Comparing the effect of DSLM web based learning vs traditional science teaching on students' conceptual learning outcome

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ABSTRACT

The purposes of this study were to compare the effect of Dual Situation Learning Model (DSLM) (She, 2002, 2003) web-based instruction context (WBC) with traditional science teaching context (TSC) on students' conceptual change learning outcom. Seven classes, 190 8th graders were involved. Five classes involved in WBC, four classes involved in TSC. In WBC, chemical reaction lessons are designed to reflect on students' misconceptions. Students' learning outcome was assessed by two-tier test pre and post conceptions and situated challenge tests. ANOVA were used for data analysis. Findings revealed students' conceptual change in WBC was better than TSC. Implication of the study would be discussed in the paper.

INTRODUCTIONS

The most well-known conceptual change model was proposed by Posner, Strike, Hewson, and Gertzog (1982). They argued that conceptual change could be defined by two cognitive processes: "assimilation" happens when individuals add information to existing knowledge structures, but "accommodation" is a more radical change that happens when a central concept is superseded or restructured. They emphasize students accept a new conception to be more intelligible(able to be understood), plausible (makes sense), and fruitful (having the potential to explain more situations)(Palmer, 2005). Learning was regarded as a series of conceptual change process(Posner, Strike, Hewson, & Gertzog, 1982; Roth, 1991) and then many studies devoted to enrich the construction of conceptual change(Cosgrove, Osborne, & Carr, 1985; Driver & Oldham, 1986; Neale, Smith, & Johnson, 1990; Nussbaum & Novick, 1982; She, 2003).

Many conceptual change models have been developed in the literature, but most of them focus on arousing students' dissonance instead of providing students with correct concepts. She (2001, 2002, 2003) developed Dual Situation Learning Model (DSLM) and tried to solve the above problems raised. In her model, teachers need to identify students' preconceptions and design teaching activities to reconcile students' misconceptions. DSLM have been used in web learning context and found successful results. Therefore, in this study, we will apply DSLM as our conceptual change teaching model and will also used in web-based context.

Our web-based DSLM was followed Dual Situated Learning Model (She, 2001, 2002, 2003, 2004a, 2004b), which consisted of six stages: (1) Stage 1 – examining the attributes of the science concept. This stage provides information about which essential mental sets are needed to construct a scientific view of the concept; (2) Stage 2 – probing students' misconceptions of the science concept. This involves probing the students' beliefs concerning the science concept; (3) Stage 3 – analyzing which mental sets the students lack. This would provide information about which mental sets students specifically lack for the construction of a more scientific view of the concepts; (4) Stage 4 – designing dual situated learning events. The design of dual situated learning events is based on Stage 3 results, related to which mental sets students' lack. If there are two mental sets needed for helping students construct a more scientific view of the concepts, it might be necessary to design at least two dual situated learning events; (5) Stage 5 – instructing with dual situated learning events on web-based DSLM e-Learning platform. This emphasizes giving students the opportunity to make predictions, provide explanations, confront dissonance, and construct a more scientific view of the concepts; (6) Stage 6 – instructing with a challenging situated learning event, this is to provide an opportunity for the students to apply the mental sets they have acquired to a new situation in order to ensure that successful conceptual change has occurred.

Our purpose in the present study was to compare conceptual learning outcome of junior high school students before, during and after their participation in an chemical reaction lessons delivered in two different ways (traditional and web-based). The specific research questions are: (a) Is DSLM web-base more effective for the science conceptual change than traditional science teaching? (b) What different in the result of conceptual change between DSLM web-base and traditional science teaching? (c) In different level academic achiever, is DSLM web-base more effective for the science conceptual change than traditional science teaching?

Method

Participants

190 8th graders (ten classes, age 13-14) selected from an average achievement class of a rural county junior high school participated in this study. Students do not learn reaction rate before they join the study. Among them, five classes assigned to experiment group randomly, they learned chemical reaction in WBC, and the others (four classes) assigned to control group, they leaned in TSC.

Treatment

DSLM for reaction rate lesson

In the DSLM, the reaction rate lesson is divided into eight main sections and eight corresponding alternative conceptions. The pre-conception test, post-conception test and challenge situated test are designed in accordance with these alternative conceptions. Pre-conception test and post- conception test ask alternative conceptions directly, both use the same question, but challenge situated test use alternative conceptions in a new science situation.

Web-based DSLM for reaction rate lesson

Both control and experimental groups take every pre-conception test before learning every chemical reaction conception. And take post conception test after the conceptual learning/lecture activity. And then all students take challenge situated test after they finish all concept learning on the web or traditional classroom.

The three tests adopt two-tier assessment, the two-tier test is a two-level question presented in a multiple-choice format. The first tier assesses students' descriptive knowledge about the conception, and the second tier explores students' reasons for their choices made in the first tier. If students choice right answer in the first tier, he get one point. In the second tier, students can get 0-2 points that rests on exactitude of his reasons. The criterion of scores was judged by the science educator and two chemical science teachers of junior high school. The score of every reason of all tests was determined by three chemical science teachers then average three score, and the scorer reliability is 0.98.

Results and Discussion

Research question 1: Is DSLM web-based more effective for the science conceptual change than traditional science teaching?

In order to compare the effective of DSLM web-based with traditional science teaching, two-ways ANOVA were conducted on 2 learning context (WBC and TSC) x 3 pre-conception test groups (Low score group of pre-conception test, Medium score group of pre-conception test and High score group of pre-conception test, all students averagely divide into 3 groups in accordance with scores of pre-conception test.) The result of the analysis is showed at table 1 and table 2.

Tables 1. two-ways ANOVA analysis of 2 learning context x 3 pre-conception test groups in challenge situated test results

source	Sum of Squares	df	Mean Square	F
Between Groups				
Pre-conception test level	12.626	2	6.313	21.619***
Learning context	10.446	1	10.446	35.774***
Pre-conception test level x Learning context	0.518	2	0.259	0.887
Within Groups	53.729	184	0.292	
Sum	334.702	190		

*p<0.05 **p<0.01 ***p<0.001

Table 2. The performance of pre-conception test, post-conception test and challenge situated test of three score groups of pre-conception test

Conception test	PrCT		PoCT		CST	
Mean scores level	TSC	WBC	TSC	WBC	TSC	WBC
Low	0.29	0.29	0.85	0.87	0.69	1.02
Medium	0.60	0.64	1.10	1.33	0.78	1.33
High	1.11	1.13	1.62	1.80	1.20	1.76

PrCT: pre-conception test. PoCT: post-conception test. CST: challenge situated test.

The results reveal that, no matter in WBC or TSC, the scores of challenge situated test of different score groups of pre-conception test have significant difference (see table1.). And then high score group students of pre-conception test perform better than medium group, and medium score group perform better than low score group (see table2.). Additionally, no matter what score groups of pre-conception test in WBC could improve significantly on their conceptual understanding in a new science situated test than TSC (see table 1. and table 2.).

Research question 2: What different in the result of conceptual change between DSLM web-base and traditional science teaching?

In order to compare the different in process of conceptual change between TSC with WBC, the mean scores of pre-conception test, post-conception and challenge situated tests of three score groups of pre-conception test be drew into figure (see figure 1. and figure 2.).

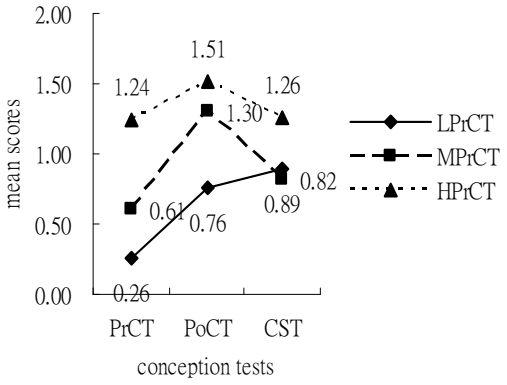

Figure1. The mean scores of PrCT, PoCT and CST of the different level PrCT students in TSC.
LPrCT: Low pre-conception test, MPrCT: Medium pre-conception test, HPrCT: High pre-conception test

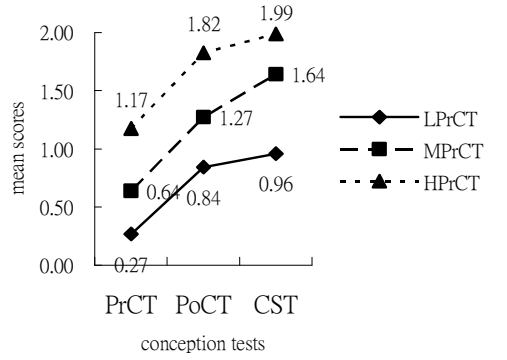

Figure2. The mean scores of PrCT, PoCT and CST of the different level PrCT students in WBC.
LPrCT: Low pre-conception test, MPrCT: Medium pre-conception test, HPrCT: High pre-conception test

The figures reveal that, in TSC groups, most students could improve obviously on their conceptual understanding in post-conception test, but not in science situated test (see figure1.). But in WBC groups, all students could not only improve obviously their conceptual understanding in post-conception test but also in new science situated test (see figure 2.).

Table3. The percentage of different level answers of two-tier test in post-conceptual test (%)

score	0		1		2		3	
Context / Concept	WBC	TSC	WBC	TSC	WBC	TSC	WBC	TSC
1	31.0	41.1	27.0	32.2	25.0	10.0	17.0	16.7
2	26.0	47.8	41.0	42.2	28.0	10.0	5.0	0.0
3	12.0	26.7	14.0	34.4	44.0	12.2	30.0	26.7
4	36.0	45.6	36.0	45.5	25.0	7.8	3.0	1.1
5	43.0	71.1	12.0	18.9	17.0	1.1	28.0	8.9
6	16.0	35.6	35.0	34.4	37.0	27.8	12.0	2.2
7	37.0	57.8	32.0	37.8	17.0	2.2	17.0	2.2
8	24.0	37.8	29.0	43.3	38.0	16.7	9.0	2.2

0: I Incorrect choice and incorrect explanation. 1: Correct choice but incorrect explanation. 2: Correct choice and appropriate explanation (has a little false). 3: Correct choice and correct explanation.

The table shows that, students in WBC can obtain lower obviously percentage in 0 points (incorrect choice and explanation). And then students in WBC can obtain higher obviously percentage either in 2 (Correct choice and appropriate explanation) and 3 points (Correct choice and correct explanation).
These results imply that, WBC provided a continued assistance in process of conceptual change and enabled students to have better performance in new scientific situation. And in degree of conceptual change, WBC was also provided a superior learning context and enabled students to have deeper conceptual learning.

Conclusions and Implications

The use of on-line education always had some myths, such as faculty receive the same course content for teaching an online course as they do for teaching a traditional course(Nicholson & Sarker, 2002). In designing on-line course, designer frame content in accordance with construction of traditional teaching, and then assume that students learn the same well as in traditional teaching context. In fact, learning in web-based course, students need clearer and more effective pattern on presentation of content(Shedletsky & Aitken, 2001).
In the study, web-base DSLM show higher benefit on conceptual change than traditional science classroom teaching. Because the web-base DSLM construct content in accordance with procedure of Dual Situated Learning Model (She, 2001, 2002, 2003, 2004a, 2004b), so the conceptual structure conform with essential mental sets are needed to construct a scientific view of the concept. Additionally, the web-base DSLM provide conceptual conflict and challenge situation that assist students in conceptual change process.
In conclusion, the result implies that DSLM is an effective instructional model not only in traditional science teaching context but also in web-base context. And future on web-based course, the website designer should apply clearer and more effective instructional model (like DSLM) in organization of website content.
Third Research question: In different level academic achiever, is DSLM web-base more effective for the science conceptual change than traditional science teaching?

To answer our second question, covariance analysis (ANCOVA) was conducted on the entire challenge situated test (see table 4.). In order to reduce the influence of per-conception test's difference on different academic achiever, the study take per-conception test's average scores as covariance.

Table 4. ANCOVA analysis of different academic achiever in challenge situated test

	N	Mean	SD	F
High achiever				
WBC	42	1.89	.48	25.730***
TSC	23	1.25	.47	

Medium achiever				
WBC	27	1.54	.48	36.675***
TSC	35	.88	.34	
Low achiever				
WBC	31	.66	.43	1.730
TSC	32	.59	.40	

The result reveals that, WBC had better effective on high and medium achiever than TSC. In low achiever, the result of challenge situated test did not have significantly difference between WBC with TSC.

These results imply that, in low academic achiever, WBC can not provide a better effective than TSC. Nevertheless, WBC was not inferior to TSC.

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In the study, web-base DSLM show higher benefit on conceptual change than traditional science classroom teaching. Because the DSLM web-base construct content in accordance with procedure of Dual Situated Learning Model (She, 2001, 2002, 2003, 2004a, 2004b), so the conceptual learning structure conform with essential mental sets are needed to construct a scientific view of the concept. Additionally, the web-base DSLM provide ordered and no jamming that assist students to concentrate their attention on conceptual self in conceptual change process.

In conclusion, the result implies that DSLM is an effective instructional model not only in traditional science teaching context but also in web-base context. And future on web-based course, the website designer should apply the conceptual learning structure that conforms to essential mental sets. Besides, provide a clearer and more effective instructional model (like DSLM) in organization of website content.

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