Collaboration skills-based multimedia-based integrated instruction (CS–MBI\textsubscript{2}): a development study on refraction concept

Y C Setiawan*, A Samsudin, E Suhendi, H Novia, I Kaniawati, D T Chandra and P Siahaan

Departement of Physics Education, Universitas Pendidikan Indonesia, Bandung, Indonesia

*Corresponding author’s e-mail: yusachavez_2014@student.upi.edu

Abstract. Development of physics interactive multimedia is still rarely found, especially regarding to collaboration skills enhancement. This study is having a purpose to develop a Multimedia-Based Integrated Instruction (MBI\textsubscript{2}) that expected to define student’s collaboration skills profile. Researcher uses Sadiman’s model of development research method which consists of identifying students need, formulating instructional objective, formulating learning materials, developing evaluation instrument, producing, and revising. As a research sample, thirty-three eight grader students in Bandung are being involved in this study. Result shows each profile of student’s collaboration skills respectively 3.30; 3.06; 3.82; and 2.70 (by maximum student’s achievement score of 4). It can be concluded that development of Multimedia-Based Integrated Instruction (MBI\textsubscript{2}) research is capable for defining junior high school student’s collaboration skills profile on refraction concept.

1. Introduction

In our twentieth first century, students or as we say learners are needed to learn not only science and social studies, but they also need some abilities or skills for their professional career in the future. The 21\textsuperscript{st} century work fields demand Information Technologies awareness in employee’s basic skills as we know that technology is now an integral part in our lives. This Information Age labor needs a new combination of skills. Careers that need repetitive or routine manual and intellectual skills are more unwanted to careers that involving advanced levels of knowledge and practical skills similar to adept thinking and complex communicating [1].

Every skilled worker needs to develop communication skill for communicating each other. The growing demand for greatly skilled workers as well means that there will be an increasing wages gap between less educated, quite unskillful labors and very educated, greatly skilled labors. Repetitive tasks are progressively being automated, and the repetitive works still done by individuals barely rewarded a living wage. The main focuses and interdisciplinary 21\textsuperscript{st} century themes are encircled by three sets of skills best in demand in the 21\textsuperscript{st} century; Information and communication skills, Thinking and problem-solving skills, and Interpersonal and self-directional skills [2].
Computer assisted multimedia is able to transport information simply and quickly. In general, the computer media used by teachers in schools is just restricted on Power Point program to enhance students’ understanding of the concept [3]. Development of multimedia is able to facilitate the self-directional skill and interpersonal skills. Researchers began to develop Multimedia-Based Integrated Instruction (MBI₂) to answer the problem. Furthermore, this media consists of curriculum, learning material, e-book, Student’s project report, and evaluation test.

Many multimedia implementations in the science field of study don’t include developing student’s skill improvement; some of them begin to conduct 21st century skills as focus development. This study takes a step toward multimedia development in defining student collaboration skills. This Multimedia-Based Integrated Instruction (MBI₂) was being implemented in physics learning, especially on refraction concept. Researchers choose refraction concept as focus study to complementing another previous study in reflection and optics. Refraction concept explains how lights behave when moving from two different medium, as that lights travel slower in a denser medium following equation 1[4].

\[ n_1 \sin \theta_1 = n_2 \sin \theta_2 \]  

The aim of this research is to define of students’ collaboration skill profile on the refraction concept on the eighth grades junior high schools using the Multimedia-Based Integrated Instruction (MBI₂) in the learning process.

2. Methods

2.1. Participant

This study conducted in the eighth grader student from Junior High School in Bandung. 33 students are involved in this study as participant as research objects using purposive sampling without any control, as researchers’ reason that impossible to achieve two equal classes to be compared. Every student divided by groups that consists by four to six students, each group has one observer who has task to evaluate each student collaborative skill profile in the same group.

2.2. Design

The research design which is used by researchers in developing this media is Sadiman’s model of development research method [5]. This method consists by six main stages: identifying students need, formulating instructional objective, formulating learning materials, developing evaluation instrument, producing, and revising.

2.3. Instrument

To measuring and defining the profile of student’s collaboration skill from 4C’s 21st Century Skills [6], four aspects were adapted from P21’s Twenty First Century Skills Rubric [2] and another research from International Reading Association [7]. It consists of respect and teamwork, participation and contribution, time management, and responsibility.

2.4. Data analysis

After student’s collaboration skill scored by observers, data were analyzed by calculating students total score for each four aspect, and calculating its average score, this data then categorized by four criteria; below expectation; meet expectation; reach expectation; and above expectation.
3. Results and Discussion

In this section, researcher will explain this study result in details for each stage of development. Based on Sadiman’s model of research development, result and discussion will be explained in six parts, another research that related to this research is included in discussion.

3.1. Identifying students need

In the first stage of development, researcher must know what students need most to advance their 21st century skills. Researcher reasons that from the past study that it turned out that the students still do not fully understand the concept of reflection of light and never doing practical work in groups. Students are still very difficult to describe the mirror images [8] so we move forward to the next subject, the refraction concept. In further research, cooperative or collaborative learning were included as a potential solution for minimizing student’s misconception [9].

3.2. Formulating instructional objectives

Researcher establishing some instructional objectives so we know what student accomplished from learning. The following Instructional objectives are listed: Students can determine how light behave when travels through two different mediums; Students can identify properties of object’s shadows in convex and concave lens refraction.

3.3. Formulating Learning Materials

On this multimedia, Curriculum that used is adapted from National Curriculum. Refraction concept divided by two sub-concepts that delivered in a series, 1) refraction and 2) lenses. Refraction sub-concept describing how lights bend when travel through different medium, refraction index. Lenses sub-concept describing how shadow formed from an object’s light travel through convex or concave lens refraction.

3.4. Developing Evaluation Instrument

From the first set of 21st Century Skills, the collaboration skills were used as the main focus of this media development. Four aspects of collaboration skills taken as indicator to measure student’s collaboration skills profile such as respect and teamwork, participation and contribution, time management, and responsibility. Each aspect has four scoring criteria by a number 1 to 4. The criteria were adapted from P21’s Twenty First Century Skills Rubric [2].

| Total Score (x) | Categories          |
|-----------------|---------------------|
| 1 ≤ x < 2       | Below Expectation   |
| 2 ≤ x < 3       | Meet Expectation    |
| 3 ≤ x < 4       | Reach Expectation   |
| 4                | Above Expectation   |

3.5. Producing

On this main stage of developing, researcher designing MBI2 with main purpose achieving students contextual learning in refraction concept in help of MBI2, so we take further research make it such a complete learning experience and to make refraction concept easy to understand by students. The multimedia is independently developed by researcher using Adobe Flash.
Figure 1. Home page of MBI2 on refraction concept. Six menus including guidebook, curriculum, learning materials, student’s project worksheet, e-book, and evaluation test.

Figure 2. Example Simulation of light refraction through different medium. Laser lights travel through air and water medium.

Figure 3. Example Simulation of object’s shadow formed through convex lenses. Showing three available sub-concept menus on the left in order from above; refraction, convex lens refraction, and concave lens refraction. This scene simulates how lights travel from object through convex lens forming object’s shadow with real, inverted, minimized shadow’s properties.

This multimedia has been implemented in research object class consisted 33 students. Observers begin to assessing student collaboration skill since beginning of teaching session. Data collected for observers are analysed to recap student’s collaboration skills profiles.

Table 2. Student’s collaboration skills profiles.

| Collab. Aspect          | Student Average Collab. Score | Categories          |
|-------------------------|-------------------------------|---------------------|
| respect and teamwork    | 3.30                          | Reach Expectation   |
| participation and contribution | 3.06                      | Reach Expectation   |
| time management         | 3.82                          | Reach Expectation   |
| responsibility          | 2.70                          | Meet Expectation    |
Data analysis shows three of four aspects reach collaboration skill rubric expectations. This finding being supported by Hermawan on conclusion that MBI₂ can be used to measuring collaboration skill profiles on reflection concept [3]. This research has similar aspect that conducted by Hermawan such as contribution, time management, and working with other (which has a similar meaning with respect and teamwork aspect in this research) [3]. Another research conducted by use of computer simulation in collaborative learning model has a potential to minimizing students’ misconceptions among other factor, such like accomplishment and failure of learning experience [10, 11].

3.6. Revising
On the process of making the final product of MBI₂, many changes have been done by researcher to make finest and comprehensive learning media including media design and learning material and animation of simulated

![Figure 4. Example Simulation of lights from flashlight in the left refracted through concave lenses. (a) Before revising, concave lens painted as thick slab glass. (b) After revising, concave lens painted as thin glass following lens refraction is based on thin lens concept, removing its misconception.](image)

On the final stage of development, MBI₂ need revising end enhancement to improve students understanding of refraction concept. A step by step progress was preceded such as revising instructional objective and learning materials. Researcher realizes that this MBI₂ still need more development in the future.

4. Conclusion
Based on data analysis, it can be concluded that the development of Multimedia-Based Integrated Instruction (MBI₂) on the refraction concept using Sadiman’s model of research development is capable to defining the profile of collaboration skills of Junior High School students.

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