

# THE DEVELOPMENT OF INTERACTIVE MULTIMEDIA ON INTRODUCTORY PHYSICS LEARNING FOR PROSPECTIVE OF VOCATIONAL HIGH SCHOOL TEACHERS IN FOODS PROGRAM

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## ABSTRACT

*The research was part of ongoing research, aimed to develop an interactive multimedia (IM) on the Introductory Physics courses to support the learning model that can develop problem solving skills and application of physics concepts for prospective of vocational high school teachers in foods program.*

*The research used Research and Development (R & D) approach by using the first three stages of 4-D models, i.e. define, design, and develop. The details of the stages were: (1) the literature review and need assessment, (2) formulation of competences indicators, (3) formulation of learning model, (4) formulation of the IM design, (4) the development of story boards, (5) obtaining relevant files, video, graphics/animation, and audio production, (6) authoring and debugging, (7) phase I try out, (8) revision I, (9) expert judgment, (10) Phase II try out, and (11) revision II. For testing purposes, the research subjects were prospective of vocational high school teacher in foods program on a state university in East Java. The sample selected by purposive random sampling technique. Data analysis performed by descriptive analysis and Mann-Whitney U test to compare the sample responses results of phase I and phase II try out.*

*The research has developed IM in elasticity and fluid concepts. The research showed that according to student responses, the IM assessed 94.8% of the ideal conditions in stage I and 96.0% in stage II. The significant improved responses occurred in sub concept "stress and strain" and "Young's modulus". The research also showed that expert judged 85.6% of ideal conditions on the content, technical and presentation of IM. These results indicate that IM has been developed appropriates for use in teaching and learning Introductory Physics for prospective of vocational high school teachers in foods program.*

**Keywords:** *interactive multimedia, introductory physics, prospective of vocational high school teachers in foods program.*

## INTRODUCTION

Physics is a science that underlies the development of technology, so that engineering students need to learn physics. Prospective of Vocational High School (VHS) teachers in foods program Department of Home Economics, Engineering Faculty, are also received the physics course (Introductory Physics or applied physics). The importance of Introductory Physics courses for home economics prospective teachers according to the statement Paolucci (in 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)

which states 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.

One of Introductory Physics courses goals on prospective of VHS teachers in foods program is to develop the adaptive ability in science and technology. These capabilities include the application of physics concepts in foods, problem-solving skills, and generic skills in science. However, the results of preliminary studies conducted on 40 prospective of VHS teachers in foods program at a university in East Java showed many problems in Introductory Physics courses in order to achieve these goals. These problems include the educational background of heterogeneous students, negative students' perceptions on physics and physics is not in accordance with their interests, resulting less optimum in their learning outcome (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 VHS prospective teachers in foods program, concerning the process and results of learning physics courses.

Based on these facts, improvement efforts are required in Introductory Physics courses for VHS teachers in foods program, by applying the learning environment that provides students the opportunity to study physics at all times necessary, can be repeated by the student until he or she understands, can provide quick feedback on student response, and attractive. The technology that can be used for that purpose is information and communication technology (ICT), with considerations that student has easy access to computers, both at the laboratory or on elsewhere. There are several alternative utilization of ICT to support the Basic Physics lecture, i.e. e-learning, virtual reality, and interactive multimedia (IM). Based on the study of the advantages and disadvantages of the three alternatives, IM selected as one of the Introductory Physics courses elements.

In general, multimedia means using multiple media including text, graphics, animation, images, video, and sound to present information (Ivers & Barron, 2002). At present, "hyper" environments, such as hypertext and hypermedia, have added to the complexity and sophistication of multimedia's definition by providing electronic, nonlinear approaches to moving through a body of information. The environment "hyper" have added to the complexity and sophistication of multimedia's definition by providing electronic, nonlinear approaches to moving through a body of information. Combining these elements results in greater comprehension, recall, and inference,

effectively accommodate students with diverse learning and cognitive styles, and hypermedia applications are better suited to transmitting knowledge that is not easily conveyed through print or verbal explanations ((Ivers & Barron, 2002). Both hypertext and hipermedia are a subset of multimedia. By combining traditional elements of multimedia, Gayeski (1993) defines computer-based multimedia as "a kind of interactive communication systems computer controlled, which create, store and display text information over the network, graphics, and audio". In other words, a multimedia involving computer-based presentation of various media formats (eg text, images, sound, and video) to convey information in a linear or nonlinear format.

Computer technology can add the feature "interactive" in the multimedia, the media sensitivity to user response. Based on the results of the study on previous studies, Finkelstein et al. (2006) identified interactive multimedia simulation characteristics that supports the learning of physics students: (1) an engaging and interactive approach; (2) dynamic feedback; (3) a constructivist approach; (4) a workspace for play and tinkering; (5) visual models / access to conceptual physical models; and (6) productive constraints for students.

Based on utilization of IM researches, it can be identified that IM in Introductory Physics courses could improve the understanding of basic physics concepts (Dori and Belcher, 2005), increased the mastery of concepts of physics teacher candidates (Darmadi et al., 2007; Gunawan et al., 2008), tackled basic physics student's misconceptions (Muller & Sharma, 2007), improved critical thinking skills of prospective teachers of physics (Budiman et al., 2008) and physics teacher (John et al., 2008), as well as generic skills in science teaching physics (John et al., 2008). IM worked in Introductory Physics courses because students are more active and independent (Darmadi et al., 2007), the IM computer animation can visualize abstract processes that are impossible to see or imagine (Burke, in Gunawan et al., 2008), capable to repeat serving required information, given students the freedom to choose and track materials, and student was guided to learn, think, discover and construct knowledge independently through interactive questions presented by the rapid response (Budiman et al., 2008). Based on the above descriptions, the research focused to know how the development of IM on Introductory Physics course for prospective VHS teachers in foods programs, how feasibility of the IM developed, and how student responses to the IM developed.

## **METHOD**

The research utilized the three stages of 4-D model according to Thiagarajan et al. (1974), i.e: define, design, and develop. The stages were detailed in accordance to the development of multimedia projects by Ivers and Baron (2002), shown in Figure 1.

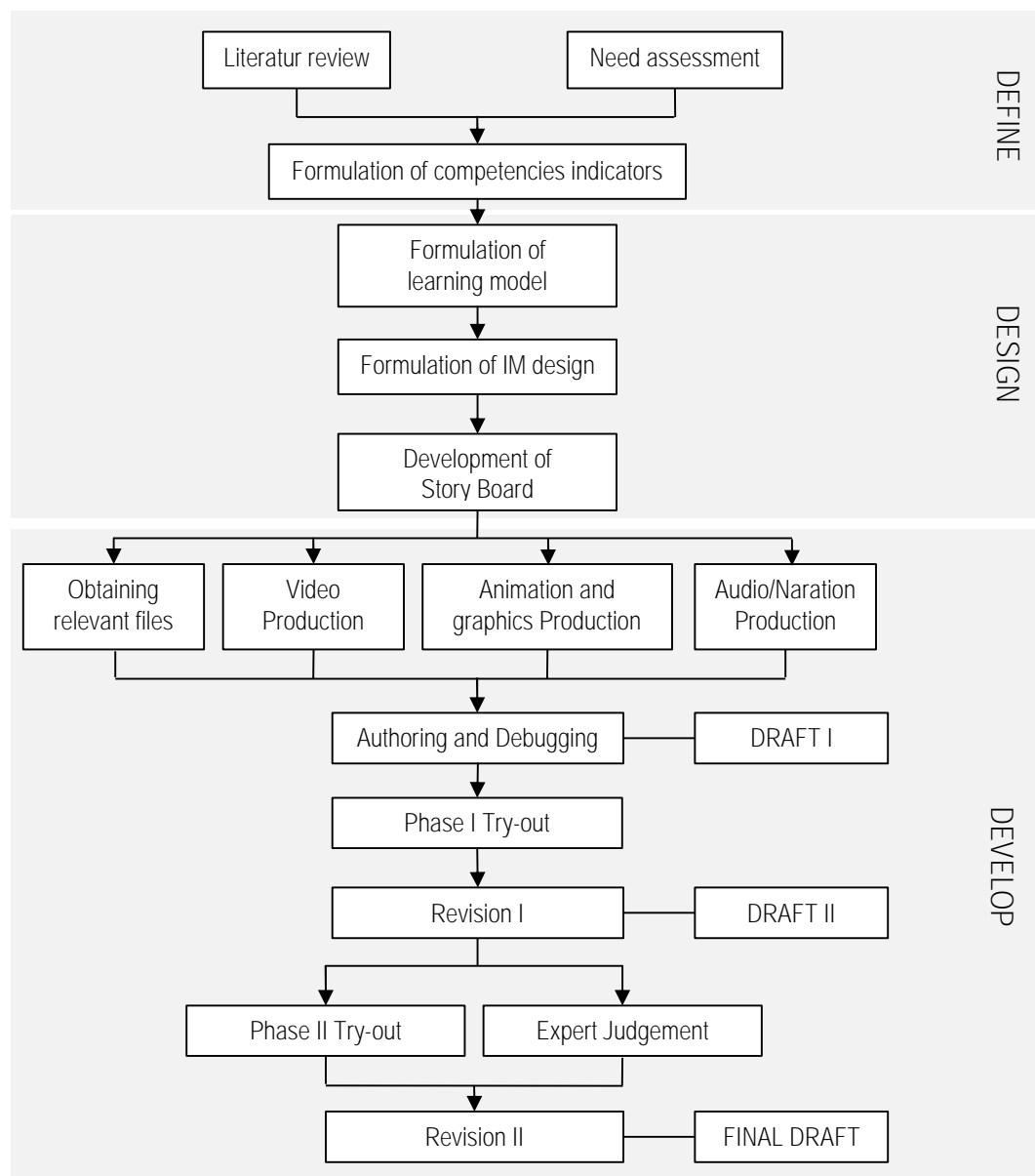


Figure 1. Research steps

Literature review conducted to identify the application of physics concepts in foods technology, including from *Food Physics* (Figura & Teixeira, 2007). Need assessment was performed to match the level of complexity of the concept to the student ability. The results of the two steps are used as consideration to formulate indicators of competences. The indicators are used as the basis for the preparation of the learning model that involves the application of IM in the model.

After the designing of the IM display, the IM scenario in the form of story boards was created. The creating of the IM's story board considered constructivist learning. In general, the story board is designed to follow: introduction of the concept, quantitative or qualitative activities by user to

discover the attributes of concept, mathematical formulation of the concept, examples of solving problems involving the concept, and problem-solving exercises.

Based on the scenarios, the development phase conducted which includes searching and selection IM files and java applets that have developed other researcher, video production, graphics production and animation, and audio production. After that, files, text, video, animation, graphics, and audio were integrated into IM, by means of an authoring program and ensure IM produced was running well. Macromedia Director MX 2004 program was used to authoring the IM, with the consideration of the program can display extension-JAR files, as well as has flexibility like Macromedia Flash MX 2004 has.

For the IM testing purposes, the population was all prospective of VHS teachers in foods program, Department of Home Economics, at a state university in East Java. The sample selected by purposive random sampling technique. The tryout was used to determine how students respond to the IM that have been produced and to determine the feasibility of the IM from the users (students), by means of questionnaire. Tryout I was conducted to the Draft I IM. Based on tryout I results, revision then had been made, including re-production of IM components if necessary. As a result was the Draft II IM. Tryout II conducted and expert judgment was done to determine the feasibility of the IM as well as for improvements based on students and experts suggestions. Expert judgments carried out by physics education expert, IM expert, IM learning specialist, and learning technologist. Expert judgments conducted by rubrics that developed by adapted the multimedia project evaluation rubric of Ivers and Baron (2002). The tryout data and expert judgments is analyzed with descriptive analysis to find the percentage score of responses to ideal score, as well as inferential analysis with the nonparametric U Mann-Whitney test to compare of student scores means on both tests.

## **RESULTS AND DISCUSSION**

The IM developed in the study includes two basic concepts: elasticity and fluid. The IM was packaged in a compact disc that can be directly run on Windows-based computers that have been installed Java and Quick Time programs. Both these programs can be downloaded freely, and are included in the disc.

### **1. Features of The IM**

The general structure of the IM is main menu, content, problem-solving exercises, and help. The links is done by clicking: label concept (the menu), questions or tasks that allow the user interactively select or do something (clicks and / or drag), the refresh button, next, back, and exit. In order to the IM is more familiar to users, the friendly character named “Kika” also created. “Kika” gives assistance if users found a problem. The concept presented at the IM by way of

introducing the concept including the possibility of its application in foods, then allowing user to perform activities of thinking (by doing a click or drag to answer questions or do something) therefore the user has a mental picture of the variables that affect the concept on his or her working memory. The mental picture is further elaborated in the form of a standard mathematical formulation of the algebra Introductory Physics. After that, users are given the opportunity to try the example of problem solving, and ending with problem-solving exercises related to that concept. Figure 2 shows examples of the activities of thinking.

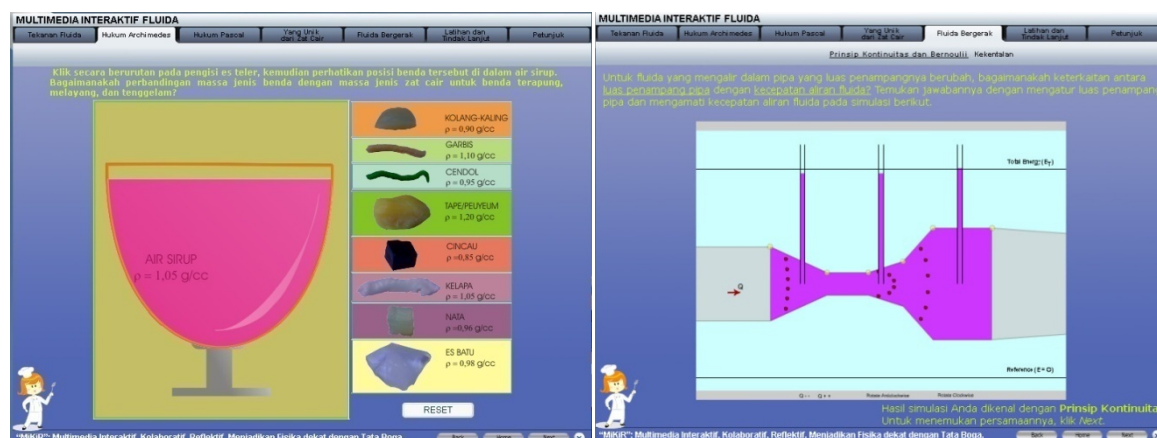


Figure 2. The examples of the IM “Fluid” display. User does thinking activity by mean of questions or interactive tasks.

## 2. Tryouts Results

Phase I Tryout conducted on 28<sup>th</sup> to thirty-first of July 2009, with respondents of 10 students. After the improvement based on the Phase I Tryout, then conducted Phase II Tryout (performed on second to 10<sup>th</sup> of September 2009). Respondents of Phase II Tryout were 8 students on the IM “Elasticity” and 13 students on the IM “Fluid”. In the tryout, students learned the concept of elasticity and fluid by using the IM. At the end of the session, the students filled out questionnaire of the IM quality and provide suggestions for the IM improvement. The student’s response included content of each sub-concept and help menu. For contents, the responses was addressed whether the content easy to understand, the ease of image / animation / video to understand, easy to operated the IM, whether the links worked, and clarity of narration. For help menu, the response includes help menu display, help menu contents, the ease of help menu understanding, and clarity of help narration. Table 1 shows the summary of students’ responses data analysis on the IM “Elasticity”.

Table 1: Summary of Students' Responses Data Analysis on the IM "Elasticity"

Scores on Menu (sub-concepts)	Stress & Strain		Hooke Law		Young Modulus		Breaking Point		Help	
	Mean Score	% from ideal	Mean Score	% from ideal	Mean Score	% from ideal	Mean Score	% from ideal	Mean Score	% from ideal
Phase I Tryout	3.77	94.3	3.8	95.0	3.62	90.5	3.92	98.0	3.97	99.3
Phase II Tryout	3.93	98.3	3.71	92.8	3.85	96.3	3.89	97.3	3.96	99.0
Z value from U Mann-Whitney test		-2.453		-.656		-2.096		-.610		-.163
p value from U Mann-Whitney test		.016*		.573		.043*		.633		.965

Table 1 show that the average score of student's responses to each menu elasticity nearing ideal score (score 4) on the Phase I Tryout and the Phase II Tryout. Students' suggestions from Phase I Tryout were used to improve the IM, resulted in increased scores significantly (at the 0.05 level) in the sub-concept of stress-strain and Young's modulus. The other sub-concepts had no change in responses score significantly, but the scores have been close to ideal scores in both trials.

The summary of data analysis of the two tryout for MMI "Fluid" is shown at Table 2. Based on Table 2 is known that every sub-concepts have approached ideal score both of the tryout. The improvements based on student's suggestions from the Phase I Tryout did not generate a response score increased significantly, because of these scores have been close to ideal. The total average score of student responses to the MMI is 3.79 (94.8% of ideal) on the Phase I Tryout and 3.84 (96.0% of ideal) on the Phase II Tryout.

Table 2: Summary of Students' Responses Data Analysis on the IM "Fluid"

Scores on Menu (sub-concepts)	Pressure		Archimedes Principle		Pascal Principle		Liquid		Motion Fluid		Help	
	Mean Score	% from ideal	Mean Score	% from ideal	Mean Score	% from ideal	Mean Score	% from ideal	Mean Score	% from ideal	Mean Score	% from ideal
Phase I Tryout	3.76	94.0	3.80	95.0	3.82	95.5	3.61	90.3	3.86	96.5	3.79	94.8
Phase II Tryout	3.82	95.5	3.83	95.8	3.86	96.5	3.78	94.5	3.82	95.5	3.78	94.5
Z value from U Mann-Whitney test		-1.380		-.804		-.130		-.922		-.973		-.293
p value from U Mann-Whitney test		.186		.446		.927		.376		.376		.832

### 3. Expert Judgment

Expert judgment conducted by 4 experts (1 expert in physics learning, multimedia expert 1 person, 1 person multimedia learning experts, and 1 educational technology expert). The expert judgment was done on the Draft II IM. They judged on the IM's content, technical, and presentation. Table 3 shows the summary of data analysis of the expert judgment, including percentage of the average score to the ideal score (score 3).

Table 3: Summary of Expert Judgment

Concept	Content		Technical		Presentation	
	Mean score	% from ideal	Mean score	% from ideal	Mean score	% from ideal
Elasticity	2.5	83.3	2.8	93.3	2.4	80.0
Fluid	2.5	83.3	2.8	93.3	2.4	80.0

Table 3 shows that from the content, technical, and presentation, the mean score of the experts ranged on the range of 80.0% to 93.3% from ideal conditions. The total mean score of expert judgment is 2.6 or 85.6% of the ideal score. These results indicate that according to expert assessment, the IM is appropriate for use.

#### 4. Discussion

The positive response of students and expert judgment to the IM developed shows that the steps of IM development using 4-D model of Thiagarajan, et al. (1974) which combined with the development of multimedia projects by Ivers and Baron (2002) can produce appropriate IM. The student's responses in line with Marr and Okolo & Ferreti finding (in Ivers and Baron, 2002), that multimedia can enhance students' motivation to learn.

The combination of video, audio, photos, graphics, text, and interactive questions that can be controlled by the user were responded positively by students. The results are consistent with Lawless and Stuart (2001) who stated that all interviewed students after using IM gave positive responses about their experience of working through multimedia activities, and they were particularly keen about the interactive nature of activities. These results are in line with the Srinivasan and Crooks (2005) statement, that IM is useful only if it is interactive and allows users to control it. These findings are also relevant to the statement of Finkelstein et al. (2006), that the IM with engaging and interactive approach, also dynamic feedback approach will supports the learning of physics students.

## CONCLUSION

Within the framework of research and development (R & D), combining 4-D model with the steps of multimedia project can be used to develop IM on concepts of fluid and elasticity. The steps

include: (1) the literature review and need assessment, (2) formulation of competences indicators, (3) formulation of learning model, (4) formulation of the IM design, (4) the development of story boards, (5) obtaining relevant files, video, graphics/animation, and audio production, (6) authoring and debugging, (7) phase I try out, (8) revision I, (9) expert judgment, (10) phase II try out, and (11) revision II

Students responded positively to the developed IM. Average student response on the whole concept / menu MMI was 94.8% of the ideal response in the Phase I Tryout and 96.0% from the ideal response in the Phase II Tryout, which shows the IM are appropriate. Increased student responses significantly occur in the sub-concept of "stress and strain" and "Young's modulus". Expert judgment on content, technical, and presentations of the IM reached 85.6% of ideal conditions. These results indicate that the developed MMI fit for use as part of the Introductory Physics courses for prospective VHS teachers in foods program.

Further research can be done by applying the IM on the Introductory Physics courses to obtain empirical data on the effectiveness of the IM in improving problem-solving skills and application of physics concepts on prospective VHS teachers in foods program.

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