

Mobile Inverted Constructivism: Education of Interaction Technology in Social Media

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•Received 30 September 2015•Revised 26 December 2015 •Accepted 29 December 2015

The combination of social media and invert teaching is a new path to inverting interaction technology education and reconstructing the curriculum of context. In this paper, based on the theory of constructivism learning, a model named Mobile Inverted Constructivism (MIC) is provided. Moreover, in view of the functional quality of social media in China, the Mobile Inverted Constructivism system (MICs) is designed on the platforms of WeChat and Baidu Post Bar. Through an interaction design course, the teaching effect of the MIC model is examined. The statistical software SAS9.3 was used to analyze the experimental data. Experimental results show that in the classes where the MIC model is applied, students are better motivated to learn and make creative achievements than those restrained by traditional classroom teaching, and the MICs are more acceptable to the digital natives. In the future, the MIC model will be further improved, to better embody the “culture of sharing”.

Keywords: mobile inverted constructivism, interaction technology, social media, creative achievement

INTRODUCTION

In recent years, Chinese educators have been inspired by MOOCs, which originated from the United States and then swept the world. From primary to higher education, the inverted classroom and micro-video teaching have become the focus of teaching reform. (Wang, 2015) However, after the initial curiosity and excitement, educators found that invert teaching and micro-video teaching also have limitations. For example, in invert teaching, information technology is the major medium for knowledge transfer in class, which requires teachers and students to be highly qualified, and schools to boast better hardware; micro-video learning is not quite suitable for practice courses, and it takes time and energy to make videos. As a result, though large quantities of manpower and financial resources were invested,

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these models still could not be widely accepted and adopted. (Li, 2014) Therefore, more and more people begin to reflect on whether the inverted classroom could bring about a real revolution in classroom teaching and whether it could fit in with the classroom teaching of different disciplines. (Bösner, Pickert, & Stibane, 2015)

For interaction technology education, such as the courses of interaction design and vision design emphasizing professional practice, design studios are advocated in teaching. (Kennon, 2014; David, 2014) Compared with the studies on pedagogy at home and abroad, the philosophy and organization pattern of interaction technology education are similar to those of invert teaching, which stresses the student-oriented concept and advocates the mechanism of mini-class (with not more than 30 students) teaching and teacher-student interaction. (Chen, 2015) Therefore, this paper will focus on the discussion about whether invert teaching could fit in with the field of education of interaction technology with the development of the mobile Internet technology, and what kinds of mobile Internet technology would be easily accepted in the implementation of interaction design courses.

The information technology driven by the mobile Internet has changed the way of our social communication, as well as the way we learn. Familiarity and comfort level with social media is well suited for the co-creation of learning artefacts in online environments. (David, 2014) In consideration of the ways digital natives learn, the fluency and wide use of social media technology and the rich information, we believe that the combination of social media and invert teaching will be a new model for inverting education of interaction technology and reconstructing the curriculum of context. Therefore, we put forward a Mobile Inverted Constructivism model (MIC model), through which students are motivated to hold the microphone (MIC) and become the protagonists in the classroom. In this model, combined with the functional quality of social media in China, a Mobile Inverted Constructivism system (MICs) is designed on the platforms of WeChat and Baidu Post Bar. The MICs is easy to operate, and does not require operators to grasp professional skills. Thus, it can relieve the situation that the invert teaching and micro-video teaching require excellent hardware condition of schools and highly qualified teachers and students. In addition, through the interaction design course, we examine the teaching effect of the MIC model (changes in design cognition and creative achievements) and study the acceptability of the MICs.

State of the literature

- The interaction technology education based on the constructivism learning theory and the practice of invert teaching is the inherent practice process of interaction design majors' self-reflection and self-criticism, as well as their reconstruction of the design curriculum.
- The constructivism of knowledge and experience, shaped to the cognitive behavior of design which acquired information from the social media, lead the cognitive behavior of design become the feature of digital native designers.
- The fluency, wide and usefulness of mobile social media technology become the new model which reducing the technical demand of invert teaching.

Contribution of this paper to the literature

- This study established a Mobile Inverted Constructivism model (MIC model), through which students are motivated to hold the microphone (MIC) and become the protagonists in the classroom.
- The MIC model combined with the functional quality of social media in China, designed on the platforms of WeChat and Baidu Post Bar. The MICs is easy to operate, dose not require operators to grasp professional skills.
- Meanwhile, through the interaction design course, this study examined the teaching effect of the MIC model (changes in design cognition and creative achievements) and studied the acceptability of the MICs.

LITERATURE REVIEW

Constructivist learning and Invert teaching

Constructivism is a viewpoint of learning theory that argues learners do not passively accept knowledge delivered by other sources but generate knowledge by constructing their own learning. (Greene, 2005) Thus, it emphasizes that learners guided, coached and supervised by teachers learn to study independently. The formation of the constructivism theory is attributed to Jean Piaget (1973), a Swiss psychologist, who suggested that teachers play the role of organizers and creators of problem situations in teaching, and let students take the initiative to find or reconstruct the content to be learned, rather than simply put students and equipment together. In addition, he argued that peer collaboration could make learning dynamic. "Situation", "collaboration", "dialog" and "meaning construction" are the four elements of the constructivist learning environment.

Based on constructivism, invert teaching is learner-oriented, in which learners take the initiative to learn, and teachers must keep observing the students and provide relevant feedback. (FLN, 2014) J. Wesley Baker (2000) famously described the evolution of the classroom teacher from "the sage on the stage" to "the guide on the side". Baker presented his paper "The classroom flip: Using web course management tools to become the guide by the side" at the 11th International Conference on College Teaching and Learning in which he advocated the use of online programs to present instructional material online as homework, allowing students to spend class time on active learning activities and collaboration with peers. (Baker, 2000). As shown in the Figure 1.

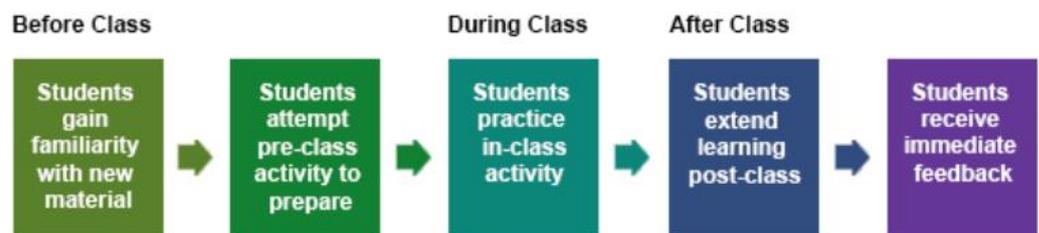


Figure 1. Sequence of elements in the student-centered pedagogy (NYU, 2015)

In the interaction technology paradigm, knowledge and understanding of a problem domain and its solution are achieved in the building and application of the designed artifact (Alan, Salvatore, & Jinsoo, 2004). Learning interaction technology design is a developmental process, in which the methods for effectively solving design problems will evolve with the increase of knowledge and experience (Curry, 2014). Constructivism learning is deeply rooted in interaction technology education. (David, 2014) In the development of mobile Internet technology, the combination with invert teaching is the learning experience of interaction design majors in solving design problems, reflecting on their own design processes and improving creativity. The interaction technology education based on the constructivism learning theory and the practice of invert teaching is the inherent practice process of interaction design majors' self-reflection and self-criticism, as well as their reconstruction of the design curriculum. The study can be helpful to the development of education of interaction technology methods and creative ideas.

Social media and learning

The social media platform is an extension of Web2.0 technology, resulting in a great change in our online interaction behavior. (Jones & Gelb, 2010) Through investigation, Pew Research Center (2013) found the social media such as Facebook,

Twitter and Blog actually conducive to students' learning and performance. On the social network sites such as Facebook and Myspace on Web2.0, users can interact by using text, images or video messages. The social media is featured by proactive contact and reminder, interconnection between social groups, and diversified apps such as multimedia apps. For example, the openness of Facebook creates more diversified opportunities for learning, and learning in any form can be combined with interaction through this social network site. (Lin & Wu, 2010) In the field of education, the use of social media technology not only expands the space of learning and promotes intercommunication, but also can reduce the technical barriers between platforms. (Chen, 2015)

According to cognitive theory and interaction design activities, it is emphasized in the learning of interaction design to develop and accumulate knowledge and experience. One way is to collect information, which is an important step in design activities. Information collection can help designers explore design tasks, and get inspiration for creation from the use of existing products or information. (Kruger & Cross, 2006) The cognitive behavior of creative design is similar to the behavior of network link operation (David, 2014), and the former is shaped through the construction of knowledge and experience. Today, uncountable information has been filtered and transmitted by the nodes in the social media network, making it a veritable information hub (Li, 2014). Growing up with the design media, those born in the 1980s and 1990s tend to acquire information from the social media. Their cognitive behavior in interaction design seems to have become a feature of digital native designers.

The social media of China

The mainstream social media platforms in China are different from those in other regions of the world, and the way and behavior of Chinese netizens also vary. As shown in *Digital, Social & Mobile in China in 2015* issued by We Are Social, a group combining social media with digital and marketing skills, WeChat promotes the use of social media on mobile devices in China, and Baidu Post Bar is a network community established by the largest search engine Baidu in China centering on the specific interests of users, which are relevant to what users search on Baidu. The "Survey Report on the Generation Born in the 1990s" of Baidu in 2014 shows that this generation of China is worthy of the name of digital natives. They each follow 24 interest bars on average, and are the mainstream users of Baidu Post Bar.

The literature above is one of the reasons for the selection of WeChat and Baidu Post Bar in the design of the MICs, and constructivism learning and interaction technology design learning provide a theoretical basis for the MIC model.

MOBILE INVERTED CONSTRUCTIVISM MODEL

The MIC model can be divided into MICs and student-centered inverted classroom.

MICs (mobile inverted constructivism system)

The MICs is the information technology platform for invert teaching based on the combination of WeChat and Baidu Post Bar. With mobile phones as media, the MICs mainly uses the relevant functions of WeChat to apply for opening an official account for a course, and set it skipping to the course bar (specially opened for the course on Baidu Post Bar) through asynchronous broadcasting in the official account. As an instant messaging window, a class group is established by using the group chatting function of WeChat.

The course official account provides services for users mainly through the messaging and the web page in the account. After students add the course official

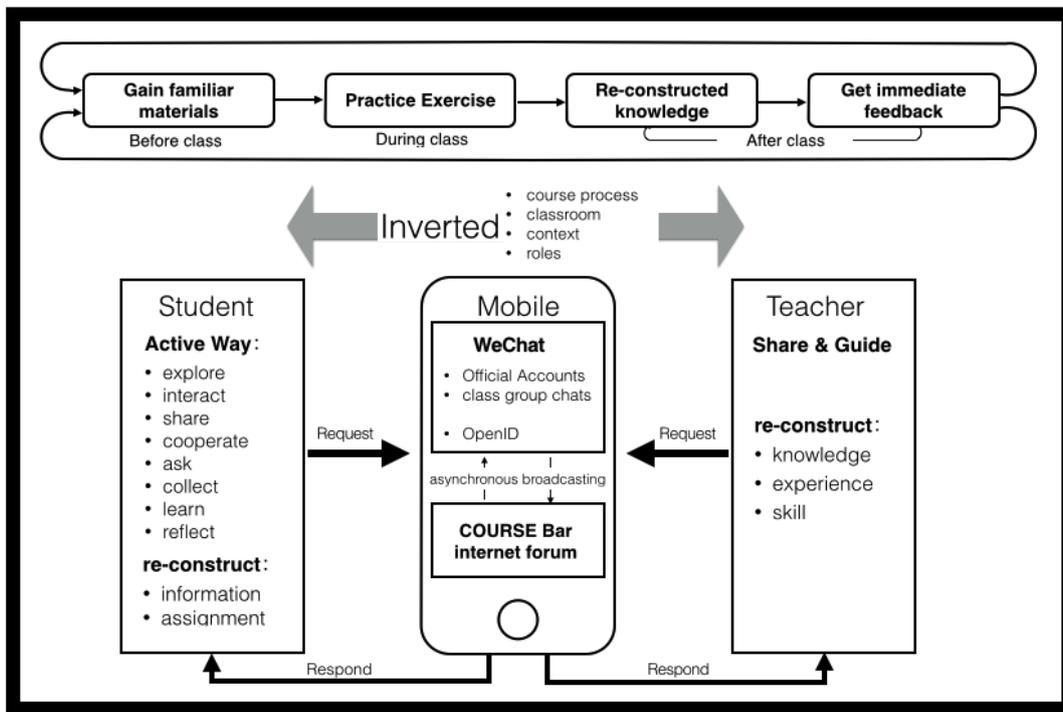


Figure 2. MIC model

account like contacts, messaging becomes the basis for the interaction between the official account and students, and provides teachers and students with the messaging services in different scenarios. The web page in the official account provides complex operation scenarios for the account, such as web page authorization for obtaining users' basic information and JS-SDK of WeChat (The original function toolkit of WeChat).

The MIC Approach

The operation flow of the MIC model: the construction and delivery of the curriculum follow the student-centered teaching sequence. The MICs inversely constructs the mechanism (as shown in the Figure 2) of the curriculum for interaction technology courses based on the accessibility of mobile phones at any time and any place and the convenient network connection. The detailed procedures are shown below:

(1) Before class: gain familiar with the teaching materials and make preparations for the class

The official account of the course can send messages simultaneously to all the students once a day and the messages can be in the forms of text, images and text, video and audio and so on, to provide interaction design and technology information (audio, images and video, etc.). It can passively respond to students' messages within 5 seconds, and can directly send messages to users with specific content templates when it is necessary to send service notices (for example, successful service reservation notices) to students.

With regard to the complex operation scenarios on the web page in the official account, the developer (for example, a teacher using the official account after application) can implement many functions on the background of the WeChat official account, by using JS-SDK of WeChat to shoot videos and broadcast audios, monitor the moments, upload local photos and take pictures. The mobile Web2.0

community interaction can be realized by obtaining a user OpenID through web page authorization and then getting access to the course bar.

(2) During class: practice exercise

During class, students have practice exercise of interaction design, and develop ideas by using the specific interaction technology design information posted by the official account. The reason for using the interaction technology design information specially pushed by teachers in design conception is that cognitive scientists found the best design ideas come from conceptually closer sources of inspiration (Chan & Schunn, 2011; Dunbar, 1997).

(3) After class: review the constructed knowledge, and get immediate feedback

The course bar is a major section for students to communicate after class, hand in homework, mutually evaluate design schemes and publish and share interaction technology design information. The official account is mainly opened for the Q&A between teachers and students, for the convenience of students to review after class.

The advantages of the MICs

The MICs integrates the mobile Internet access function of cellphones, instant communication function of WeChat, the messaging function of official accounts and the BBS interaction function of Web2.0.

The functional advantages of MIC

(1) Teachers' microphone after class

When students have interaction design activities before and after class, the MICs is just like the teacher's microphone. Students can discuss with the teacher and classmates about what makes them confused by using the group chatting function of WeChat, or directly send a message to the official account, which can be received by the teacher through the official account assistant, and get an instant response. The group-messaging function of the official account makes the important message delivered by the teacher seen at a glance.

(2) A portable disk of interaction design course materials

When having classes in a classroom without computers, students can find inspiration for interaction design exercise from the materials provided by the teacher through MICs and those uploaded by their classmates, which become a database. In this way, design fixation can be reduced, and students' creative thinking ability can be improved in class. Design fixation is usually caused by the shortage of design materials for reference in traditional classroom teaching.

(3) Reduction of technical barriers and popularization

The combination of WeChat and Baidu Post Bar reduces the original technical barriers between the platforms, and the way of switching by asynchronous broadcasting shortens the response time for switching from the course official account to the course bar. Students' WeChat OpenID can be obtained by web page search, making the MICs more fluent.

Based on the habit of students born in the 1990s to use social media in China, they also meet the students' needs and cognitive habit, and do not require additional installation or operation instructions due to the needs of the course.

The course bar allows login from WeChat official account, as well as the web version of Baidu Post Bar on the computer.

(4) The system is stable and does not require teachers to grasp development skills.

Both WeChat and Baidu Post Bar boast technical stability in the system. It does not require the teachers directly operating the course official account platform to grasp development skills.

(5) The MICs data information

The public platform of WeChat and the management platform of bar leader on Baidu Post Bar both provide the function of learning about and analyzing the basic data of the platforms. This allows teachers to check the condition of students' using the MICs on the background, thus to be more targeted in compiling information, adjust the orientation of information content pushing and improve the quality of the MICs content operation.

The advantages in teaching

- (1) In class, teachers can spend more time interacting with students.
- (2) The MICs provides students with an open space for sharing and learning.

CASE STUDY: UNDERGRADUATE INTERACTION DESIGN COURSE

The case study focuses on the interaction design course in the second semester of the sophomore, which lasted for 5 weeks, with 8 class hours per week.

Course Overview

- Develop an eye for seeing, and a language for talking about, interaction design
- Become familiar with human interface guidelines, principles of usability and fundamental interaction design details
- Practice evaluating if and how interactions can be improved
- Develop a portfolio to demonstrate your interaction design prowess

Generally, teaching materials ordered by schools or compiled by teachers in charge of the course are used in traditional interaction design courses. 16 class hours are for class teaching, and 24 class hours are for practical operation.

The MIC model was adopted for the class as the object of the research; the teaching material compiled by the teacher in charge was used as textbook; in the course, students played a major role of teaching, while the teacher gave guidance and made supplements.

Participants

The participants were the freshmen majoring in visual communication in a university in Guangdong of China, 4 classes in total. When enrolled, they were divided into different classes by random draw. They had finished Fundamentals course, such as UX Research & Strategy, before the interaction design course.

The experimental group: Class A (31 students) and Class B (29 students), using course MICs and the invert teaching strategy.

The control group: Class C (28 students) and Class D (29 students), using traditional teaching strategies.

The same teacher is arranged for the teaching of the 4 classes. The experimental group and control group share the same teaching content, homework content and requirements, and teaching schedule.

Course MICs architecture

Set the customized menu on the background of WeChat official account. The primary menu can be composed of no more than three blocks, and the secondary menu includes no more than five blocks. (As show in the Figures 3 & 4).

Course materials compose the primary menu of the first block in the customized menu of the course official account, under which the secondary menu is established, including user's mental model and cognition, visual interaction design and information design, designing experiments. The materials used in preview before mobile invert teaching classes are stored in this block.

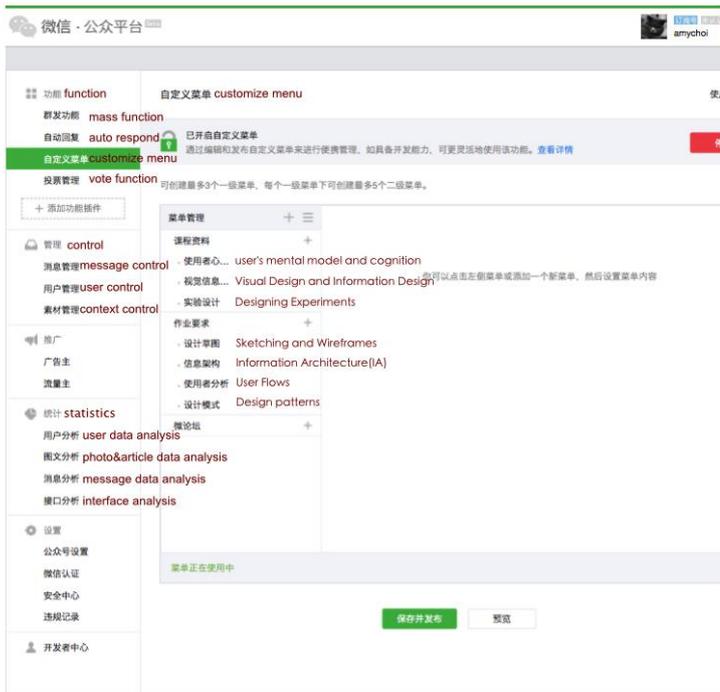


Figure 3. The WeChat public platform of the course

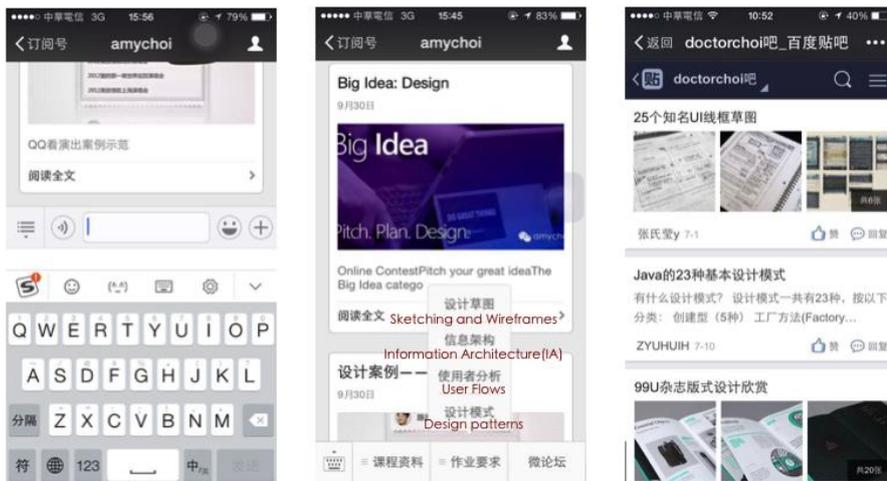


Figure 4. WeChat official account messages, internet forum (course post bar)

The primary menu of the second block is homework requirements, under which design patterns, information architecture, user flows, sketching and wireframes. This block is used for setting after-class requirements.

In the third block, the primary menu is micro-BBS. When clicked, it will skip to the course login page of the course bar (doctorchoi bar) on Baidu Post Bar, where students can interact with classmates and the teacher. The bar leader is the teacher, and students can voluntarily apply for becoming subordinate bar leaders, to manage the internet forum (the course post bar) of the course together.

WeChat official account messages, group messaging: push daily interaction technology news, 1-4 articles, in the forms of videos, images and text and so on.

Methodology and research model

We take into consideration that many factors may influence how students can learn well in interaction technology education, such as students' cognition of the

course, the quality of the curriculum framework design, learning environment and motivation. To explore whether invert teaching is suitable for the field of interaction technology, we apply the MIC model in interaction design courses. Based on the constructivist learning theory, we start from the perspective of cognitive development, and acquire the data related to students' design cognition changes, learning motivation and creative achievements in the MIC model with the method of experimental design, and make analysis.

In addition, on the basis of TAM, quantitative research is made on students' acceptance of MICs, to see the relationship between the MICs and students' learning motivation and creative achievements.

Students' design cognition types

The theoretical basis of this study: The cognitive development theory is the source of constructivist learning theory. In the study of design cognition, reports show: design cognition and creativity have reported that high and low creativity outcomes are affected by design cognition types during the design process (Atman et al., 1999; Christiaans & Dorst, 1992; Kruger & Cross, 2006). Kruger and Cross (2006) applied protocol analysis to identify the design strategies of nine industrial designers. The results suggested that design strategies can be categorised into four types: problem-driven, information-driven, solution-driven, and knowledge-driven design. Problem-driven design emphasises defining a problem and finding a solution as soon as possible. Information-driven design emphasises gathering information from external sources as the basis for developing solutions. Solution-driven design emphasises generating solutions without spending time defining a problem. Knowledge-driven design emphasises using prior structured and personal knowledge to develop a solution. These strategies can be regarded as distinctive design cognition types.

Interaction design majors of different years vary in design cognition types. Studies have shown that interaction design majors in their freshman or sophomore year tend to use information-driven design cognition; solution-driven strategy can obviously forecast creative achievements; internal motivation is in a significant positive correlation with problem-driven, information-driven, solution-driven and knowledge-driven cognition. (Lu, 2015)

Therefore, it is assumed that the design cognitive types of students in the experimental group and the control group would be significantly different before and after class.

In this study, the creative design cognition type scale was used (Lu, 2015). As students have the design courses and acquire a deeper understanding of design, their design cognition types will also change. In other words, they change with time and course learning. According to the degree of difference in the design cognition types of the students in the experimental group and control group before the course, it is discussed and proved that the MIC model can change design cognition types through the course. The change of design cognition types can improve creative achievements and have an influence on interaction technology education.

Hand out questionnaires: questionnaires were handed out twice, before and after the interaction design course respectively, to test the students' design cognition types.

The acceptability of MICs

To find the technical acceptability of MICs in inverted interaction design classroom and its influence on students' creative achievements, a research model was built based on literature discussion, in combination with TAM (Technology Acceptance Model) and the theory of creative achievements (Carson, Peterson, and

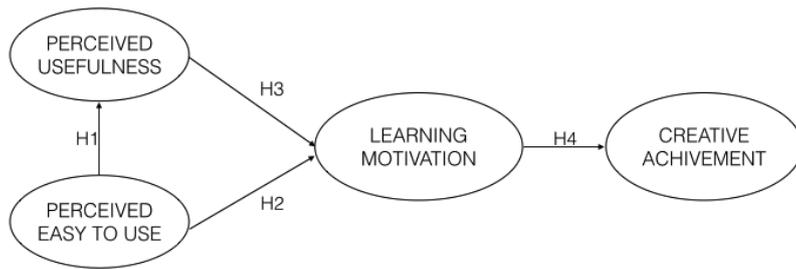


Figure 5. MICs Research Framework

Higgins, 2005), as shown in the figure 5. In this study, the predictor of the design students' outcome was creative achievements. Amabile, Hill, Hennessey and Tighe (1994) found in research that people's motivation could affect creative achievements. (Amabile, 1983) To measure creative achievements, the creative achievement questionnaire developed by Carson, Peterson, and Higgins (2005) was employed in this study. The scale is based on the theory of constructivism. The research variables included learners' perceived easiness to use, perceived usefulness, learning motivation of the system acceptance and creative achievement. Four hypotheses are proposed.

H1: Learners' perceived easiness to use can positively forecast their perceived usefulness.

H2: Learners' perceived easiness to use can positively forecast the learning motivation.

H3: Learners' perceived usefulness can positively forecast the learning motivation.

H4: Learning motivation can positively forecast the creative achievement.

Questionnaire design

The questionnaires for this study are divided into the questionnaire on students' creative cognition types and that on MICs acceptability.

The questionnaire on design cognition types developed by Lu (2015) was used. It was comprised by four types containing of problem-driven, information-driven, solution-driven and knowledge-driven. The questionnaire on the acceptability of the MICs was developed by the perceived ease-of-use (PEU) scale and perceived usefulness (PU) scale of TAM, and the learning motivation scale of the Meaningful Learning Model was used for the survey on learning motivation. (Huang, et al., 2011). The Creativity Achievement Questionnaire developed by Carson, Peterson, and Higgins (2005) was used.

The survey questions and items were defined based on relevant literature and expert opinions, and the trial survey was also carried out by experts. The total 31 items (shown in Appendix A) were measured by a 7-point Likert scale ranging from "strongly disagree = 1" to "strongly agree = 7". Afterwards, the questionnaire copies were handed out for pretest to students in the university where the experiment participants came from. Thus, the validity of the questionnaires can definitely be guaranteed.

The questionnaire on students' creative cognition types

In this study, the questionnaire on design cognition types developed by Lu (2015) was used. To ensure the face validity (Holden, 2010) and the authenticity of the questionnaire, we borrowed the instructions of 2015 Imagine CUP in our design cognition questionnaire.

The results were measured by the 7-point Likert scale. The statistical software SAS9.3 was used to analyze the experimental data.

Table 1. Reliability and factor analysis

Constructs and items	Shapiro-Wilk	P-value	KMO	Loading>0.7	Cronbach's α
problem-driven(PD)	0.97652	0.0006	0.76		0.79
PD1	0.938654	< 0.0001	0.77	0.72	0.77
PD2	0.87833	< 0.0001	0.74	0.84	0.69
PD3	0.906304	<0.0001	0.77	0.82	0.71
PD4	0.89644	<0.0001	0.76	0.74	0.76
information-driven(ID)	0.982712	0.0056	0.71		0.82
ID1	0.877336	<0.0001	0.81	0.77	0.78
ID2	0.929472	<0.0001	0.7	0.72	0.8
ID3	0.900343	<0.0001	0.81	0.73	0.79
ID4	0.939698	<0.0001	0.66	0.83	0.76
ID5	0.857632	<0.0001	0.62	0.75	0.79
solution-driven(SD)	0.937089	<0.0001	0.71		0.86
SD1	0.881932	<0.0001	0.73	0.87	0.83
SD2	0.906	<0.0001	0.65	0.92	0.75
SD3	0.884377	<0.0001	0.76	0.86	0.85
knowledge-driven(KD)	0.979174	0.0015	0.84		0.87
KD1	0.92355	<0.0001	0.84	0.78	0.85
KD2	0.923348	<0.0001	0.86	0.8	0.85
KD3	0.910302	<0.0001	0.83	0.8	0.84
KD4	0.918495	<0.0001	0.85	0.84	0.83
KD5	0.913491	<0.0001	0.81	0.82	0.84

In the analysis of the 4 design cognition types, the variables in the questionnaire were first analyzed, including assumption testing, test of appropriate, the reliability and validity testing of the factors, factor loading and factor score. The experimental data is in normal distribution, through Linearity Homogenous.

Henry Kaiser (1970) introduced an Measure of Sampling Adequacy (MSA) of factor analytic data matrices. According to MSA, the appropriateness of experiment data was tested. Based on Kaiser's (1974) point of view, if $KMO < 0.5$, it is not suitable for factor analysis; if the MSA of each factor of the experiment data > 0.5 , and the MAS of each variable > 0.5 , it is suitable for factor analysis. The factor loading, KMO and reliability of all items are shown in Table 1.

The Questionnaire on the Acceptability of the MICs

This study practically collects questionnaire data about the effectiveness of implementation of MICs and the procedure of questionnaire forming. The definition of measuring aspect and the items are based on literature and expert opinions, which are used for creating a formal questionnaire.

The evaluation was conducted by a questionnaire survey which comprised 3 parts of perceived easiness to use, perceived usefulness and learning motivation and 1 part of creative achievement. The questionnaire was designed to find out about the learner acceptance of this system. The perceived ease-of-use (PEU) scale and perceived usefulness (PU) scale of TAM were used in the survey on perceived easiness to use and perceived usefulness (Zhuang, 2008), and the learning motivation scale of the Meaningful Learning Model was used for the survey on learning motivation. (Huang, et al., 2011) In addition, for the remaining part of the questionnaire on creative achievements, the Creativity Achievement Questionnaire developed by Carson, Peterson, and Higgins (2005) was used. Some text of the scales is modified slightly to meet the demand for relevance to the text and course content compiled of the case studied in this paper. The final measurement contains 4 questions. The results were measured by the 7-point Likert scale. Academic experts reviewed the content validity of the questionnaire. Items less discrimination were

deleted and those with ambiguous wording were revised. The statistical software SAS9.3 was used to analyze the experimental data.

The factor analysis includes assumption testing, test of appropriateness, reliability and validity test of each factor, factor loading and factor score. The experimental data is in normal distribution, through Linearity Homogenous. According to MSA, the appropriateness of experiment data was tested. Based on Kaiser's (1974) point of view, if $KMO < 0.5$, it is not suitable for factor analysis; if the MSA of each factor of the experiment data > 0.5 , and the MAS of each variable > 0.5 , it is suitable for factor analysis. The factor loading and reliability of all items are shown in Table 2.

Data analysis

The analysis of students' design cognition types

In the analysis of students' design cognition types, Ttest results show that the 4 design cognition types of the students in the experimental group and control group are not significantly different before class, which means that the students are similar

Table 2. Reliability and factor analysis

Constructs and items	Shapiro-Wilk	P-value	KMO	loading>0.7	Cronbach's α
Perceived usefulness	0.88384	<0.0001	0.78		0.92
PU1	0.844855	<0.0001	0.74	0.9	0.9
PU2	0.80286	<0.0001	0.72	0.95	0.87
PU3	0.820432	<0.0001	0.88	0.9	0.9
PU4	0.826077	<0.0001	0.78	0.86	0.92
Perceived ease-of-use	0.864929	<0.0001	0.74		0.89
PEU1	0.848447	<0.0001	0.78	0.89	0.86
PEU2	0.826278	<0.0001	0.7	0.92	0.81
PEU3	0.857184	<0.0001	0.74	0.9	0.84
Learning Motivation	0.931909	0.0024	0.7		0.86
LM1	0.879636	<0.0001	0.65	0.92	0.75
LM2	0.874249	<0.0001	0.75	0.86	0.84
LM3	0.759909	<0.0001	0.73	0.87	0.83
Creative Achievement	0.92534	0.0013	0.75		0.81
CA1	0.875798	<0.0001	0.72	0.83	0.75
CA2	0.853964	<0.0001	0.7	0.86	0.72
CA3	0.848334	<0.0001	0.84	0.7	0.81
CA4	0.836542	<0.0001	0.8	0.8	0.76

Table 3. Ttest results on the experimental group and control group after class

Class	N	PD			ID			SD			KD			
		Mean	SD	Pr> t	Mean	SD	Pr> t	Mean	SD	Pr> t	Mean	SD	Pr> t	
Pre-test	A\B	60	5.8165	1.0717	0.2204	6.2849	1.3271	0.4595	11.9838	2.9073	0.4507	5.5145	1.3929	0.747
	C\D	58	5.5717	1.0867		6.1274	0.9382		12.4412	3.6295		5.5841	0.8819	
Post-test	A\B	60	7.2847	0.9816	<0.0001	7.6594	1.1298	0.0014	14.8306	3.1436	0.0098	6.8916	1.1298	0.772
	C\D	58	6.5665	0.7302		7.0363	0.9287		13.4413	2.5672		6.8373	0.8813	

Note: Pr<0.05

Table 4. Ttest results of the experimental group before and after class

Class	Test	N	PD			ID			SD			KD		
			Mean	SD	Pr> t	Mean	SD	Pr> t	Mean	SD	Pr> t	Mean	SD	Pr> t
A\B	Pre-test	60	5.8165	1.0717	<.0001	6.2849	1.3271	<.0001	11.9838	2.9073	<.0001	5.5145	1.3929	<.0001
	Post-test	60	7.2847	0.9816		7.6594	1.1298		14.8306	3.1436		6.8916	1.1298	

Note: Pr<0.05

in this aspect, and it is suitable to make inference about the influence of the MIC model on interaction design courses.

The Ttest results on the experimental group and control group after class show that the knowledge-driven cognition of the two groups are not significantly different, but the students' problem-driven, information-driven and solution-driven cognition vary a lot (As show in Table3).

From the Ttest results of the experimental group before and after class, the 4 design cognition types are all found to differ significantly from one another. (As show in Table4)

From the Ttest results of the control group before and after class, only the solution-driven cognition is found not to be significantly different (As show in Table5).

Inference: by teaching with the MIC model, the most significant change can be achieved in the solution-driven cognition of Class A and B in the experimental group, and a more significant change can also be seen in the problem-driven and information-driven cognition of Class C and D in the control group. According to the literature in section 3.3.1, students' solution-driven cognition and creative achievement are in positive correlation, so it can be inferred that the experimental group performs better than the control group in creative achievements. Based on this inference, the Ttest conducted on the creative achievement of the experimental group and the control group shows that the creative achievement differs significantly.

It can be seen that the MIC mode is applicable to the field of interaction technology education.

Analysis of learning motivations and creative achievements

The learning motivation of the creative achievements was a dependent variable, and perceived simple device operation and perceived usefulness were independent variables used for determining if one could forecast the other.

H1 explained the perceived usefulness with variance explained by 45.82%. The adjusted R² showed the explanatory power of 43.88%.

In H2, Perceived easiness to use was also selected to explain the learning motivation of the creative achievement with variance explained by 28.53%. The adjusted R² appeared the explanatory power of 25.97%.

Perceived usefulness was selected as a variable in H3 which explained the learning motivation of the creative achievement with variance explained by 40.81%. The adjusted R² was the explanatory power of 38.70%.

H4 explained the learning achievement with the variance explained 18.61%. The adjusted R² was the explanatory power of 15.71%.

According to Overall Model Test (F test):

$y = \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_i$ H0: $\beta_1 = \beta_2 = \dots = \beta_i = 0$, when the value of $p < 0.05$, the regression equation proves to be accept.

H1, $P < 0.001$; H2, $P = 0.0008$; H3, $P < 0.0001$; H4, $P = 0.0018$. Therefore, the hypotheses mentioned above all prove to be accept.

Table 5. Ttest results of the control group before and after class

Class	Test	N	PD			ID			SD			KD		
			Mean	SD	Pr> t	Mean	SD	Pr> t	Mean	SD	Pr> t	Mean	SD	Pr> t
C\D	Pre-test	58	5.5717	1.0867	<.0001	6.1274	0.9382	<.0001	12.4412	3.6295	0.0897	5.5841	0.8819	<.0001
	Post-test	58	6.5665	0.7302		7.0363	0.9287		13.4413	2.5672		6.8373	0.8813	

Note: Pr<0.05

Table 6. Summary of multiple regression model

Hypotheses	Paths	Pr > t	beta	Support
H1	Perceived ease-of-use → Perceived usefulness	<.0001	0.77620***	Yes
H2	Perceived ease-of-use → Learning motivation	0.0002	0.67185***	Yes
H3	Perceived usefulness → Learning motivation	0.0006	0.62756***	Yes
H4	Learning motivation → Creative Achievement	<.0001	0.76394***	Yes

Note *** denote $P < 0.001$

For regression coefficient test, the regression equations of H1, H2, H3 and H4 were obtained from the estimated parameter values gradually selected, namely

$$H1 \text{ PREDV1: } 2.82366 + 0.57785 * IV2$$

$$H2 \text{ PREDV2: } 3.64198 + 0.46449 * IV2$$

$$H3 \text{ PREDV3: } 2.27302 + 0.66246 * IV1$$

$$H4 \text{ PREDV4: } 2.93912 + 0.51488 * DV1$$

After the regression equations were obtained, Pearson Correlation was employed to conduct multiple regression cross validity testing for prediction accuracy and the criteria recommended by Cohen (1988) were used to test the relationship strength between the predicted and actual values (As show in Table 6).

DISCUSSION AND CONCLUSIONS

In the context of mobile Internet development, based on the theory of constructivism learning, invert teaching, social media learning, an MIC model is presented in this paper, which can be a new model combining social media and invert teaching. Through empirical study, we demonstrated MIC as a new way of inverting interaction technology education and reconstructing the content of interaction education.

Besides, in the MIC model, according to the habit of using social media of the generation born in the 1990s in China, we combined the platforms of WeChat and Baidu Post Bar, and designed a new invert teaching platform for interaction technology education—MICs. It is easy to operate without high requirements of technical skills, and can be widely used, which is a contribution of this study. During the interaction design course lasting for 5 weeks, the teacher found from observation that MICs could not only be used as a new platform of invert teaching, but also become virtual class that digital natives are most dependent on when learning the course. Compared with the instant communication in the course official account, students prefer switching and logging into the course bar. It is because they regard the course bar as different from common virtual class. In other words, they prefer the open community where the members are acquaintances on the platform of web2.0 for strangers. Such a behavior characteristic of them also makes us reflect on a better development orientation of the MICs in the future—“culture of sharing”. Through social media technology, the culture of sharing can form a vital space full of wisdom and interest, benefiting everyone.

The purpose of this paper is to realize the combination of education of interaction technology and invert teaching in the context of social media. The MIC model is presented, which enables interaction design majors to take up the microphone and become protagonists in the classroom. In this model, combined with the functional quality of social media in China, a Mobile Inverted Constructivism system (MICs) is designed on the platforms of WeChat and Baidu Post Bar. The MICs is easy to operate, and does not require operators to have professional skills. Thus, it can relieve the situation that the inverted classroom and micro-video teaching require excellent hardware condition of schools and highly qualified teachers and students.

From the experiment results of the interaction design courses, these findings can be summarized into the following points, providing references for other educators.

(1) The Chinese digital natives born in the 1990s are strongly featured by the use of the Internet, especially the mobile Internet. They can get familiar with MICs very quickly, which thus can stimulate students' learning motivation and creative achievement.

(2) The social media in China boasts unique characteristics, and the selection of proper mobile social platforms can make the MICs even better.

(3) Though repeated comparison of the experimental group and the control group, the MIC model can promote the solution-driven design cognition type, which can forecast creative achievements and learning motivations.

(4) The research framework built with TAM as its core is very important. Results show that perceived easiness to use can forecast perceived usefulness. The accessibility of the MICs can facilitate learning and perceived usefulness. In addition, perceived easiness to use and perceived usefulness can forecast motivation. Prediction shows that these two variables will influence learners' motivations. In other words, creative achievements can be predicted through the MIC model and based on its usefulness in learning.

(5) Students' role has changed and they also participate in the building of the interaction design course. In the MIC model, teachers have to pay more attention to students' learning in the virtual environment, and limit and reduce design resources. Managing the MICs jointly with students after class, teachers can save time spent in such management. In addition, students organize themselves. The success of the learning space is shared, which depends on the student-driven goals, and is a core aspect of triggering students' motivation in constructivist learning.

RESEARCH LIMITATIONS AND FUTURE RESEARCH PROSPECTS

Currently, the research mainly analyzes the MIC model from an empirical perspective, which inverts the interaction design teaching and reconstructs the teaching content of interaction design courses in social media. In the experimental process, as the researcher didn't participate fully in the learning process of students, the data sources for the MIC and the MICs are only restricted to questionnaire data. In the research, the subjective factors such as students' emotion and family backgrounds were not taken into consideration. In addition, due to the constraint of paper length, students' design cognition types described in the MIC have not been further discussed in detail by using the theories of constructivist learning and cognitive development. In future studies, it is hoped to better improve the MIC model based on the invert teaching combined with social media and by taking digital natives' learning characteristics and knowledge sharing into consideration, to further embody "the culture of sharing".

REFERENCES

- Amabile, T. M., Hill, K. G., Hennessey, B. A., & Tighe, E. M. (1994). The work preference inventory: assessing intrinsic and extrinsic motivational drivers. *Journal of Personality and Social Psychology*, 66(5), 950-967.
- Atman, C., Chimka, J., Bursic, K., & Nachtman, H. (1999). A comparison of freshman and senior engineering design processes. *Design Studies*, 20(2), 131-152.
- Baker, J. (2000). The 'classroom flip': Using web course management tools to become the guide by the side. In J. A. Chambers (Ed.), *Selected papers from the 11th International Conference on College Teaching and Learning*, 9-17. Jacksonville, FL US: Florida Community College at Jacksonville.
- Bösner, S., Pickert, J., & Stibane, T. (2015). Teaching differential diagnosis in primary care using an inverted classroom approach: student satisfaction and gain in skills and

- knowledge. Bösner et al. *BMC Medical Education* (2015) , 15-63. doi: 10.1186/s12909-015-0346-x.
- Carson, S., Peterson, J. B., & Higgins, D. M. (2005). Reliability, validity, and factor structure of the creative achievement questionnaire. *Creativity Research Journal*, 17(1), 37-50.
- Chan, J., Fu, K., Schunn, C. D., Cagan, J., Wood, K. L., & Kotovsky, K. (2011). On the benefits and pitfalls of analogies for innovative design: ideation performance based on analogical distance, commonness, and modality of examples. *Journal of Mechanical Design*, 133, 081004.
- change in science. In T. B. Ward, S. M. Smith, & J. Vaid (Eds.), *Creative thought: An investigation of conceptual structures and processes*, 461-493, Washington, D.C.
- Chen, Y. (2015). Action Research of InDesign and Layout Course for Graduate Students with Flipped Classroom: Facebook Platform as an Example (Master's thesis). Available from Airtitlibrary database.
- Cheng, P., Mugge, R., & Schoormans, J. P. L. (2014). A new strategy to reduce design fixation: Presenting partial photographs to designers. *Design Studies*, 35 (2014) , 374-391. <http://dx.doi.org/10.1016/j.destud.2014.02.004>.
- Christiaans, H. H. C. M. (2002). Creativity as design criterion. *Creativity Research Journal*, 14(1), 41-54.
- Christiaans, H., & Dorst, K. (1992). Cognitive models in industrial design engineering: a protocol study. In D. L. Taylor, & D. A. Stauffer (Eds.), *Design theory and methodology (DTM92)*. New York: American Society of Mechanical Engineers.
- Chung, H. S., & Fan, K. K.,(2014). Design and Evaluation of Learning Motivation, and Achievement on Mobile Knowledge Sharing System for Game Design Course Acceptance, *Journal of Internet Technology*, Vol. 15, No. 7, pp. 1197-1208, Dec., 2014. <http://jit.ndhu.edu.tw/>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Curry, T. (2014). A theoretical basis for recommending the use of design methodologies as teaching strategies in the design studio. *Design Studies*, 35 (2014) , 632-646. <http://dx.doi.org/10.1016/j.destud.2014.04.003>
- David, G.(2014, Dec). SOCIAL MEDIA, CONSTRUCTIVISM AND DESIGN STUDIO: LESSONS LEARNED. *The DesignEd Asia Conference*. http://www.designedasia.com/2014/Full_Papers/2014/19_Social%20Media%20Constructivism%20and%20Design%20Studio.pdf.
- Dunbar, K. N. (1997). How scientists think: on-line creativity and conceptual
- Flipped Learning Network (2014) The four pillars of F-L-I-P. Retrieved June 8, 2014, from http://fln.schoolwires.net/cms/lib07/VA01923112/Centricity/Domain/46/FLIP_handout_FNL_Web.pdf, doi: 10.4018/978-1-4666-4987-3.ch007.
- Greene, M. (2005). A constructivist perspective in teaching and learning in the language arts. C. Twomey Fosnot (Ed.), *Constructivism: Theories, perspectives, and practice* (pp. 99-109) (2nd ed.). New York: Teachers College Press.
- Holden, R. B. (2010). Face validity. In I. B. Weiner, & W. E. Craighead (Eds.), *The corsini encyclopedia of psychology* (4th ed.). 637-638, Hoboken, NJ: Wiley.
- Huang, Y. M., Chiu, P. S., Liu, T. C., & Chen, T. S. (2011). The design and implementation of a meaningful learning-based evaluation method for ubiquitous learning. *Computers & Education*, 57(4), 2291-2302.
- Jones, M. & Gelb, D. (2010) Course Co-Creation vs. Course Management: Wikis as a Potential Alternative to Traditional Learning Management Systems. T. Kidd & I. Chan (Ed.) *Wired for Learning: An Educators Guide to Web 2.0*, eds. 179-194, Charlotte, NC: Information Age Publications.
- Kaiser, H. F., (1974). An index of factorial simplicity. *Psychometrika*, 39, 31-36.
- Kennon, M. S.,(2014). Becoming Oneself. *Personality and Social Psychology Review*, (2014), Vol.18 (4), pp.349-365. doi: 10.1177/1088868314538549
- Kietzmann, J.H., Hermkens, K., McCarthy, I. P. & Silvestre, B. S. (2011). "Social media? Get serious! Understanding the functional building blocks of social media". *Business Horizons* 54: 241-251. doi:10.1016/j.bushor.2011.01.005
- Kruger, C., & Cross, N. (2006). Solution driven versus problem driven design: strategies and outcomes. *Design Studies*, 27, 527-548.

- Li, M. (2014). MOOC development opportunities and comprehensively improve the quality of higher education, *Journal of Education Research*, 5, 68-74.
- Lin, C. Y., & Wu, C.,(2015). A Study on the Influence of Facebook Learning Communities on Knowledge Construction in Digital Art Creation, *Journal of Design Science*, (2015), Vol. 18(1), 123-145.
- Lu, C. C. (2015) .The relationship between student design cognition types and creative design outcomes. *Design Studies*, 36 (2015). <http://dx.doi.org/10.1016/j.destud.2014.08.002>
- New York University (2015). The flipped class demystified. Retrieved June 27, 2015, from <https://www.nyu.edu/faculty/teaching-and-learning-resources/instructional-technology-support/instructional-design-assessment/flipped-classes/the-flipped-class-demystified.html>.
- Piaget, J. (1973). To understand is to invent: The future of education. 301- 409. New York: Grossman Publishers.
- Smith, K. M. (2014). Conditions influencing the development of design expertise: As identified in interior design student accounts, *Design Studies*, 36 (2015), 77-98, <http://dx.doi.org/10.1016/j.destud.2014.09.001>
- Wang, B. H.(2015, April 1). Explore educational logic “flip”. *China Education Daily*. Retrieved from http://paper.jyb.cn/zgjyb/html/2015-04/01/content_433163.htm?div=-1
- Zhuang, Z. J,(2008). The cognition and users satisfaction relationship of instant message software.



APPENDIX A

Constructs and items

Students' Creative Cognition Types (Lu, 2015)

problem-driven(PD)

PD1: I list the problems that must be resolved through design to adhere to the design goals and direction.

PD2: I thoroughly formulate my design goals and direction.

PD3: My ideas result from the design goal and direction that I establish.

PD4: I focus on the design goal and direction during the overall design process.

information-driven(ID)

ID1: I ask questions if the problems in the design task are unclear.

ID2: I spend a substantial amount of time gathering information.

ID3: I consider how to gather and organise information.

ID4: I try to identify problems that must be resolved through design from substantial amount of information.

ID5: I set the design goal and direction according to the design task and information gathered.

solution-driven(SD)

SD1: I always generate more design ideas than others do.

SD2: I can generate design ideas in a short amount of time.

SD3: I can generate various design ideas to provide diversity.

knowledge-driven(KD)

KD1: I remember to consider similar design.

KD2: I review my design knowledge to examine the problem that must be resolved through design.

KD3: I believe that my design knowledge assists me in developing design ideas.

KD4: I develop design ideas based on similar designs I remember.

KD5: I depend on prior design experience to generate design ideas.

Acceptability of the MICs

Perceived usefulness (PU) (Zhuang, 2008; Huang, et al., 2011; Su and Fan, 2014;)

PU1: I think that MICs is helpful to my learning.

PU2: I think that MICs can help me better understand the learning contents.

PU3: I think that using MICs in the course of and instruction is a good choice.

PU4: I think that the mobile device provided by MICs is good for learning.

Perceived ease-of-use (PEU) (Zhuang, 2008; Huang, et al., 2011; Su and Fan, 2014;)

PEU1: I think that MICs is easy to use.

PEU2: I think that MICs is convenient to use.

PEU3: I think that MICs is easy to understand.

Learning Motivation (LM) (Zhuang, 2008; Su and Fan, 2014)

LM1: I think that MICs can enhance my learning intention.

LM2: I will continue to use MICs in learning in the future.

LM3: I think that MICs provides a good learning approach.

Creative Achievement (CA) (Carson, Peterson, and Higgins, 2005)

CA1: I have taken lessons in this area.

CA2: People or teachers have commented on my talent in this area.

CA3: I have sold a piece of my work.

CA4: I have won a prize or prizes at a juried design show.
