A Pilot Study: Can Interactive Projectors Enhance Students' Performance and Interactivity in the Classrooms?

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Abstract: This study reports on a measurement that is used to investigate interactivity in the classrooms and examines the impact of integrating interactive projector into junior high school science classrooms on classroom interactivity and students' biology learning. The results show that there was no significant difference in students' learning achievement between teaching through interactive projector or general data projector. Thus, the integration of interactive technologies in the classrooms might not be able to ensure a better learning performance or teaching efficiency although more types of interactive actions were observed.

Keywords: Teacher-pupil interaction, interactivity, interactive projector

Introduction

Nowadays, interactive white board (IWB) has been regarded as a powerful educational technology which not only supports clear and seamless instruction but also raises the level of interactivity in classrooms. Many researches indicate that students are more involved and motivated while information and communications technology (ICT) presented [1]. But taking the price and ease of use into consideration, the interactive projectors, which are more flexible and low-cost, seem to be a better choice than IWBs for us. However, does it really bring more interactions into classrooms while interactive projectors are integrated into biology teaching? What is the impact of interactive projectors on classroom interactivity and student learning outcomes? As interactive projector is a very new technology released recently, its actual teaching efficiency and effectiveness have not been empirically addressed so far. This study therefore focuses on investigating the impact of integrating interactive projectors into biology teaching from the aspect of classroom interactivity.

1. Theoretical Framework

Generally speaking, traditional IWBs have large display devices connected with computers. Once the disconnection between computer and display board happened, the instruction is disrupted and student attention is terribly disturbed. Furthermore, in order to easily manipulate computers and display boards, instructors or students are often restricted to stand in front of IWBs or other interactive technologies in the whole class teaching. By using the interactive projectors, instructors and students can remotely control all objects displayed from a distance, and there is no need to change any classroom settings. We can still enjoy the functions that IWBs or computers can provide, for example, zoom-in, erasing, focusing, sharing, undoing, annotating and so on. Most of researches point out that, interactive technologies, such as interactive projectors and IWBs, play a crucial role in improving teacher-pupil interactivity. However, some studies indicate that teacher-centered teaching is unexpectedly strengthened, when the educational media, especially interactive technologies, are newly introduced into the classes [2].

Although it's widely believed interactivity will make an impact on learning outcomes, there is still no clear and common definition about the nature of interactivity in real teaching circumstance. Therefore, how to measure and clarify the interactivity in the classrooms is an important issue. Some researches point out that the reason why ICTs can support teaching activities depends a lot on their intrinsic and constructed features [3], once these features are perceived and transformed into external representations, they are actions. Therefore, this study attempts to investigate these actions about interaction in the classrooms and further to examine the perceived effectiveness.

2. Methods

2.1 Participants

Totally four classes of 7th grade students (n=126) were involved in this study. To investigate the effectiveness of interactive teaching through the use of interactive projector, two of them were taught through using the interactive projector (interactive group), whereas the other 2 classes were instructed by general data projector (information group) (Table 1).

Table 1. Number of participants in the study

	interactive group	information group	Total
Students	61	65	126

2.2 Materials

This study employed the unit of digestion system as instructional content regarding to its complicated characteristics. The teaching materials were mostly identical between interactive and information groups. Both of them adopted several video clips and short flashes to motivate pupils' learning. However, in an attempt to appropriately utilize the functions that interactive projector provides, some materials were slightly changed to make it more actively operable. These changes included replacing the static contents with more dynamic and movable one to allow the occurrence of more human-computer interactions (e.g. dragging, writing, and selecting).

2.3 Research Procedure

Both groups (interactive and information) received 2 sessions (90 mins) of digestion system teaching by the same instructor. In order to exclude novelty effect resulted from the invasion of new technologies, instructors have started to use either interactive or general data projector for teaching two weeks before conducting this study. A knowledge assessment was administrated to students as a posttest after instructions. The whole class teaching was recorded by camcorders for further analyzing during study period.

2.4 Instruments

2.4.1 Knowledge Assessment

The development of knowledge assessment for Digestion System included two phases. The original version of assessment was acquired from the previous study [4]. One biological education expert, one biology teacher and one graduate student majoring in biology were invited to review and modify the items to ensure expert and facial validity. Moreover, a pre-trail test (n=146) was conducted and several ill-suited items were further excluded from the assessment according to the results of difficulty and discrimination analyses. At the end, a knowledge assessment consisting of 31 multiple-choice questions for measuring participants' understanding of digestion system were finally formulated (Cronbach's α=0.92).

2.4.2 Coding system for interactivity analysis

A coding system for analyzing classroom interactivity was developed to investigate the impact of integrating interactive projectors into science classrooms in this study. Some researchers have emphasized that only when the special features of interactive technologies are perceived and performed by both teachers and students, can influence of them be revealed [3]. Hence, we further defined "classroom interactivity" as "actions which are performed by teachers and students once they perceive the supported features of educational technologies and regard the features as a facilitator for initiating reciprocal dialogue, constructing learning environment and scaffolding knowledge, and these actions can be observed in the classrooms."

According to the previous research, there are 20 actions that ICTs can provide to construct instructional content and reveal potential efficiency [3]. Referring to the theoretical framework they put forth, we distributed these 20 actions into three categories depending on the role that interactive technologies can play in the classes [1]: *object*, *participant*, and *tool*. When ICTs are considered as a passive role which are used to perfectly present people's commands, they are *objects*. People interact *about* ICTs in this category to merely display the materials prepared in advance. On the other hand, when ICTs are considered as *participants*, people interact *with* them. ICTs now serve as learning environments and might be able to be initiators of action and may pose unanticipated feedbacks to students' responses. Finally, if ICTs play a role of *tools*, people interact through them. ICTs now are considered as media which are used to help achieve final learning goals and prompt deeper thinking processes [5]. Table 2 represents the developed coding system which describes the roles ICTs can play and the actions they can provide under each category.

Table 2. Roles that ICTs can play and possible actions they can provide

Action	Description
Object: Interact about ICTs	
Selecting	A resource or procedure can be chosen from a list.
Comparing	Different features of an object or different objects can be compared.
Retrieving	Resources or saved files can be opened or accessed to.
Apprehending	Contents displayed can easily be watched and understood.
Transforming	Teaching materials can be showed in different information types or through different media.
Revisiting	The same materials or concepts can be emphasized by using repeated processes of activity in the same class.
Undoing	The status of entire process can be returned to the previous step or the very

	initiation.
Repeating	A saved or automatic process can be repeated.
Participant: Interact with ICTs	
Focusing	Particular aspect or specific process of presentations can be paid attention to.
Role playing	Some roles can be assumed in learning activities in fictional settings as in real lives.
Annotating	Notes can be added to a process or presentation.
Modeling	Relationships between variables can be showed to simulate process.
Responding	Complete actions can be prompted or demanded through ICTs.
Questioning	Questions that ask for answers can be showed through ICTs.
Prompting	Some short sentences or movements that trigger someone to do something can be showed by ICTs
Tool: Interact through ICTs	
Composing	Ideas can be organized and recorded once they arise.
Editing	Information stored and demonstrated can be easily modified without traces.
Collating	Different facilities can be integrated into single resource.
Sharing	Resources and ideas can be easily interchanged and communicated.
Cumulating	Different resources can be integrated into single presentation content

Note. Modified from "The features of interactive whiteboard and their influence on learning," by S. Kennewell and G . Beachamp, Learning, *Media and Technology, 32*(3), 232-233.

2.5 Data analysis

2.5.1 Classroom interactivity

For both groups, the video recordings of classroom observations were simply edited for interactivity analysis. We randomly edited a one-minute video clip in 5 minute intervals, which finally generated 22 video clips for information group and 28 clips for interactive group. Two researchers (coders) were participated in the coding procedure. Before coding, the developed coding system was clearly discussed and the definition of each action was carefully clarified by the two researchers until the consensuses on them were reached. Then the coding task was conducted independently. Researchers had to not only take down every different action they observed in the video clips and how many times the action happened, but also subjectively score the teaching efficiency brought by each action from 0 (no efficiency) to 4 points .

Two scores, *categorical* and *effective*, were calculated according to what actions were observed. For calculating *categorical score,* each action was simply given 1 to 3 points according to what category they are in. For example, actions which show ICTs serving as *object* for directly responding to our commands were scored 1 point each. If ICTs, as *participants,* are used not only for giving feedback to our manipulations, but initiating a discourse space for teachers and students, actions in this category were scored 2 points each. Finally, when ICTs are used as a synergistic role to help teacher and students to construct knowledge, they act as *tools.* Actions in this category were given 3 points each. Categorical score was generated by simply summing up the categorical points of observed actions. On the other hand, teaching efficiency rated by researchers for each action was multiplied by times and then summed up, resulting in *effective score*.

Furthermore, researchers were additionally required to score the whole-class interactivity (from 1 to 10 points) for the sake of reciprocally verifying the reliability. The final effective and categorical score and whole-class interactivity were obtained by respectively averaging scores between the two researchers.

2.5.2 Learning achievement

Students' responses to multiple-choice questions of the knowledge assessment were scored as correct or incorrect. They were given one point for each correct answer, which resulted in a maximal full score of 31 points. Analysis of covariance (ANCOVA) was run to examine if there was any difference in student performance on knowledge assessment between interactive and information groups. The obtained score of knowledge assessment was employed as independent variable and instructional treatment (interactive and information groups) was adopted as dependent variable. Student performance in biology on the first midterm exam was used as covariate.

3. Results

3.1 Interactivity

Table 2 shows the coded actions. For information group, there were totally 10 actions observed and 9 of them were coded by both researchers, whereas a total of 15 actions (and 12 of them were in common between researchers) were coded for interactive group. The result shows there were more actions observed in interactive group than information group for either all actions observed or actions coded in common by both researchers. Table 3 represents categorical score, effective score and whole-class interactivity for both groups. The results reveal that effective score of information group (177.25) was better than interactive group (136.00); contrarily, categorical score of interactive group (70.25) was higher than information group (49.25). The scores of whole class interactivity were almost the same between the two groups (5.75 and 5.50, respectively).

Table 3. Actions observed by coders

	information group	interactive group
types of actions	selecting, comparing, apprehending, revisiting, focusing, responding, questioning, prompting, sharing, *transforming*	selecting, comparing, apprehending, undoing, focusing, annotating, responding, questioning, prompting, composing, editing, sharing, *retrieving, transforming, revisiting*
total actions observed	10	15

Note. Actions that were observed by both researchers were showed in normal and those observed by just one researcher were showed in italic.

Table 4. Effective score, categorical score and whole-class interactivity for groups

	effective score	categorical score	whole-class interactivity
information group	177.25	49.25	5.75
interactive group	136.00	70.25	5.50

3.2 Learning achievement

The results of ANCOVA for student performance on knowledge assessment were shown in Table 5. It is found that there is no significant difference in student knowledge acquisition between information group (Mean=19.20, SD=6.72) and interactive group (Mean=19.22, SD=7.28).

Table 5. Statistic results of ANCOVA for performance on knowledge assessment

component	sum of squares	df	mean square	F value
Sectional examination scores	2811.99	1	2811.99	104.42
Between	59.31	1	59.31	2.20
Within	3285.34	122	26.93	
Total	52582.00	126		

4. Discussion

In our study it is interesting to find that no significant difference in student achievement between teaching by interactive and general data projectors was revealed. However, Interactive group did perform more classroom interactivity when it comes to either all actions observed or actions coded in common, and the categorical score of interactive group was actually higher than information group. But the more interactive actions seemed to not be able to promise the perceived teaching efficiency as the effective score of interactive group was lower than information group. In other words, student learning outcomes and perceived teaching efficiency were not able to be enhanced, although more interactive actions were observed in interactive group. The possible interpretations are as below.

4.1 Ceaseless interactive actions cause cognitive overload

According to the field notes of classroom observations made by researchers, the ceaseless interactive actions unexpectedly leaded students to become continually multi-tasking and frequently interrupted student learning processes [6][7]. Either instructor or students had to spend a lot of time interacting with the interactive projector; however, some of these interactive actions are actually complicated. In this case, students had to switch attentions among learning materials, instructors, peers and teaching media all the time because of the use of interactive projector in the classrooms, which terribly results in extremely heavy cognitive load [8].

4.2 Recommendation

When an interactive technology is newly introduced into classes, pupils generally need a period of time to get used to it [9]. So the designed learning tasks should be appropriately scaffolded [10], for example, tasks should be arranged from easy to complicated gradually, or students may spend too much time on writing and annotating, and the learning content may still be hard to be recognized.
In this study we developed a coding system for investigating classroom interactivity and primarily examined the effectiveness of the use of interactive projector on classroom interactivity and student learning outcomes. This is a first try. We suggest that more researches, such as interviews and discourse analysis, could be conducted to further reveal what really happen in the classrooms and how is the relationships between actions, interactivity, teaching efficiency and learning outcomes in the future.

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