APPLICATION-BASED INSTRUCTIONAL TOOLS FOR ENHANCING STUDENTS' PROBLEM SOLVING SKILLS IN HOME ECONOMICS

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ABSTRACT

The main purpose of education is to help students learn in a way that allows them to use what they have learned in solving problems in new situations. As problem solving acts as the basis of education, lecturers are expected to develop students' ability on it. This study aims to describe (1) the working course plan in inducing problem solving skills in various learning models, (2) student's activity during the learning process, and (3) the problem solving skills after the class ends. This study implemented instructional tools to boost students' problem solving skills, of which was conducted at Home-Economics Department, Universitas Negeri Surabaya (UNESA) with 67 participants. The instruments included a work- sheet of the developed course plan, observation sheet of learning activities, and test. Data were analyzed using descriptive qualitative and quantitative analysis methods. Results showed that the students improved their higher order thinking skills into more critical and creative during the learning activities. In conclusion, the use of appliances in home economics instructional tools can increase students' problem solving skills because the agreement of the interconnected systems or subsystems with the problems faced.

Keywords: *Education, home economics, best practice, curriculum*

1. INTRODUCTION

Thinking is in fact a cognitive process, yet also known as an active mental process to acquire knowledge (Costa, 1985). It is a process to manage and transform the information in memory (Santrock, 2008). Its activities include forming concepts, reasoning, critical thinking, decision making, creative thinking, and problem solving.

A problem occurs when there is a missed linkage between reality and expectation, while one cannot find any ways of solving the discrepancy. Generally, a problem can be solved by a series of solving steps; 1) identifying and defining the problem occurred, 2) developing problem-solving strategy, 3) applying problem-solving strategy, and 4) evaluating the strategy that has been undertaken. Students who have experiences in the scientific processes, tend to possess problem solving skills and know how to attribute meanings to occurring events and to form different perspectives. In coping with clearer concept, a problem solving strategy is a plan or method to achieve a goal (Seyhan, 2015).

Creative thinking is a fundamental process of producing something original and valuable (Stenberg, 2012). In general, this process involve several stages namely preparation, incubation, intimation, illumination or insight and verification. Some indicators of creative thinking are that students can provide a number of answers for a question, instead of only being fluent in expressing ideas quickly. In accordance with aspects of assessment, the assessment used is not merely based on its results; rather, it should include the assessment of student's process in solving a problem given by a teacher (Amtiningsih, 2016). In addition, creative thinking skills can be influenced by teachers' supports in term of providing broader insights such as appreciations, compliments, and activities that can encourage students to be more active (Munandar, 2009).

In this case, Lai (2011) argues that critical thinking is in accordance with contents and skills embedded in the curriculum and promotes a mixed approach that combines the general with specific subject approaches. In general, teachers need to integrate critical thinking principles with the application of critical thinking skills in the context of specific subject matter. Critical thinking skills involve reflective and productive thinking which includes evaluation and evidence (Santrock, 2008). Moreover, it includes a complex combination of skills. Paul and Elder (2006) stated that the standards of critical thinking skills include accuracy, precision, relevance, depth, breadth, logic, significance and fairness. Critical thinking can be applied to assist in the analysis of critical conclusions and reasons, credibility of source, observations, logic, experiments, arguments, generalization, decisions, and definitions.

Santrock (2008) suggest that the aim of problem solving is to find the right way to achieve an optimum solution. In similar tone, Reed (in Stenberg, 2008) states that it is an attempt to overcome obstacles that impede the path to the solution. Problem solving skill determines one of the roles that individuals undertake in dealing with their environments. Problem solving skill is often associated with decision making and scientific rationale (Abdullah & Shariff, 2008). Lecturers should observe students' problem solving achievements, provide them feedbacks and support them to acquire these skills optimally (Jeon, Huffman & Noh, 2005).

Based on the above discussion, solving a problem can be defined as a cognitive process used in an effort to find an effective way to generate a solution. The word "effort" in

this definition implies that problem solving is a process that follows the general pattern (heuristics) or certain steps (algorithmic).

Gano (2010) introduced a set of steps to generate a solution involving; defining the problem, determining the causal relationships including the actions and conditions of each effect, providing a graphical representation of the causal relationships with specified actions and conditional causes, providing evidence to support the existence of each cause, determining whether each set of causes is sufficient and necessary to raise effects, providing effective solutions, and changing or controlling one or more event's causes. Solutions must be shown to prevent recurrence, meet objectives, easily controlled, and implementable and tracked on the effectiveness of each solution. Adair (2007) summarizes the steps into the following stages; defining problem/goal, resulting in the possible options, and choosing the most optimal solution. Pretz et al (2003) stated that problem solving process is considered a cyclical process comprising several stages such as recognizing or identifying problem, defining or conceptualizing the problem, developing strategy to solve the problem, organizing knowledge related to the problem, allocating mental and physical direct resources toward problem solving, monitoring progress toward achieving goals, and evaluating the goals for accuracy. The cycle is descriptive and does not imply that all problem solving proceeds sequentially through sequential stages, however, successful problem solvers are those who are flexible. Various studies suggest that successful problem solving relies on a combination of domains, such as knowledge strength, knowledge, problem solving strategies, and self-confidence (Lorenzo, 2005).

Instructional tools (instruction/ learning materials) which are integral to teaching and learning are aids which are used to enhance students' learning process (Smaldino et al., 2008). NCVER-NCCBT suggests that instructional tools are all kinds of materials used to help teachers, lecturers, or other instructors in delivering their subject matter. It can be in a form of either written or non-written materials. As what to be previously encountered, books and student activity sheets (MFIs) are included in learning tools. From the perspectives of the course, problem solving skills can be trained through various relevant subjects.

Applying a learning process integrating high-level thinking skills is difficult in term of its planning and the implementation (McGregor, 2007). This study develops learning tools for Home Economics in Home Economics Department, Engineering Faculty, Universitas Negeri Surabaya (Unesa). This gives students a basic understanding of the background of Home Economics, issues related to household problems and how to achieve a family welfare, as well as the study about Home Economics itself. The purposes of this study are to examine the applicability of the course plan, to assess students' activities during the learning process when applying a learning model and to measure students' problem solving skills after the learning process.

2. METHODOLOGY

To achieve the aim of this study, the efficacy of the instructional tools of Home Economics appliances in improving students' problem solving skills need to be assessed. A pre-experimental design method was adopted where the applicability of two instructional model were assessed. The population was the undergraduate students of Home Economics Department at Unesa. The samples were 67 students who took Home Economics course.

2.1 Data collection and instruments

Data were collected in three stages, pre-test prior to the implementation of activities, observations during activities that enable students to practice their problem solving skills during the application of the learning model and post-tests to obtain data of students' problem solving performances after activities. Two research instruments were employed in this study were namely, an Observation Sheet of Student Activities (OSSA) and a subjective test for problem solving skills.

The test consisted of seven open-ended questions and was applied to measure students' knowledge on gender issues. This test consisted of questions related to etymology and usage, gender equality, gender identity and role, gender studies, legal status, and gender and society factors in affecting the rate, yet determining biological factors and views. The views from experts regarding the validity and reliability of the test had been sought.

2.2 Procedure

A week before the related data gathering stage, students were given questions about the effects of kinds of job and society's responses to gender equality. The students were asked to define, analyze and evaluate the problem. During the application week, it was considered which factors can be related to gender equality by conducting cooperative learning strategies. In addition, discussion among students about the research method and experiment findings was provided. At the end of the two-week period, students' observation related to the experiment and their responses to the questions assigned were controlled and given feedbacks

2.3 Data analysis

Data were analyzed using descriptive statistics methods. The observational data of the applicability of learning activities were analyzed by calculating the total values of all observers, and then, calculating the average of ratings for each learning stage. The rating of each learning stage activity was further interpreted in Table 1.

Table 1: Likert Scale interpretations

Scores	Categories
4	Very good
3	Good
2	Fair
1	Poor

*Adapted from Likert Scale initiated by Riduwan (2012)

The percentage of activities recorded on the observation sheet was calculated with the following formula

$$Percentage\ of\ the\ students'activities\ = \frac{A}{B} x\ 100\%$$

Notes:

A = Σ frequency of the observed learning activities

B = Σ total frequency of the activities

Furthermore, the observation of students' activity obtained during the learning was interpreted in Table 2.

Table 2: Score Interpretation of Students' Activities

Average Scores	Categories
0-20	Poor
21-40	Fair
41-60	Average
61-80	Good
81-100	Excellent

*Adapted from Likert Scale initiated by Riduwan (2012)

Furthermore, the students' problem solving skills were determined based on the students' test results comprising pre-tests and post-tests. The results of both tests were used to determine the N-gain score which represents the increase in students' problem solving skills. The quantitative descriptive analysis was conducted to determine the learning outcomes (Hake, 1999) using the following formula.

$$\langle g \rangle = \frac{S_{post} - S_{pre}}{Smax - S_{pre}}$$

Notes:
<g> = gain score (improved students' learning outcomes)
S_{post} = *post-test* score
S_{pre} = *pretest* score
S_{mak} = maximum score

The *N-gain* revealed the difference in mastering or understanding before and after the treatment. The *N-gain* criteria according to Hake (1999) fall into three categories, namely:

(i) If <g> ≥ 0.7 categorized as high
(ii) If 0.7 > <g> ≥ 0.3 categorized as average
(iii) If <g> ≤ 0.3 categorized as low

3. RESULTS AND DISCUSSION

3.1 Observational data on applicability of learning activities

Observations data were gathered to determine the applicability of the teaching and learning activities during a learning process. Based on the observation results, it was agreed that the activities were in accordance with the stages in cooperative learning and problem based learning (PBL) models. During the observations, the lecturer was also in charge as the observer during the learning process, assisted by one peer observer. Table 3 shows the results of the applicability assessment.

Table 3: Results of applicability of course planning

No.	Phases	Average	Categories
1	Communicating the course objectives and stimulating the student's interest	3.75 = 94%	Very good
2	Delivering information	3.5 = 87.5%	Very good
3	Organizing students into study groups	4 = 100%	Very good
4	Scaffolding the group tasks and learning	3.83 = 97%	Very good
5	Assessment	3 = 75%	Good
6	Giving rewards	4 = 100%	Very good

Based on the phases presented in Table 3, the applicability of the learning models was considered as "very good", the percentage of the applicability gained 100%, which means that all the learning activities were implemented as designed. All the activities carried out belonged to "very good" category, while the student's presentations fit into "good" category.

In the first meeting, there were still problems in investigating the *ill- defined* problem due to lack of clarity in the lecturers' direction given to students. It resulted in the students' low level of understanding. Furthermore, the students were unfamiliar with the learning method used, in particular the Students' Worksheet used to train problem solving skills. In the subsequent follow up meetings, considerable positive changes were observed. There were excellent interactions among students, as well as with students and lecturer. From the second meeting onwards, the students were getting used to the learning method applied during the lesson. The lecturer's class management at these meetings was also improving and good. The scores on all measures were thus increasing from the first to the last meeting.

3.2 Observational data of students' activities

Figure 1 shows the observation results related to the students' activities in each meeting.

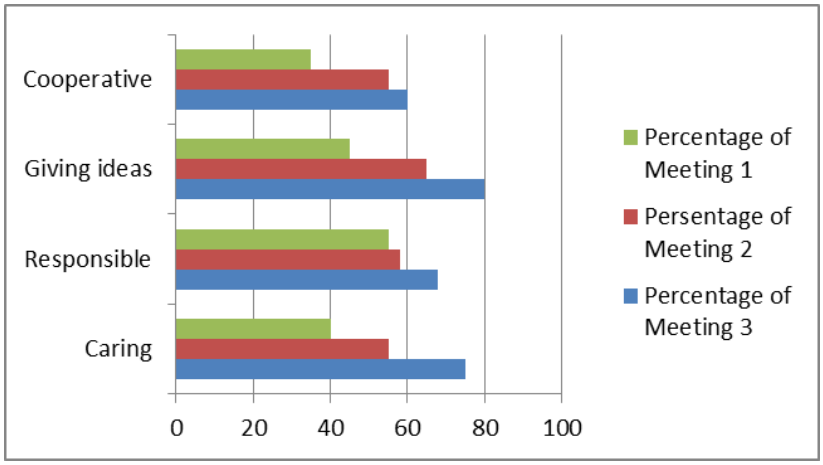

Figure 1: Students' activities in each meeting

Figure 1 reveals that the aspects which improved most in each meeting were contributing ideas and caring, whereas the other aspects showed similar results over several

meetings. Based on the calculation of the observation results of students' activity, it also obtained the percentage of each aspect as seen in Table 4.

Table 4: Observation results of students' activities

Aspects assessed	Percentage	Categories	N-Gain
Cooperation	50	85	0.7
Contributing ideas	49	83	0.67
Responsible	50	79	0.58
Caring	60	86	0.65

As in the previous lessons experienced by students, they are only given materials or new concepts, questions and examples relevantly with the concept that had been discussed. In addition, the students did not get used to learning in groups, discussing and sharing ideas with other members in the same group as well as presenting the results of their discussion. This did not enable the students to coordinate well with their group members. Therefore, the first meeting was not running optimally. It got worse since the students were all individualists. However, at the second and third meetings, the students' activities and interactions gradually improved and the learning objectives were achieved well. The students' enthusiasm emerged at the third meeting as the students really understood the rules of problem-based learning model.

3.3 Data of pre-test and post-test

Before conducting this study, the researchers administered a pretest to determine the initial students' ability. Table 5 shows the pretest results.

Table 5: Pre-test results

Data	Scores
Maximum score	54
Minimum score	32
Mean	45.82
Median	47
Modus	49
Standard Deviation	5.331

In addition to the pretest results, the students' initial problem solving skills were classified into several categories. The percentage of the students' levels of initial problem solving skills is drawn in Table 6.

Table 6: Percentages of the students' levels of initial problem solving skills

Levels of Initial Problem Solving	N	Percentage (%)
Very low	30	45
Low	24	36
Average	11	19
High	0	0
Very high	0	0

After the implementation of learning activities is formulated in the learning tools in the form of Student Worksheet (MFIs) and tests, the evaluation was administered to find out the increase of students' learning outcomes in the form of post-test (see Table 7).

Table 7: Post-test results

Data	Scores
Maximum score	84
Minimum score	55
Mean	74.07
Median	77
Modus	79
Standard Deviation	9.024

The percentages of students' levels of initial problem solving skills can be seen in Table 8.

Table 8: Percentages of the students' levels of initial problem solving skills

Levels of Initial Problem Solving	N	Percentage (%)
Very low	0	0
Low	3	4
Average	15	22
High	26	39
Very high	23	34

3.4 Calculation of N-Gain

The improved problem solving process that the students experienced can be seen from the N-gain average value of 0.577. This value is categorized in 'medium' level. Table 9 describes the results of N-gain.

Table 9: N-Gain results

Data	Pretest	Post-test	N-Gain
Maximum score	54	84	0.652
Minimum score	32	55	0.338
Mean	45.82	74.07	0.577

The results of problem-solving test data (pretest and posttest) were obtained in accordance with the achievement indicators as described in Table 10.

Table 9: N-Gain results

Problem Solving Indicators	Pretest	Post-test	N-Gain
Understanding the problem	41	79	0.764
Planning the problem solving	49	81	0.627
Implementing the plan of the solution	50	79	0.58
Reviewing the solution	51	81	0.707

The Student worksheets (MFI) were applied and regarded as one of the factors that played a role in increasing the students' problem solving skills. This was because the developed MFI had guided the students to practice problem solving skills, including understanding the problem, planning the problem solving, implementing the solvency, and reviewing the results of troubleshooting. The MFI provided the students with opportunity to define a problem through the phenomenon presented at the MFI. Afterwards, they should investigate the components of the problem. After these stages, the students would be able to

note down possible solutions to the problem by synthesizing theory and practicality in accordance with the problem. Afterwards, it was important to determine a solution or a most relevant plan to solve the problem. In the final stage, the students should be able to execute/implement the plan correctly, then, to evaluate the implementation.

Problem solving skills are more defined as a process rather than a result (Kneeland, 2008). Therefore, it is incorrect to decide the problem solving skills by only considering the last product (solution). Problem solving applies the basic thinking skills to solve an unknown or undefined difficulty, collect facts about the difficulty and find necessary information, make inferences or suggest alternative solutions and test them for compliance, simplify explanations and eliminate mismatches, provide solutions for checking the values that can be generalized. In addition, the stages of the MFI activity were in line with Pretz et al (2003) who stated that problem-solving is considered a cyclical process comprising several steps. The cycle consists of 1) recognizing/identifying the problem, 2) defining and representing the problem mentally, 3) developing a solution strategy, 4) organizing knowledge about the problem, 5) allocating resources for solving the problem, 6) monitoring progress toward the goals, and 7) evaluating the solution for accuracy.

The second factor affecting the significant increase of problem solving skills was the two learning models applied in this study, i.e. the problem based and cooperative learning models. Both models contained positive elements that were able to enhance the problem solving skills. The first element of the problem solving skills was the students' learning of the concepts through discussion. Arends (2004) suggested that the discussion provided information about what the students already knew to create new knowledge; it was therefore able to foster/improve cognitive development. Some studies also revealed that the learning objective of the concept and performance was associated with the use of active learning model (Midgley, Kaplan and Middleton, 2001). In addition, the students learned the new concepts in groups. Wentzel cited in McInerney and McInerney (2010); Joyce and Weil (1992) figured out that the group work improved the students' achievement through three different ways consisting of improving attention, mutual help, and responsibility. The second positive aspect of integrating the models was that both models started with the presentation of a phenomenon revealing problems for the students to solve. Based on the previous discussion, MFI and the applied learning model accommodated higher level students with the involvement of the problem solving process so as to make the students trained in solving more complex problems in the real-world contexts as the authentic problems.

4. CONCLUSION AND RECOMMENDATIONS

Problem solving is a set of processes or efforts to provide the optimum solution toward a problem faced. Determining and evaluating efforts made by students and how they find a solution are very important because problem solving process begins with recognizing the problem. People gain information about the problem, search sources, and gather the data. A person who solves the problem has already developed a number of hypotheses according to the data obtained; making appropriate selections among them and finding a solution. In this study, based on the students' feedbacks, it is understood that students have some misunderstandings about gender issues even these misunderstandings can be corrected. The students sometimes cannot relate the data and findings, in which this becomes the major factor causing misunderstandings. For example, the salient mistake found in this study

shows that the linkage between planning problem and understanding problem is not yet determined. Another misunderstanding is about the relation between contributing ideas and cooperation. However, at the end of this study, it was observed that when students are given opportunities, their problem solving skills can be developed. Planning the course with the activities such as narration technique and scenarios affects the attitude of the course positively. This fact should not be ignored while planning the course. Also, this develops students' problem solving skills.

In this study it was observed that students discussed their findings in their group before an open session and this provides cooperation and positive attitude in the course. Moreover, students' responsibility, self-confidence and self-proficiency were developed. Students who used brainstorming in problem solving processes, gain greater ability in speaking, agreement and cooperation. Reasoning on the results and making preferences make students gain empathy, compromising and sharing the responsibility of the decision made. In conclusion, students can be an independent evaluator for their jobs by evaluating their errors and preferences. Therefore this study suggests that further study related to the implementation of the course book "Learning for Solving Problems" can be conducted on a larger scale as the current study has provided some evidence for its applicability in a small scale study.

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