

25
Vol. I No. 1 2010

B.b.1
ISSN : 2087—4782

Proceedings



✦ The 1st UPI International Conference on Technical and Vocational Education and Training

*"Competence Development for the World of Work
and for Sustainable Development"*

November 10-11, 2010
ASTON TROPICANA Hotel, Bandung, INDONESIA

In co-operation with :

- Ministry of National Education,
Republic of Indonesia
- German Development Cooperation

Organized by
Faculty of Technology and Vocational Education
UNIVERSITAS PENDIDIKAN INDONESIA

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11. Fulvia Jordan, US, A Case Study on Agroforestry Education: Seeking a Paradigm for the Sustainable Development of Rural Youth in Darien, Rep. of Panama (474-483)
12. Han Xu, Shijie Song, China, The survey and research of the participation of enterprises in the practical teaching of secondary vocational school (484-492)
13. Iskandar Muda Purwaamijaya, Rina Marina Masri, Indonesia, Learning Development of Third Engineering Mechanic by Structural Analysis Assisted Computer for Increasing Understanding of Civil Engineering Students (493-502)
14. Johar Maknun, M. Syaom Barliana, Indonesia, Analysis of Teacher Education Institutions (LPTK) Capability To Support Increasing Proportion of Vocational High School (SMK) Students (503-508)
15. Kai Gleißner, Diana Nikolaus, Germany, Teacher training in Indonesia with a focus on Sustainable Development - Concept for a Joint Project between the OVGU Magdeburg and P4TK Medan (509-516)
16. Losina Purnastuti, Indonesia, Does It Pay to Invest in Vocational Education?: An Empirical Evidence from Indonesian Data (517-525)
17. Mohd Ali Jasmi, Mohd Amin Zakaria, Sahul Hamed Abdul Wahab, Malaysia, Perception of Lecturers on Workload in Relation to Effectiveness in Teaching and Learning at Polytechnics (526-533)
18. Mohd Amin Zakaria, Norani Mohd Noor, Mohd Ali Jasmi, Malaysia, Culinary Art Education : A Demanding Profession In Culinary Tourism for Malaysian's New Economy Niche (534-542)
19. Mumu Komaro, Amay Suherman, Yayat, Indonesia, Comparative Study of Improving TVET Student Learning Outcome using Competency-Based Module with Teacher centre at the Initial of a Different Ability (543-550)
20. Norman Lucas, UK, Researching the Learning of TVET teachers in the workplace (551-556)
21. Ramlee Mustapha, Norhazizi Lebai Long, Fouziah Mohd, Malaysia, Career Decision Process among Women in Technical Fields (551-569)
22. Sahul Hamed Abdul Wahab, Mohd Amin Zakaria, Mohd Ali Jasmi, Malaysia, Transformational of Malaysian's Polytechnic into University College in 2015: Issues and Challenges for Malaysian Technical and Vocational Education (570-579)
23. Soeprijanto, Indonesia, The Role of Cooperation Partners to the Implementation of Synergic Partnership Scope in Preparing Vocational Teachers (579-585)
24. ✓ Wahono Widodo, Agus Setiawan, Indonesia, Improving Problem Solving Skill on Prospective Teachers of Vocational School in Foods Programs through "MiKiR" (586-593) ✓

Improving Problem Solving Skill on Prospective Teachers of Vocational School in Foods Programs Through "MiKiR"

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Abstract

Improving problem solving skill on prospective teachers of vocational school through introductory physics course is one of challenging tasks, but it is less studied. The objective of the research was to know the effectiveness of learning model "MiKiR" which integrating of interactive multimedia, collaborative, and reflective thinking on introductory physics course to increase problem solving skill on prospective of vocational school teachers in foods program.

The research used control group pre-test-post-test design. The populations were students of prospective of vocational school teachers in foods program of state university in East Java. The samples were taken by purposive random sampling technique, and then divided into two groups, 35 students on experiment group as well as 33 students on control group. On experiment group, students posed by problems that had to resolved collaboratively. In order to resolve the problems, student learned concepts underlies of the problem through interactive multimedia. After problems were resolved, students reflected the steps of resolving problems. Problem solving test on elasticity, fluids, as well as temperature and heat was used as instrument. Data was analyzed with Mann-Whitney U Test, to compare normalized gain between experiment group and control group

Result showed that integration of interactive multimedia, collaborative work, and reflective thinking on Introductory Physics course was effective to improve the problem solving skills on prospective of vocational high school teachers in foods program.

Keywords: *interactive multimedia, collaborative, reflective, "MiKiR", problem solving skill, prospective of vocational school teachers in foods program.*

1 Introduction

Prospective of Vocational School (VS) teachers in Foods Program Department of Home Economics must take Introductory Physics course. The importance of Introductory Physics course for home economics prospective teachers according to the statement Paolucci [Vaines 1979], that the focus of the home economics are inter-dependencies and inter-relationships between *physical* phenomena and processes of social and cultural influence human development, as well as Cebotarev [1979] stated that basic knowledge of home economics are *physics*, biology, social science, and art, while McElwe [2004] emphasized the importance of understanding *science* as

part of the home economics course. Physics course also can be used to increase generic skills that must be achieved by prospective VS teachers, i.e. logical and analytical thinking, problem solving, and intellectual curiosity [Basset 2004].

Preliminary studies conducted on prospective students 40 vocational teachers at one PKTB universities in East Java showed many problems in physics courses. These problems include the educational background of a heterogeneous student, a negative perception of students of physics, and properties of physics are not in accordance with their interests, resulting less optimal in their learning outcomes [Widodo 2009]. The preliminary study results are consistent with Rauma, *et al.* [2006] which showed 40 of 167 home economics teachers in Finland declared that science education at university level are too abstract and too far from everyday life. On the other hand, the results of McElwe's research [2004] in Ireland showed that third level of home economics students have many misconceptions on the scientific principles used in cooking. These results, follow Gallagher thinking [in Rauma *et al.*, 2006], shows that there are many problems in science-physics education for VS prospective teachers in foods program, concerning the process and results of learning physics courses.

Based on these facts, improving the learning process and outcome on Introductory Physics courses for prospective of VS teachers in Foods Program is needed. One of the efforts undertaken in this research is to encourage students to deepen the concepts of physics through problem-solving activities that apply the concepts of physics in foods. Giancoli [2001] stated the importance of the application of physics concepts in various fields [according to area of expertise of non-physics majors] and that is learned within the framework of problem solving so that students will master these concepts.

Problem solving skill is a higher order thinking skill that need to be achieved by a vocational prospective teacher. According to Cohen [Presseisen 1985], problem solving using basic thinking processes to solve a problem that is known or defined, assembling the facts about the difficulties and find the necessary additional information, or suggest alternatives and test solutions for compliance, simplify explanations and eliminate mismatches, providing solutions for checking the values that can be generalized. Problem solving skills developed in Introductory Physics in general is to present a situation where certain information is given, more often as the numerical values for the variables in the situation, and the value of one variable can be determined. In this context, a person who solves the problem will find the unknown quantity demanded in the statement of the problem, so the problem tends to *well defined*. However, in the context of prospective of VS teachers in Foods Program, physics placed as one of the science underlying the applications in the field of foods. In this context, the ability to apply physics concepts in the field of foods problems is more necessary, and the problem tends to *ill defined* in the context of physics applications in food technology. The model of learning that appropriate to the purposes is problem-based learning (PBL).

There are many crucial factors that influence the success of PBL, such as skills of team-working [Yeo 2007], orienting students to a new instructional strategy, picking the problem, and forming the teams [Peterson 2004]. In the context of the Introductory Physics for non-physics majors, the crucial factors can be elaborated into: 1) the availability of learning resource for students to obtain and study the physics concepts as a basis for problem-solving activities; 2) collaborative setting in order to solve problems; and 3) opportunities for students to reflect on the process and result of problem solving activity.

Information Communication Technology (ICT) can be applied to support in providing learning resources and opportunities for student to reflect his or her problem solving activities. Learning resources to support PBL were selected to provide students the opportunity to study physics at all times necessary, can be repeated by the student until the student understands, can provide quick feedback on student response, and interesting. Interactive multimedia (IM) is an appropriate form for this purpose. Lorenzo [2005] indicates that IM can be used to help student to understand the steps of systematic problem solving. On the other hand, Zheng & Zhou [2006] shows that the IM can help working memory, cognitive capacity, as well as providing a source of cognitive in solving the problem.

Activities in PBL can be held by students individually or in groups. However, according to Gick & Holyoak [Pretz et al. 2003], guidance from the environment can affect the definition or representation that is used for solving the problem. The statement shows that the present social context such as collaborative is useful in increasing of problem solving skills, as shown in the research Nurjanah [2008]. Collaboration in the form of coordinated and synchronized activities will generate the building and sharing common conceptualization of the problem and the procedures followed to solve it. The role of social interaction is central to the teaching and learning science and in various studies, and according to Vygotsky benefit from the interaction to the individual is the integration of knowledge from friends and the environment [Dori & Belcher 2005].

Reflection is a vital component in the process of learning with PBL. Roger [2001] states that reflection is a process that allows student to integrate the understanding gained through experience that allows selecting the option or action better and strengthen the overall effectiveness. Based on the above descriptions, the research focused to know effectiveness of the learning model "MiKiR", which integrating of IM, collaborative work, and providing opportunities for reflection on the Introductory Physics courses in improving problem-solving skills on prospective of VS teachers in Foods Program.

2 Methods

This research used experimental methods, with the *control group pre-test-post-test* design. A group of students selected from the population based on problem solving pre-test score into two groups, namely an experimental group and a control group. Furthermore, the experimental group

was lectured Introductory Physics with “MiKiR” as shown in Figure 1. For this purpose, the IM has been developed on the concept of elasticity and fluid [Widodo & Liliyasi 2009] as well as temperature, heat, and heat transfer. For collaborative working purpose, the Students Activity Sheets which contain problems and “hint” to solve the problem have been developed [Widodo & Setiawan 2008]. The problems were designed to be solved through the application of physics concepts in foods. For example, “Devise ways to determine the crispy of food. Test your design”. To facilitate reflection, students were encouraged to discuss about the process of resolve the problems. Beside that, student was encouraged to upload his/her artefacts on his/her e-portfolio while made comments to the process and result of the resolving problems. In the control group, students learned Introductory Physics conventionally (ordinary Introductory Physics course), i.e.: lecturing activities, recitation sessions, and home working.

The population of the study was students of prospective of VS teachers in Foods Program on a state university in East Java. Samples were taken with purposive random sampling technique. Only students in Introductory Physics course on semester I 2009/2010 selected as the samples. Based on pre-test score, samples were selected randomly and then divided into two equality groups: experimental (35 students) and control (33 students).

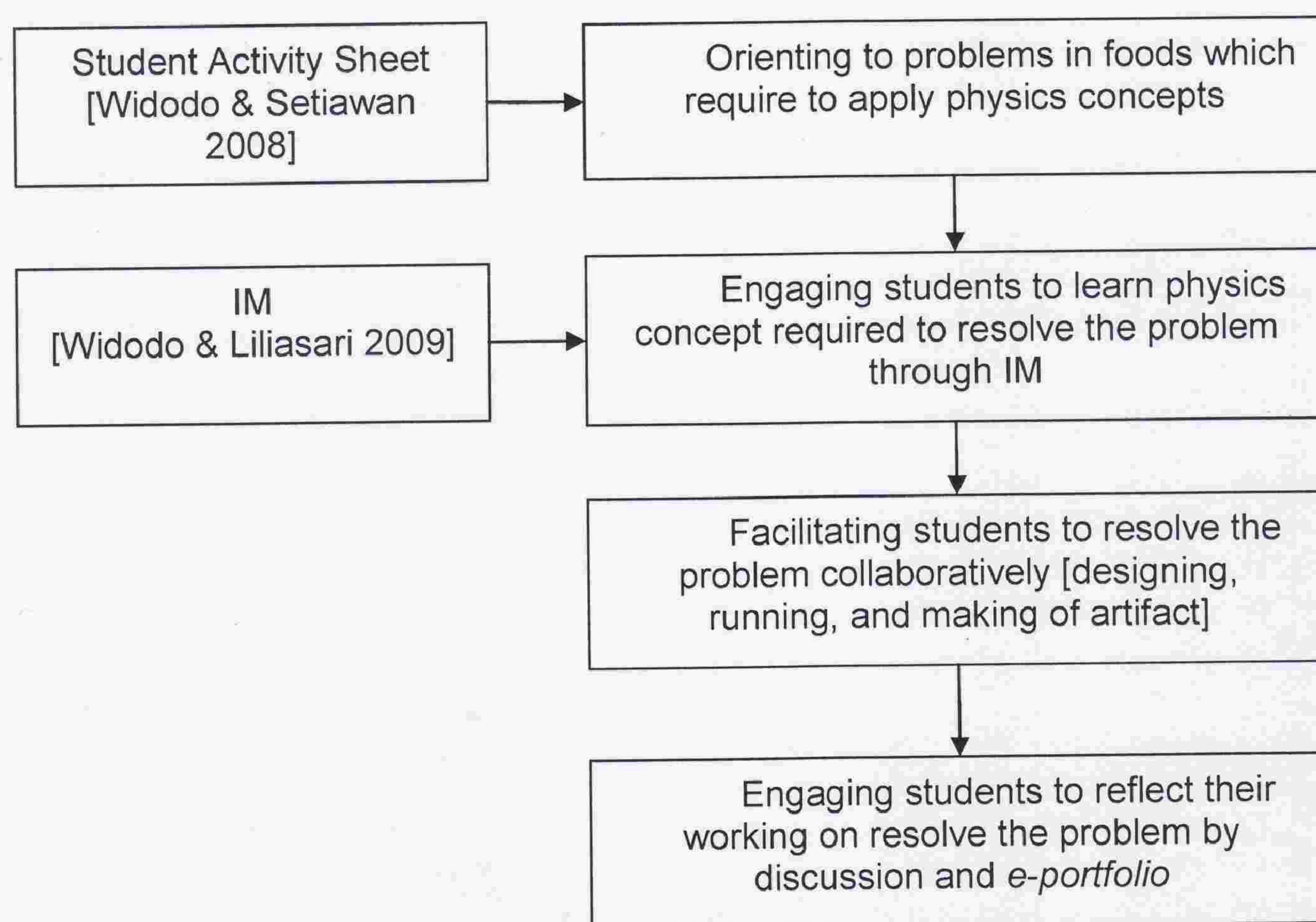


Figure 1: The phases of “MiKiR” on experimental group

Instrument of the study was problem solving test on elasticity, fluid, as well as temperature, heat, and heat transfer concepts. Problem solving test was objective test with five options, based on steps of problem solving indicators developed by McGregor [2007]. Based on expert judgment, test items can measure indicators of problem-solving. Based on the trial, reability of the instrument

[alpha cronbach] is 0.843 for 35 items. Adding with two repaired items, tests composed of 37 items. The effectiveness of the course were tested with a difference test on normalized gains (N-gain) according to Hake [1998] between the control group and experimental group using the U Mann-Whitney test.

3 Result and Discussion

Figure 2 shows the summary of the average problem-solving test scores for the control group and experimental group, and percentage N-gains for the two groups. The average problem solving pre-test at the control group was 25.1% (standard deviation = 5.26%), while the average posttest was 37.0% (standard deviation = 8.81%), with an average N-gain of 15.3%. On the experimental group, average problem solving pretest was 25.0% (standard deviation = 7.01%), average posttest was 58.6% (standard deviation = 12.87%) with the average N-gain was 44.1%. Based on Hake's criteria [1998], the control group's average N-gain was "low" category, while "medium" category in the experimental group.

Based on the difference test to N-gain mean between the two groups using the U Mann-Whitney test, it was obtained $Z = -6.149$, so that H_0 was rejected to a significance level of 0.000. As a consequence H_A : there are differences in N-gain mean between the control group and experimental group, accepted. Because of experimental group's N-gain mean was greater than control group's, it can be concluded that the integration of IM, collaborative work, and reflective thinking on the Introductory Physics lecture was effective to improve problem solving skills on prospective of VS teachers in Foods Program.

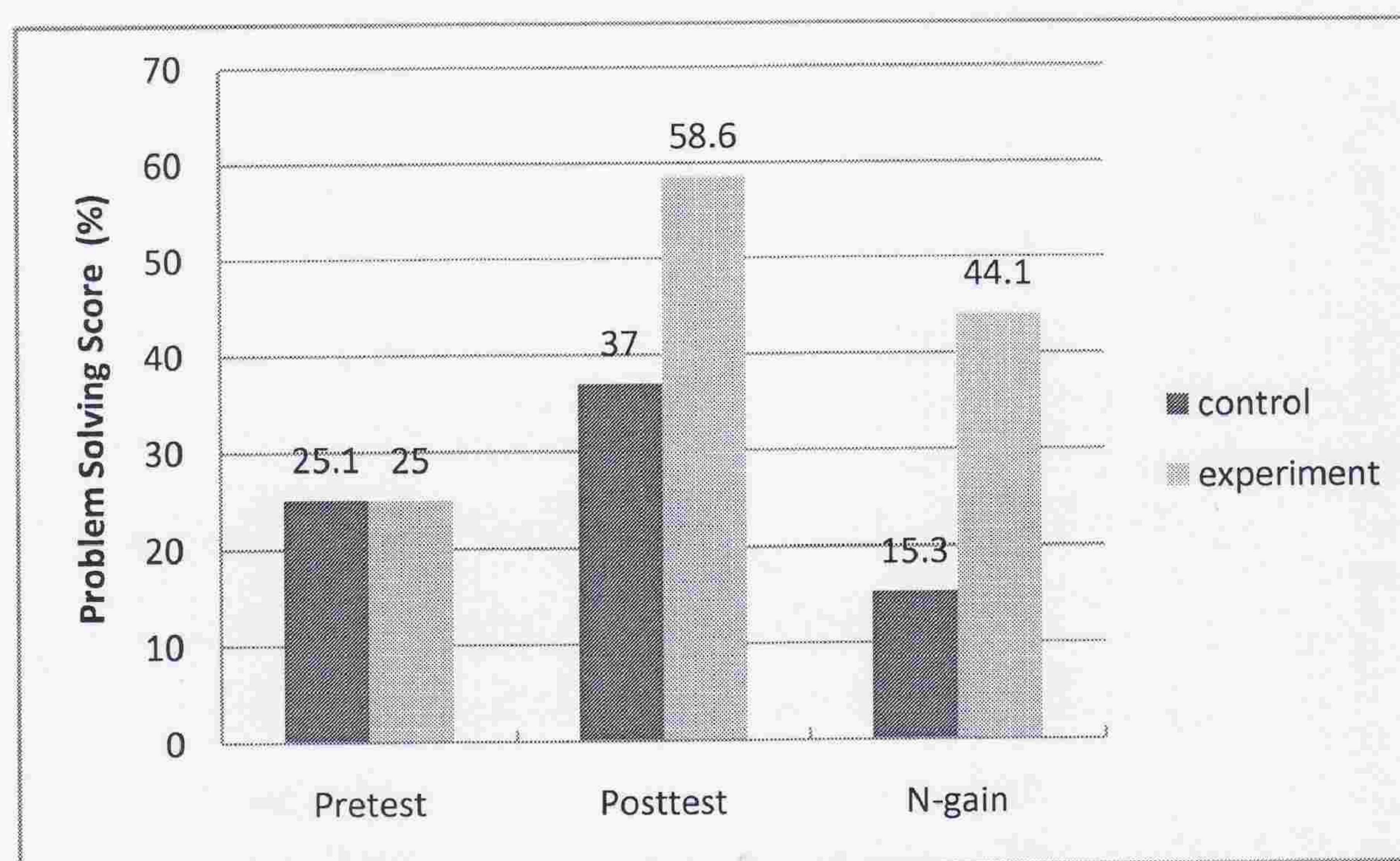


Figure 2: The average score of pre-test, post-test, and N-gain of the overall problem-solving aspects of the experimental group and control groups.

Furthermore, the difference of each aspect of problem solving skill is considered. As Figure 3 shows, it appears that all of problem solving skills aspects in both groups were increase after

Introductory Physics course. However, the increase in the control group based on Hake's criteria [1998] only into "low" category, except on "Clarifying of the problem" that lied on "medium" category. All of problem solving skills aspects of the experimental group lied on "medium" category.

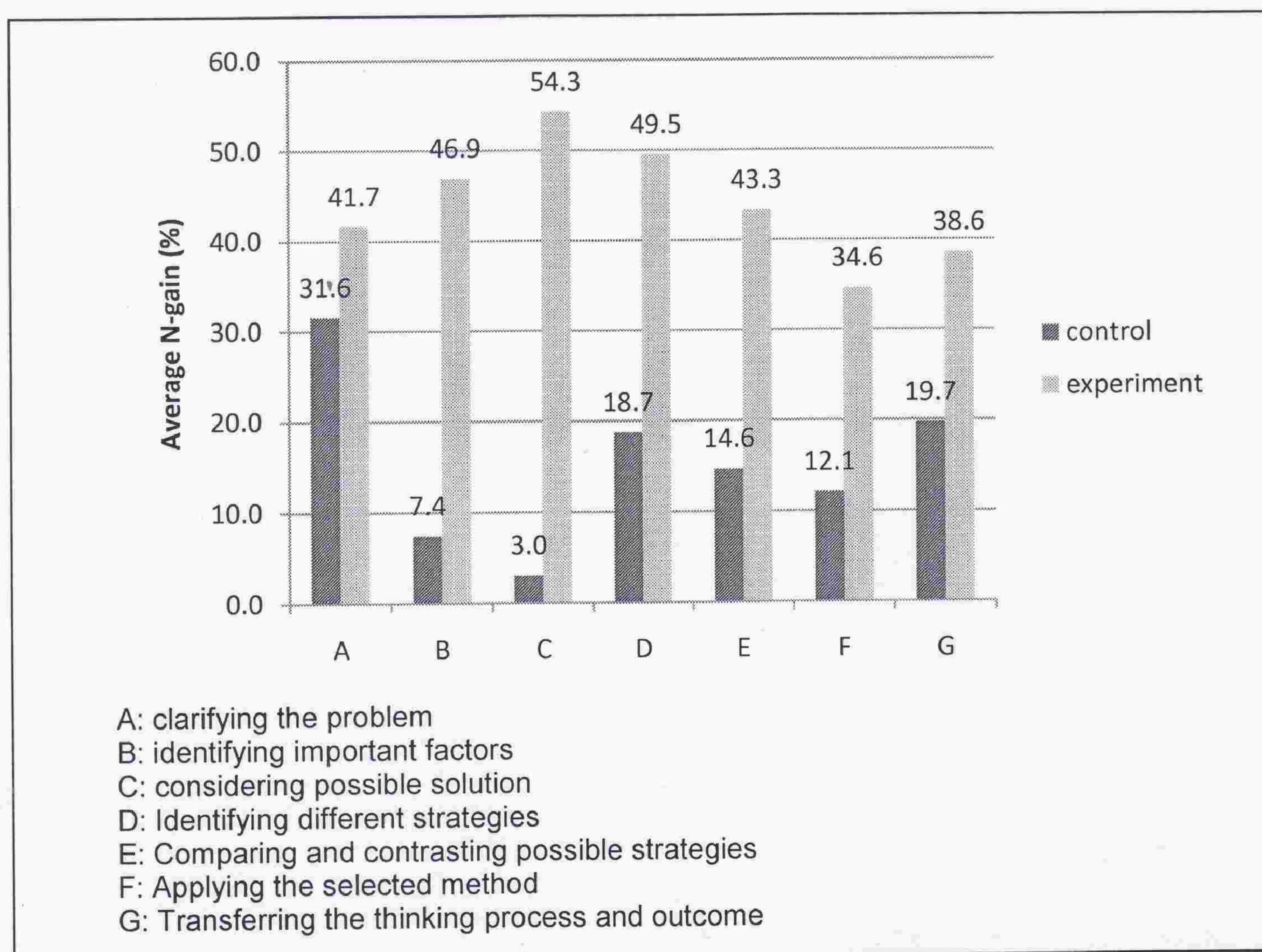


Figure 3: The average N-gain of each aspect of the problem-solving on experimental groups and control groups

Table 1 shows the recapitulation of the difference test of N-gain of the seven aspects of these problem solving skills. Based on Table 1, it can be known that on indicator of clarifying of the problem, there is no difference between the two groups. The Introductory Physics course on both groups does not make a difference on clarifying of the problem. This could be because this aspect according to McGregor [2007] only uses a "simple analysis" of cognitive skills, which are also achieved in conventional lectures. There were differences in N-gain [for $\alpha = 0.05$] between the two groups on the following aspects: 1] identifying important factor; 2] considering possible solutions; 3] identifying different strategies; 4] comparing and contrasting possible strategies; 5] applying the selected method; as well as 6] transferring the thinking process and outcome.

Table 1 The Summary of Difference Test of the Problem Solving Skills Aspects

	Clarify	Identify	Alt. Cons	Str. Identify	Comp. Str.	Apply	Transfer
Mann-Whitney U	519,500	177,500	207,500	314,500	295,000	313,000	402,000
Wilcoxon W	1080,500	738,500	768,500	875,500	856,000	874,000	963,000
Z	-,725	-4,930	-4,634	-3,309	-3,653	-3,260	-2,228
Asymp. Sig. [2-tailed]	,468	,000	,000	,001	,000	,001	,026

The results of data analysis showed that the combination of IM, collaborative work, and reflective thinking in the Introductory Physics lecture effectively to improve problem-solving skills on prospective of VS teachers in Foods Program. The results enrich Dori & Belcher [2005] that combines visualization and simulation of physics with group interaction improved students' cognitive abilities. If compared, this study is more specific to the effort to improve problem-solving skills, and provides students the opportunity to reflect on his or her working to resolve the problem. These results also reinforce the findings of Zheng & Zhou [2006], that IM can provide cognitive resources that play a role in solving the problem. This research is also consistent with Nurjanah [2006] that collaborative learning can assist in problem solving skills training. Collaboration that occurs in the course was coordinated and synchronized activities to build and share a common conceptualization of the problem and the procedures followed to solve it. These results also reinforce the opinion of Roger [2001] who states that reflection is a process that allows student to integrate the understanding gained through experience that allows selecting the option or a course of action the better and strengthen the overall effectiveness.

4 Conclusion

Based on the results of data analysis can be concluded that the Introductory Physics courses that integrate IM, collaborative work, and reflective thinking which called "MiKiR" can significantly improve problem-solving skills on prospective of VS teachers in Foods Program. The future reseach could be held to test the model for another of prospective vocational teachers, including examining the motivation, responses, and student attitudes toward physics courses after the application of this model.

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This is to certify that

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**“Competence Development for the World of Work
and for Sustainable Development”**

Bandung, November 10th and 11th 2010

Organized by

**Faculty of Technical and Vocational Education
Indonesia University of Education**

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