Improving Learning Motivation in a Learning Style Integrated Mobile Cooperative Learning Environment

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Abstract--**Motivation is an essential factor to promote academic performance and learning satisfaction. Moreover, the development of mobile cooperative learning has become important in the mobile learning environment. Taking different learning styles into consideration when designing instructional materials will meet individual needs and improve learning outcome. However, limited research has been done on investigating motivation in mobile cooperative learning considering individual differences, this study developed a mobile cooperative learning environment that integrates different learning styles (LSIMCLS) and tries to compare students' motivation between the groups with and without integrating learning styles. In this study, the MSLQ developed by Pintrich et al. was modified to evaluate learning motivation. The results showed that the participants in the LSIMCLS group performed better than the non- LSIMCLS group. Moreover, the participants in the LSIMCLS group were more motivated in value, expectancy, and affective components. The results will be valuable when instructors want to develop a mobile cooperative learning environment integrating individual learning differences.**

I. INTRODUCTION

In an educational environment that integrates modern technology, how to guide learners to produce an effective interaction becomes indispensable [2, 6, 28]. Cooperative Learning has been usually used to improve interaction [19, 31]. With the current development in e-learning, most research regarding cooperative learning has gradually applied in internet-based learning. From these research, most of them claimed that cooperative learning have positive influence on learning. Moreover, computer mediated cooperative learning are indispensable in aiding teaching [1, 3, 24, 32]. Currently, most of the computer mediated cooperative learning requires student to sit in front of computers and communicate through computers. However, traditional desktop computers are not able to enable students to interact face-to-face, face-to-face interaction is very essential in an effective cooperative learning environment. Applying mobile tools is suitable to solve this problem. Mobile tools, such as tablet pc and mobile phones, can create a mobile cooperative learning environment that enables students to interact face-to-face naturally [33]. Zurita and Nussbaum [35] also pointed out that mobile cooperative learning enables learning groups not only interact face-to-face, but getting rid of the restriction of spaces, the information from the internet can also be utilized. One of the most commonly used strategies in cooperative learning is Jigsaw [21, 17, 34]. There are five steps in this strategy and they are: (a)Topic assignment; (b) Individual study; (c) Expert group meeting; (d) Jigsaw group meeting; and (e) Class presentation [4, 5, 17, 21].

Although computer mediated communication will promote learners' learning performance and develop the ability to solve complex problems, some researchers asserted that computer mediated communication has negative impact on students with low and mediate performance. Students should be provided with appropriate and prompt assistance according to their needs [22].

Felder and Silverman [11] recognize students' individual differences. In the learning process, every student has their own learning preference. In most instances, learning difficulties occur when students' learning style can't match teachers' teaching style. Teaching is the interactive process between teachers and students. If a teacher wants to make the teaching successful he/she should not only have appropriate teaching skills but take students' individual differences into consideration. Students will obtain knowledge only when they are given the most appropriate teaching. When designing learning materials, instructors should take learners' learning style into consideration [9, 12, 14, 15, 20, 30]. Felder and Silverman [11] organized students' learning style into active/reflective, sensing/intuitive, visual/verbal, and sequential/global.

In this study, two types of Felder and Silverman's [11] learning styles related to designing self-studied materials including visual/verbal, and sequential/global were used to design adaptive ebooks. The ebooks were used in the "individual study" step in the Jigsaw model in the mobile cooperative learning environment. Besides comparing the difference before and after learning, the effect of comparing integrating learning style or not was also conducted.

Motivation is believed to improve learners' satisfaction and performance in education [7, 16, 18, 29]. The sources that motivate learners may differ from each other. The expectancies for success and ability beliefs, and task value are usually investigated [23]. Learners' interest in a task including intrinsic and extrinsic goal orientations are also discussed [13]. Pintrich, Smith, Garcia, and McKeachie's [25] motivational model mainly covered these topics and there are three components in the model:

1. Value Components: Intrinsic goal orientation, extrinsic goal orientation, and task value are included in this category. Intrinsic goal orientation refers to the degree to which a student perceived a learning task to be engaging because of its mastery and challenges, etc. On the other hand, extrinsic goal orientation focuses on reasons such as grades, rewards, and competition. Task value means the extent to which a student regards a task to be interesting,

useful, or important [25]. Both goal orientations and task value positively affect academic performance [8, 27].
2. Expectancy Components: Control beliefs and self-efficacy for learning and performance are in the category. Self-efficacy refers to the extent to which a student perceived one's ability to succeed in certain tasks. A student with strong self-efficacy usually stimulates more effort to overcome challenges [10]. Control belief means a student's belief that learning relies on one's effort rather than on external factors.
3. Affective Components: Test anxiety is mainly discussed in this category and has negative impact on academic performance [25].

In sum, because of the development of mobile cooperative learning, and importance of taking different learning style into consideration, limited research has been done on investigating motivation in mobile cooperative learning, this study developed a mobile cooperative learning environment that integrates different learning styles and tries to compare students' motivation between the groups with and without integrating learning styles.

The purpose of the study was to understand whether a learning style integrated mobile cooperative learning system improves elementary students' level of academic performance and whether this system results in higher learning motivation. The research questions are listed below:

1. In the mobile cooperative learning environment, whether the students in the learning style integrated mobile cooperative learning system (LSIMCLS) will improve their academic performance?
2. In the mobile cooperative learning environment, is there any difference in the learning outcome between the students in or not in the learning style integrated mobile cooperative learning system?
3. In the mobile cooperative learning environment, is there any difference in learning motivation between the students in or not in the learning style integrated mobile cooperative learning system? Is there any relationship between each component and the posttest scores?

II. METHODOLOGY

This was a quasi-experimental research study and two intact classes were used. The research was conducted in a primary school in Taiwan. In order to find out if adaptive cooperative mobile learning will motivate participants' interest in learning health, 3 nutrition topics were chosen and the course materials were designed as mobile ebooks. Almost 51.43% of them were male and 48.57% were female. All students in the research were required to read course materials and participate in Jigsaw activities. One class was randomly assigned as an adaptive mobile cooperative learning group, which used e-books integrating learning styles and jigsaw in the class. The other class was named as non-adaptive mobile cooperative learning group and the course was taught with Jigsaw activities and e-book without considering individual learning styles. Both classes were all taught by the same instructor with the same content.

The entire treatment lasted for six weeks. The participants were required to take a pretest and Learning Style Questionnaire before the treatment to investigate their prior knowledge and learning styles. Besides pretest, a comprehensive posttest was investigated after the treatment to find out if there is significant difference in learning outcome between groups with or without considering individual learning styles. During the treatment, the Jigsaw strategy was employed and the adaptive ebook was used in the independent study process. Each pretest and posttest included 25 questions and both had different questions but with similar level of difficulty. The tests were developed by the instructor and reviewed by content experts.

After the treatment, both groups were required to take the Motivated Strategies for Learning Questionnaire (MSLQ) and Learning Experience Questionnaire. The MSLQ was adopted from Pintrich, et al. [25] to investigate learners' level of motivation toward the class. It contains 31 questions with 5-point Likert-scale items that measure learners' motivational reactions to the class. The MSLQ is considered a valid instrument and the Cronbach's alpha coefficients were robust, ranging from .68 to .93 [26]. In this study, the survey was modified to find out how adaptive mobile cooperative learning affects students' learning motivation and the survey was administered at the end of the study. The modified instrument includes 31 Likert-scale items ranging from 1(strongly disagree) to 5 (strongly agree). The questions included (a) four questions about attitudes towards intrinsic goal orientation; (b) four questions regarding students' attitudes towards extrinsic goal orientation; (c) six questions related to their task value; (d) four questions regarding students' control beliefs; (e) eight questions about self-efficacy for learning and performance, and (f) five questions regarding attitudes towards test anxiety.

After collecting the survey data, Cronbach alpha coefficients were calculated to determine the instrument's internal reliability. Respondent ratings of students' attitude towards intrinsic goal orientation, extrinsic goal orientation, task value, control beliefs, self-efficacy for learning and performance, and test anxiety obtained from the questionnaire were all judged to be fairly reliable with an internal consistency reliability coefficient of 0.899, 0.917, 0.936, 0.791, 0.939, and 0.834.

II. RESULTS

A. Research Question One: In the mobile cooperative learning environment, whether the students in the learning style integrated mobile cooperative learning system will improve their academic performance?

To answer Research Questions One, dependent t-test was employed to look at the pre-test and post-test scores in the LSIMCLS grouop. The pretest and posttest were

administered to the students in the experimental group at the end of the six weeks of study. There is a statistically significant mean difference (t= -11.54, df=30, p<.01) between pre-test and post-test in the LSIMCLS group. The posttest score (mean= 81.94, s= 8.12) was higher than the pre-test score (mean= 65.87, s=9.96). The 95% Confidence Interval suggests the true mean difference is included in -18.91<μ<-13.22. The results are shown below in Table 1.

B. Research Question Two: In the mobile cooperative learning environment, is there any difference in the learning outcome between the students in or not in the learning style integrated mobile cooperative learning system? Is there any relationship between each component and the posttest scores?

The results from the pre-test showed that there was no statistically significant difference in the pre-test between both groups (t=-.198, df =54.35, p=.844). The 95% Confidence Interval indicates the true mean difference (.629) may range from -7.00<μ<5.74. On average, participants in the LSIMCLS group (M=65.87, SD=9.96) had similar level of prior knowledge before the treatment with the non-LSIMCLS group(M=66.50, SD=14.85). The results are shown below in Table 2.

The results from the post-test showed that there was statistically significant difference in the post-test between both groups (t=4.899, df =61, p<0.01). The 95% Confidence interval indicates the true mean difference (11.69) may range from 6.92<μ<16.46. On average, participants in the LSIMCLS group (M=81.94, SD=8.12) performed better academically than the non- LSIMCLS group (M=70.25, SD=10.60). The results are shown below in Table 3.

C. Research Question Three: In the mobile cooperative learning environment, is there any difference in learning motivation between the students in or not in the learning style integrated mobile cooperative learning system?

Independent t-test was used to answer research question three. The MSLQ regarding students' motivation towards learning was administered to the students at the end of the six weeks of study in order to answer this research question. The survey includes six subscales and they are: (a) the level of intrinsic goal orientation; (b) the level of extrinsic goal orientation; (c) the level of task value; (d) the level of control beliefs; (e) the level of self-efficacy for learning and performance; and (f) test anxiety.

1) MSLQ: Intrinsic Goal Orientation

A composite score from questions 1, 18, 24, and 26 was used to determine students' intrinsic goal orientation. Composite score ranged between 4 and 20. There was statistically significant difference in their intrinsic goal orientation between both groups (t=6.495, df =61, p<0.01). The 95% Confidence Interval indicates the true mean difference (5.02) may range from 3.47<μ<6.56. On average, participants in the LSIMCLS group (M=16.58, SD=2.58) had higher intrinsic goal orientation than the non- LSIMCLS group (M=11.56, SD=3.47). The results are shown below in Table 4.

2) MSQL: Extrinsic Goal Orientation

A composite score from questions 8, 12, 14, and 34 was used to determine students' extrinsic goal orientation. Composite score ranged between 4 and 20. There was statistically significant difference in extrinsic goal orientation between both groups (t=4.906, df =61, p<0.01). The 95% Confidence Interval indicates the true mean difference (4.01) may range from 2.38<μ<5.64. On average, participants in the LSIMCLS group (M=16.32, SD=3.02) had higher extrinsic goal orientation than the non- LSIMCLS group (M=12.31, SD=3.45). The results are shown below in Table 5.

TABLE 1. SCORES OF THE LSIMCLS GROUP

Test	Mean	Std. Deviation	N
Pretest	65.87	9.96	31
Posttest	81.94	8.12	31

TABLE 2. SCORES OF THE PRE-TEST

Groups	Mean	Std. Deviation	N
LSIMCLS	65.87	9.96	31
Non- LSIMCLS	66.50	14.85	32
Total	66.19	12.59	63

TABLE 3. SCORES OF THE POST-TEST

Groups	Mean	Std. Deviation	N
LSIMCLS	81.94	10.45	31
Non- LSIMCLS	70.25	10.87	32
Total	76.00	11.08	63

TABLE 4. MSLQ: INTRINSIC GOAL ORIENTATION

Types	Mean	Std. Deviation	N
LSIMCLS	16.58	2.58	31
Non- LSIMCLS	11.56	3.47	32
Total	14.03	3.96	63

TABLE 5. MSLQ: EXTRINSIC GOAL ORIENTATION

Types	Mean	Std. Deviation	N
LSIMCLS	16.32	3.02	31
Non- LSIMCLS	12.31	3.45	32
Total	14.29	3.80	63

TABLE 6. MSLQ: TASK VALUE

Types	Mean	Std. Deviation	N
LSIMCLS	25.23	4.08	31
Non- LSIMCLS	17.84	4.77	32
Total	21.48	5.77	63

3) MSLQ: Task Value

A composite score from questions 19, 28, 11, 29, 5, and 25 was used to determine students' perception towards task value. Composite score ranged between 6 and 30. There was statistically significant difference in their task value between both groups ($t=6.589$, $df=61$, $p<0.01$). The 95% Confidence Interval indicates the true mean difference (7.38) may range from $5.14<\mu<9.62$. On average, participants in the LSIMCLS group (M=25.23, SD=4.08) had higher task value than those in the non- LSIMCLS group (M=17.31, SD=4.77). The results are shown below in Table 6.

4) MSLQ: Control Beliefs

A composite score from questions 2, 20, 10, and 27 was used to determine students' control beliefs. Composite score ranged between 4 and 20. There was statistically significant difference in control beliefs between both groups ($t=5.650$, $df=61$, $p<0.01$). The 95% Confidence Interval indicates the true mean difference (3.67) may range from $2.37<\mu<4.97$. On average, participants in the experimental group (M=16.58, SD=2.78) had higher control beliefs than those in the control group (M=12.91, SD=2.37). The results are shown below in Table 7.

5) MSLQ: Self-efficacy for Learning and Performance

A composite score from questions 6, 7, 13, 17, 22, 23, 32, and 35 was used to determine students' self-efficacy for learning and performance. Composite score ranged between 8 and 40. There was statistically significant difference in their self-efficacy for learning and performance between both groups ($t=5.271$, $df=61$, $p<0.01$). The 95% Confidence Interval indicates the true mean difference (7.77) may range from $4.82<\mu<10.72$. On average, participants in the LSIMCLS group (M=32.74, SD=5.18) had higher self-efficacy for learning and performance than those in the non- LSIMCLS group (M=24.97, SD=6.43). The results are shown below in Table 8.

6) MSLQ: Test Anxiety

A composite score from questions 3, 9, 16, 21, and 31 was used to determine students' test anxiety. Composite score ranged between 5 and 25. There was statistically significant difference in test anxiety between both groups ($t=-5.899$, $df=53.77$, $p<0.01$). The 95% Confidence Interval indicates the true mean difference (-5.16) may range from $-6.91<\mu<-3.41$. On average, participants in the experimental group (M=7.87, SD=2.70) had less test anxiety than those in the group (M=13.03, SD=4.12). The results are shown below in Table 9.

TABLE 7. MSLQ: CONTROL BELIEFS

Types	Mean	Std. Deviation	N
Experimental	16.58	2.78	31
Control	12.91	2.37	32
Total	14.71	3.16	63

TABLE 8. MSLQ: SELF-EFFICACY FOR LEARNING AND PERFORMANCE

Types	Mean	Std. Deviation	N
LSIMCLS	32.74	5.18	31
Non- LSIMCLS	24.97	6.43	32
Total	18.05	4.49	63

TABLE 9. MSLQ: TEST ANXIETY

Types	Mean	Std. Deviation	N
LSIMCLS	7.87	2.70	31
Non- LSIMCLS	13.03	4.12	32
Total	10.49	4.33	63

7) Relations between Test Score and Components

There is statistically significant relationship between posttest grades of the respondents and intrinsic goal orientation($r=0.402$, $p<0.01$), extrinsic goal orientation ($r=0.354$, $p<0.01$), task value ($r=0.389$, $p<0.01$), control beliefs ($r=0.405$, $p<0.01$), self-efficacy for learning and performance ($r=0.397$, $p<0.01$), and test anxiety ($r=-0.482$, $p<0.01$).

IV. DISCUSSIONS

The purpose of this study was to investigate whether motivation and academic performance improve when using LSIMCLS in learning. The findings of this study confirm that LSIMCLS facilitates effect of learning in primary education. In the LSIMCLS group, the post test scores demonstrated tremendous improvement from the pretest. From the pre-test scores in this study, there was no statistically significant difference in test scores between LSIMCLS and non-LSIMCLS groups. However, the LSIMCLS group had a higher post-test score than the other group. Integrating LSIMCLS in learning help improve participants' academic performance. From the motivation questionnaire, there was statistically significant difference in the composite scores between LSIMCLS and non- LSIMCLS groups in their perceptions towards intrinsic goal orientation, extrinsic goal orientation, task value, control beliefs, self-efficacy for learning and performance, and test anxiety. First five factors have significant positive relationships with posttest scores while test anxiety has negative relationships with the scores. Higher motivation may lead to higher academic performance in the LSIMCLS environment. Future research could extend to different levels of education, learning subjects, and larger sample size to examine the effect of learning styles integrated mobile cooperative learning systems.

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