learning are discussion, presentation, analysis of scientific articles, and mind mapping. While the formative assessment strategies of practicum learning are discussion, presentation, and practice report. Data were analyzed using paired t-test to see the difference between pre-test and pos-test, and one-way anova test was used to see the increase in the values of habits of mind per category. The increase in students' *habits of mind* is measured based on N-gain. The N-Gain criteria used are according to Meltzer (2002):

Table 2. Criteria N-Gain

Gain Normalized	N-Gain
Low	0 – 0.30
Medium	0.31 – 0.69
High	0.70 – 1.00

Results and Discussion

Improved habits of mind

The effect of formative assessment through the stages of UbD is known by the analysis of pre-post test values in habits of mind. The results of the analysis with SPSS-21 program show the value of t-count of 14.704, the value of sig 0.000, which means that there is a significant difference between the value of habits of mind before and after treatment. In addition there is also an increase in the value of pre-test and post-test of 43.9% which is included in the category of medium.

Figure 1 shows a graph of the comparison of N-Gain categories obtained. From the graph it can be seen that the increase of habits of mind values only ranges between low and moderate, there is no student who experience high scores of habits of mind (0%).

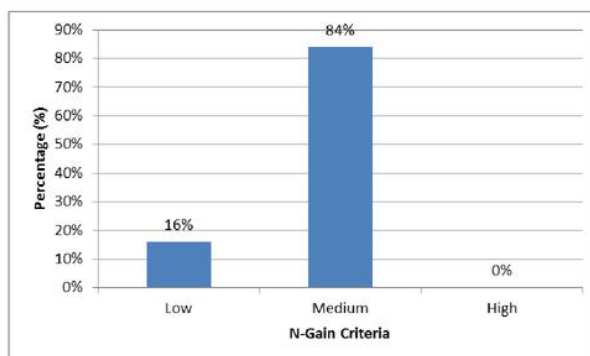


Figure 1. The N-Gain category of students's habits of mind

Although the increase of habits of mind is within the medium range but based on the result of t-test analysis the increase is significant. Formative assessment applied gives positive impact on the improvement of habits of mind. This is because formative assessments train students to gain categories that belong to the habits of mind. This is in line with the results of Sriyati's (2015) study which concludes that formative assessments contribute to the formation of habits of mind. The contribution given is a continuous training that takes place during the learning process.



Increased habits of mind per category

To know the increase of each category from 16 habits of mind category, one-way anova test result can be seen in Table 2. Increased habits of mind value per category

Table 3. Increased habits of mind per category

No	HOM	Pre	Post	N-Gain	sig.	Criteria
1	Persisting	49.0	69.0	38	0.000	Significant
2	Managing impulsivity	46.0	69.0	41	0.000	Significant
3	Listening with understanding and empathy	55.0	76.0	42	0.000	Significant
4	Thinking flexibly	42.0	65.0	36	0.000	Significant
5	Metacognition	52.0	74.0	40	0.000	Significant
6	Striving for accuracy	49.0	71.0	41	0.000	Significant
7	Questioning and problem posing	45.0	71.0	42	0.000	Significant
8	Applying past knowledge to new situations	41.0	68.0	41	0.000	Significant
9	Thinking and communicating with clarity and precision	44.0	63.0	31*	0.000	Significant
10	Gathering data through all sense	45.0	71.0	42	0.000	Significant
11	Creating, imagining and innovating	37.0*	62.0*	38	0.000	Significant
12	Responding with wonderment and awe	56.0**	73.0	37	0.000	Significant
13	Taking responsible risk	49.0	72.0	40	0.000	Significant
14	Finding humour	50.0	70.0	49	0.000	Significant
15	Thinking interdependently	53.0	77.0**	50**	0.000	Significant
16	Remaining open to continuous learning	54.0	75.0	42	0.000	Significant

* the lowest value

** the highest value

In Table 2 we can see that all values of the habits of mind category increased significantly. The highest pre-test score was obtained by category responding with wonder and awe (56.0), while the lowest score was obtained by category of creating, imagining and innovating (37.0). The highest post-test value was obtained by the thinking interdependently category (77.0), and the lowest score was obtained by the category of creating, imagining and innovating (62.0). The

highest N-gain was obtained in the category of thinking interdependently (0.50), while the lowest N-gain was obtained in the thinking and communicating with clarity and precision category (0.31).

The habits of mind values obtained in this study are shown in Figure 2. Graph of habits of mind.

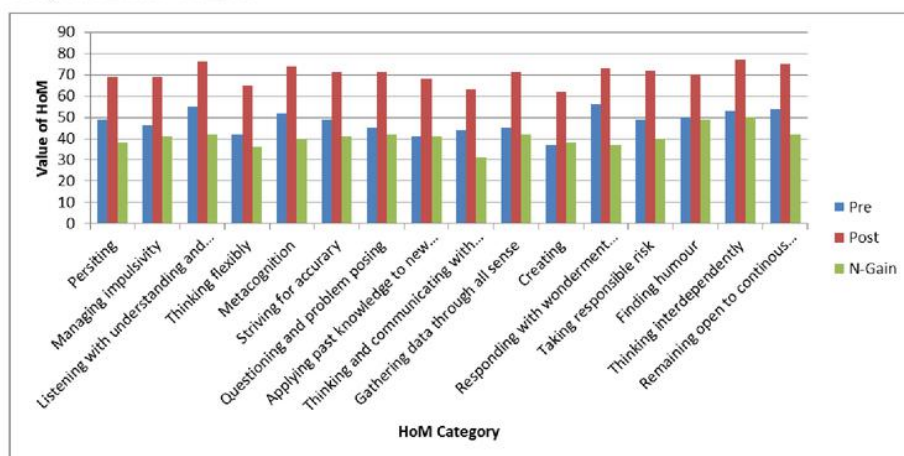


Figure 2. Graph of increased habits of mind values

Students' Habits of Mind formed after the implementation of formative assessment through the stages of UbD is evident from the value of the gain. Each category of habits of mind has a significant increase, explaining the formative assessment through the UbD stages is effective in improving the habits of mind. Formative assessment strategies used can train and form student's habits of mind. Students have been given the opportunity to conduct self-assessment in every task or activity. By conducting self-assessment students are given the opportunity to have greater control over themselves (Ezzahra, 2015). In addition feedback given by lecturers gives students the opportunity to know the shortcomings they have, while the peer assessment they receive gives students the opportunity to do the job becomes more perfectly.

The greatest increase in the thinking interdependently (0.50) category, proves that the formative assessment strategy chosen through the UbD stages of discussion and presentation yields positive results. Discussions and presentations both during theoretical and practicum lessons train students' collaborative skills. Since humans are social beings, they would prefer to live in groups (Costa Kallick, 2008). At the time of discussion the students will make a reciprocal relationship, students will realize that by working together the results obtained will be better.

The lowest N-gain was obtained in the thinking and communicating with clarity and precision category (0.31), explaining the lack of good language skills in the students. Nevertheless there is still an increase, meaning habits of mind category thinking and communicating with clarity still formed. Presentations and



discussions that occur at the time of learning can train students' language skills, if done continuously it will have a very positive impact.

In general, each category of habits of mind has increased, proving that the components of the formative assessment have had a positive effect. Formative assessment components in the form of feedback, peer assessment, and self assessment occur during the learning process. During discussions and presentations there will be more opportunities for peer assessment. Peer assessment occurs when students ask questions, give criticism or arguments during the discussion. Peer assessment will train students to consider suggestions and not hasty, think flexibly when accepting criticism of friends, try to solve problems and able to discuss well. Peer assessment also encourages students to practice good communication (Thinking and communicating with clarity and precision), and collect data through all senses (Gathering data through all sense). Yusuff's (2015) study proves that peer assessment can facilitate student involvement in encouraging students' trust in the use of critical thinking and decision making.

Feedback during the learning process either by the lecturers or by the practicum assistant can encourage the desire to improve and not easily give up or Persisting (Ramaprasad, 1983).

Self assessment will encourage the formation of Meta cognitive, cultivate prior knowledge to create new contexts (Applying past knowledge to new situations), and can enjoy and find out all new things (Responding with wonderment and awe). Through the three components of the formative assessment students will be trained on how to control and accept all the problems faced with humor (Finding humor).

Conclusion

Formative assessment through the Ubd stages is effective in forming the habits of mind of Costa & Kallick. It was proved by a significant increase in the value of habits of mind before and after the learning process. The value of habits of mind increases at moderate level.

Each category of Costa & Kallick's habits of mind consisting of 16 categories has significantly increased. The greatest increase of habits of mind values was obtained in the interdependently thinking category with $N\text{-gain} = 0.5$, while the lowest habits of mind value was obtained in the thinking and communicating with clarity and precision category, with $N\text{-gain} = 0.31$.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Ria Yulia Gloria · Graduate Program at UNNES Semarang, Jawa Tengah Indonesia, Science Teaching-Biology at IAIN Syekh Nurjati of Cirebon, Jawa Barat, Indonesia

Sudarmin · Graduate Program at UNNES Semarang, Jawa Tengah Indonesia.

Wiyanto · Graduate Program at UNNES Semarang, Jawa Tengan Indonesia.

Dyah Rini Indriyanti · Graduate Program at UNNES Semarang, Jawa Tengah Indonesia.

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