Conceptions of learning in technology-enhanced learning environments

A review of case studies in Taiwan

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Abstract

Purpose – The purpose of this paper is to provide an overview of how students and teachers in Taiwan conceptualize learning, especially in technology-enhanced learning environments. Their conceptions of learning reveal the extent to which the prevalence of technological use in education has facilitated students to cultivate a more advanced conception of learning and develop a deeper learning approach.

Design/methodology/approach – It reviews a total of nine relevant case studies, covering the contexts of conventional schools (from elementary schools to college, and cram schools) as well as technology-enhanced environments (internet-assisted learning and mobile learning); and participants from Grade 2 students to adult learners as well as teachers. Their conceptions of learning and preferred learning approaches are summarized.

Findings – Results of the studies show the Taiwanese students' and teachers' conceptions of learning in general and of technology-enhanced learning in particular. The students tended to be passive learners to receive instructions and considered examinations as a short-term goal for their study, with surface learning approaches commonly adopted. Despite technology may help to promote their cultivation of a more sophisticated conception of learning, many of them still opted for rote memorization and practice as the major ways to study. The potentials of technology in enhancing learning thus have not been fully realized.

Originality/value – The results shed light on an Asian-specific educational culture which is exam oriented. They reveal the challenges regarding the use of technology in education, which hinder the promotion of students' advanced conceptions of learning. They also highlight the directions of future work to create a more accessible and gratifying technology-enhanced environment.

Keywords Conceptions of learning, Technology-enhanced learning, Technology-enhanced learning environments

Paper type Case study

Introduction

Technology-enhanced learning is one of the key emphases in contemporary education across the globe. In Taiwan, the adoption of technology for learning is also in a rising trend during the past decade. This has not only led to the development of technology-enhanced learning environments which has become highly prevalent, but also affected students' and teachers' conceptions of learning. This paper aims to examine – in the context of Taiwan where technology-enhanced learning has been commonplace – how students and teachers conceptualize their daily routine of “learning,” and the major distinction toward the conceptions of learning in various educational contexts especially with the adoption of technology.

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This paper reviews a collection of relevant studies on conceptions of learning, which covered various responses from students and teachers in Taiwan through interviews, questionnaires, and drawings. It captures their conceptions in diverse educational stages and angles, in the settings of conventional classroom learning and technology-enhanced learning environments. The results shed lights on the needs of future research that extends the scope and depth of the study of conceptions of learning.

Conception of learning

Conception of learning refers to a set of hierarchical conceptions toward the nature of learning. As proposed by Säljö (1979), it represents students' different epistemological stages in understanding the very act of learning itself. Conception of learning is hierarchical in the sense that it classifies learning into stages, ranging from the most fundamental study modes, namely rote memorization and practice, toward the more sophisticated ideas, including the realization of the context of knowledge as well as its possible applications. Basically, the conception of learning is deterministic to a student's approach in learning the subject.

Säljö (1979, p. 19) proposed that there are five categories of conception of learning as follows:

- (1) learning as the increase of knowledge;
- (2) learning as memorizing;
- (3) learning as the acquisition of facts, procedures, etc., which can be retained and/or utilized in practice;
- (4) learning as the abstraction of meaning; and
- (5) learning as an interpretative process aimed at the understating of the reality.

The first two categories were only "reproductive," repeating knowledge through memorization without further insights or investigations, whereas the last two were "reconstructive," which is a thematic way of studying by situating the knowledge into context, representing a deeper approach toward knowledge acquisition. The third category denotes a transition from the "reproductive" to the "reconstructive" perspective toward learning. Although the categories of conception of learning are hierarchical, they are never fixed. It means that students, when gradually moving onward from elementary schools toward universities, would develop their conceptions of learning from a simpler to the more sophisticated levels. In other words, conception of learning is developmental.

Over the years, the notion of conceptions of learning had been enriched by further studies and experiments. Studies (Eklund-Myrskog, 1998; Marshall *et al.*, 1999; Marton *et al.*, 1993) have shown quite similar conceptions of learning across different cultural groups and majors as proposed by Säljö (1979).

Technology-enhanced learning

Technology-enhanced learning refers to the employment of technology in the educational contexts, to assist the learning process and facilitate the communication between peers and teachers. Different from conventional face-to-face classroom lecturing, technology-enhanced learning not only facilitates the showcasing of multimedia teaching materials, but also encourages students to take initiative to research on their own, and to share with peers about their personal insights in online forums. It is hypothesized that students can cultivate more sophisticated conceptions of learning with the aid of technology in learning process (Tsai, 2009). Various approaches of technology-enhanced learning have been developed, such as internet-assisted learning, ubiquitous learning, mobile learning, and online education.

Significance of studying the conceptions of learning in technology-enhanced environments

The way students conceptualize their learning experience is highly relevant to the respective approaches they take for their study. If a student conceptualizes studying to be the preparation for examination or the preliminary way to secure a better job, they may only take a comparatively shallow approach in their study, and the ultimate study outcome would not be as satisfied as the educators have planned. As proposed by Kember *et al.* (2004), there are four major study approaches of learning, including the following:

(1) Surface motive.

The students have short-term goals in their studies, for example, they consider study as the preparation for examinations, and usually the examination results are indicators for their learning outcomes and efficiency.

(2) Surface strategy.

The students hold rather simplistic and mechanical ways to approach their study, for example, they memorize all the important points in textbooks, or practice calculation exercises only for passing the examinations.

(3) Deep motive.

The students are to a great extent contented with their learning experience, and are willing to continue the study process beyond the school context and explore extra related knowledge on their own.

(4) Deep strategy.

The students have the sense to relate new knowledge into the whole framework of the subject, or even beyond it, and show initiation to apply them to tackle unfamiliar problems.

For the above strategies, the first two are surface approaches while the last two are deep approaches toward learning. Surface approaches are the reproduction of acquired knowledge through routine procedures such as practicing, while deep approaches attempt to transform and generate further meanings of the knowledge in new contexts. As such, the study of technology-enhanced learning is to investigate how technology can promote students' use of deep approaches, thus a more inclusive and better learning attitude, moving onward from the sense of study-for-examination to study as in anywhere, anytime and as a life-long process.

Review of studies on conceptions of learning

This paper reviews a total of nine studies relevant to the conceptions of learning from various stakeholders in education. They altogether illustrate how conceptions of learning are understood in different manners. The studies involve discovery and comparison of students' conceptions of learning in the conventional campus environment, as well as key elements of technology-enhanced learning. The results also reveal the changes of students' and teachers'/adults' conceptions of learning when new technologies were introduced.

Study 1 – an exploration of elementary school students' conceptions of learning: a drawing analysis (Wang and Tsai, 2012)

This study interviewed 101 elementary students aged 10-12 regarding their conceptions of learning based on two questions: what is "learning," and what is the meaning, or the actual situation, of "learning" reveals to you. This study took the form of drawing to cater the interest and the presentation capability of elementary school students, while occasional

interviews were used whenever the drawings were unclear. A following-up study extended the learners to high school students (Hsieh and Tsai, in press). Figures 1-5 (drawings collected from Hsieh and Tsai, in press) are the prominent examples of the students' drawings, which reveal some aspects of conceptions of learning from the elementary and high school students' points of view.

These illustrations show explicitly different conceptions of learning in the conventional context of elementary education to secondary education in Taiwan (Hsieh and Tsai, in press;

Source: Hsieh and Tsai (in press)

Figure 1.
A drawing by a 12th grade student showing a teacher trying to put books into his cracked open head

Source: Hsieh and Tsai (in press)

Figure 2.
A drawing by an 8th grade student showing the situation of learning English vocabulary

Figure 3.
A drawing by an 8th
grade student
showing his
conception of “life”
before and after a test

Source: Hsieh and Tsai (in press)

Figure 4.
A drawing by a 12th
grade student
showing knowledge
increasing with time

Source: Hsieh and Tsai (in press)

Wang and Tsai, 2012). They mainly involve rote memorization – a teacher trying to manually insert knowledge into a student’s brain, and another teacher stressing the importance to memorize the vocabulary (Figures 1 and 2). The drawings also emphasize the school examination as a key event for the students, which dramatically “darken” their lives if they have gained poor results in it (Figure 3). Some students also considered learning as a process to increase one’s knowledge (Figure 4), and that the acquired knowledge can be applied to solve new problems (Figure 5).

Figure 5.
A drawing by a 12th grade student showing the application of knowledge to new problems

These drawings strike a similar chord to the conception of learning proposed in literature by reflecting some of its hierarchical categories, such as “memorizing,” “increase of knowledge,” and “retaining and utilization of knowledge.” They also reflect a conception of learning as to “tackle the exam” which was rarely covered in literature.

Study 2 – conceptions of learning science among high school students in Taiwan: a phenomenographic analysis (Tsai, 2004)

Students’ conceptions of learning may be dependent on the subject matter and culture. To have a more structural understanding about the characteristics and qualitative differences of the conceptions of learning, this study examined 120 Taiwanese high school students’ conceptions of learning in the science subject. The study took the form of interviews. The following guiding questions were asked:

- What do you mean by “learning science”?
- How do you know when you have learned something about science?
- How do you learn science?

Based on the students’ response, keywords such as “memorize,” “remember,” and “rehearse” were sorted out to generate the categories of conception of learning in science. The categories were then analyzed using the phenomenographic method, to give a set of indicators showing the qualitative difference among the conceptions. Seven categories of conception of learning science were generated:

- (1) Learning science as memorizing (“memorizing”) – learning science was characterized as the memorization of definitions, special terms, laws, and formula. The students in this category may learn science by reproducing knowledge through rehearsal or rote memorizing techniques.
- (2) Learning science as preparing for tests (“testing”) – examination was placed to be the priority and the ultimate goal of learning science. The students’ examination

scores were considered as the indicator for the effectiveness of their learning. This category may reflect the special culture in Taiwan that emphasizing test scores for learning.

- (3) Learning science as calculating and practicing tutorial problems (“calculating”) – science learning was conceptualized as a series of mechanical training, such as calculating, practicing tutorial problems, and manipulating formulae and numbers. This category may be related to the learning subject (i.e. science) under investigation, as science involves a lot of calculating and problem solving.
- (4) Learning science as the increase of knowledge (“increase”) – science learning was conceptualized as the accumulation of scientific knowledge, or the “correct knowledge” to be learnt in a formal academic setting.
- (5) Learning science as applying (“applying”) – this category stresses the importance of application of scientific knowledge to practical situations.
- (6) Learning science as understanding (“understanding”) – science learning was conceptualized as the way to construct integrated and theoretically consistent knowledge in a larger scientific framework. It is also a process in making sense of the natural phenomena.
- (7) Learning science as seeing in a new way (“seeing in a new way”) – science learning is to acquire a new way to interpret the nature.

These seven categories form a framework as illustrated in Figure 6, which shows three major dimensions in the conception of science learning.

- (1) The “form of knowledge acquisition” – ranging reproducing, knowing, and extending and developing.

For “memorizing” and “increase” (increase scientific knowledge), they belong to a more fundamental form of knowledge reproduction. On the other hand, for “applying” and “seeing in a new way,” they are aligned to the more sophisticated “extending and developing” form of study.

Figure 6.
A framework which
describes students'
conceptions of science
learning

Source: Tsai (2004, p. 1,745)

- (2) The “motivational orientations” – external vs internal.

For the students’ motives in learning science, the lower conceptions of “memorizing,” “calculating,” and “testing” are originated from external factors, such as the want of passing examinations, while the other categories are more oriented toward the students’ own initiative in crafting new knowledge.

- (3) The “standards of evaluating learning outcomes” – quantitative vs qualitative.

Different categories of conception of learning reflect the anticipated effectiveness of the learning activity itself. In Figure 6, the conceptions of “memorizing,” “testing,” “calculating,” and “increase” lie more toward to the quantitative side. The students uphold a more quantitative view in learning science, such as getting the right answer, or achieving high scores in examinations, while the other categories show a qualitative approach in learning science, where the students are intuitive to integrate the things they learnt into a more grand structure of science framework.

Study 3 – cram school students’ conceptions of learning and learning science (Tsai and Kuo, 2008)

Students’ conceptions may be related to the learning or educational context. The purpose of this study is to determine the students’ conception of learning, focusing specifically on the cram schools as a unique educational context among Asian culture. Cram schools provide after-school instruction to the students to consolidate their learning, and to assist them in achieving good results in examinations. The study investigated whether the highly exam-oriented educational context affects the students’ conceptions of learning.

This study interviewed 45 Taiwanese junior high school students’ conceptions of learning in general and learning science in particular. The interviews included a total of five guiding questions:

- (1) What do you understand by “learning” (or “learning science”)?
- (2) When someone asks you “what is learning (or learning science)”, how will you tell him or her?
- (3) How do you know when you have learned something (about science)?
- (4) How do you learn (or learn science)?
- (5) Describe a learning environment.

The responses of the interviews were grouped and divided into the seven categories of learning conception: memorizing, preparing for tests, calculating and practicing tutorial problems, the increase of knowledge, applying, understanding, and seeing in a new way. These categories are exactly the same as those in Tsai (2004).

The study further compared the conceptions of learning in general as well as especially for those of learning science, and then revealed concurrence between the two. Over 75 percent of the students expressed same categories of the two conceptions. It shows that, in the context of Taiwanese cram schools, there exists a certain generality in conceptions of knowledge regardless of the knowledge domains. By counting students’ conceptions of learning across the seven categories, the study also shows that the majority of the conceptions lied in the quantitative side (more than 95 percent), and were motivated mainly by external factors (more than 90 percent). It also shows that the form of knowledge acquisition was restricted only to “reproducing” and “knowing,” but never reached the level of “extending and developing” when referring to the illustration in Figure 6.

The results showed that the educational context of Taiwanese cram school does affect the students' conception of learning. The educational practice of cram school is to atomize the school knowledge by training the students in isolated fields of knowledge. The schools also urged them to practice and memorize the isolated knowledge for the sole objective of obtaining high scores in public examinations. As a result, the students would only apply the surface study approach, e.g. practicing and calculating, and the domain-specificity of the conceptions of learning is greatly diminished.

The results of Studies 1-3 reveal that Taiwanese conventional educational contexts (i.e. elementary schools, high schools, and cram schools) mainly cultivate students' lower level of conceptions of learning, for example, by only memorizing text-book knowledge or practicing supplementary exercises to tackle examinations. However, the rise of technology-enhanced learning presents the need to investigate whether the extensive change in instruction techniques would cultivate students' deeper levels of conceptions of learning. The respective findings are presented in the following studies.

Study 4 – conceptions of learning vs conceptions of web-based learning: the difference revealed by college students (Tsai, 2009)

As the learning context plays an important role in students' conceptions of learning (Tsai and Kuo, 2008), it is interesting to know if technology-enhanced learning context may have influences on them. With the increased popularity of web-based learning, this study searched for evidence regarding students' conceptions of learning after experiencing web-based instructions. It interviewed 83 Taiwanese undergraduate students who had experience in web-based learning. Comparing with conventional instruction, web-based learning features promotion of interaction between peers and teachers, as well as self-initiated research of course materials. The interview covered the following questions.

Questions on conceptions of learning:

- (1) What do you understand by "learning"?
- (2) How do you know when you have already learned something?
- (3) How do you learn?
- (4) Please describe a situation in which you think you are learning.

Questions on conceptions of web-based learning:

- (1) What do you understand by "web-based learning"?
- (2) How do you know when you have learned something in a web-based context?
- (3) How do you learn in a web-based context?
- (4) Please describe a situation in which you think you are learning in a web-based context.

Based on the data, students' conceptions of learning and conceptions of web-based learning were compared. For students' conceptions of learning, the categories of "memorizing," "getting a better status" (such as getting a better test score or future job), "calculating and practicing," "applying," "understanding," and "seeing in a new way" were found. For their conceptions of web-based learning, the results show that none of the students considered web-based learning as "memorizing," "getting a better status," and "calculating and practicing." The students' demonstrated more in-depth understanding toward learning, when web-based instruction was introduced.

That is, in general, the students tended to expressed more advanced conceptions of web-based learning when compared with learning in general.

The results reveal that college students generally hold more sophisticated conceptions toward web-based learning. The students would look differently into the knowledge gained from a non-school context. Such difference may be originated from the flexibility of web-based learning, which makes knowledge more accessible and applicable, and hence the higher percentage of students choosing the categories of “applying” and “seeing in a new way.” The results suggest that web-based instruction can enhance students’ conceptions of learning or change the conceptions into more mature ones.

Study 5 – effects of different forms of physiology instruction on the development of students’ conceptions of and approaches to science learning (Lin et al., 2012)

As known from the previous study, the web-based learning context may be a promising way of fostering students’ conceptions of learning, this study further examined the effects of technology-enhanced instruction to students’ conceptions of learning science and their study approaches. It involved 79 college students which were divided into an “internet-assisted instruction group” and a “traditional instruction group.” Both groups attended a physiology class taught by the same lecturer, and used the same text-book. For the traditional instruction group, the students mainly learnt through one-way lecturing along with the chapters of the book and PowerPoint slides, while the internet-assisted instruction group was asked to search for extra materials on the internet after each class and to participate in online discussion. Students of both groups also participated in two questionnaire surveys regarding their conceptions of learning as well as approaches to learning before and after the instructions.

By analyzing the students’ questionnaire responses via a series of ANCOVA analyses via using the pretest scores as co-variables, it was found that after the classes, the internet-assisted instruction group scored lower in the less advanced conceptions of learning science (i.e. memorizing, testing, calculating and practicing) than the traditional instruction group, while this group obtained higher scores in the more-advanced conceptions (i.e. increase one’s knowledge, applying, understanding, and seeing in a new way).

Moreover, the learning approaches of the students indicated that the internet-assisted instruction group tended to take more sophisticated learning approaches, i.e. deep motive and deep strategy, than the traditional instruction group. However, this group also got a high score in surface motive, which means they were also afraid of failures in study such as getting low examination marks.

It is concluded that the higher flexibility and interactive prompt of internet-assisted instruction provides students with wider options for acquiring knowledge, such as using online resources as well as gaining insights from the discussion with peers. The study shows that internet-assisted instruction focused more on the learning process rather than paving the way to examinations as a final goal. As a result, the students of the internet-assisted instruction group expressed more agreement with the idea that learning is to see things in a new way, and the tendency to adopt deeper motives and strategies in approaching their study. However, they also expressed concerns regarding their performance in the class, in terms of whether they could achieve the teachers’ expectations when the means of performance evaluation were obscure.

Study 6 – college students’ conceptions of context-aware ubiquitous learning: a phenomenographic analysis (Tsai et al., 2011)

This study explored another context of technology-assisted education – the area of ubiquitous learning (u-learning), which emphasizes learning anywhere and anytime with the assistance of mobile devices, so that students can go out of the classroom and situate themselves in the authentic context of the subject.

The study aimed to determine the categories of students' conceptions of u-learning. It interviewed 22 Taiwanese college students who had participated in a u-learning activity studying the history of coins in a numismatic museum. The students were given personal digital assistants (PDAs) with radio-frequency identification readers that could show multimedia and interactive information to accompany their studies. After the study activity, the students were interviewed with the following questions:

- (1) Based on your experiences, what do you mean by "u-learning"? Please describe your experiences of your u-learning.
- (2) When your friends ask you about the u-learning activities, what will you tell them?
- (3) What do you do and think about u-learning activities?

Based on the interview response, five categories of students' conceptions of u-learning were discovered as follows:

- (1) U-learning as the application of technology – students conceptualize u-learning as a way to employ modern technology in the learning process, such as using PDAs to show multimedia information.
- (2) U-learning as a platform for attaining information – students consider that the main function of u-learning is to provide information instantly, and that it is convenient to use technology to obtain information anywhere.
- (3) U-learning as a timely guide – students consider technology as a means to provide timely guidance whenever they are lost during the learning process.
- (4) U-learning as increase of knowledge – students consider u-learning as a way to increase their general knowledge, so that they can relate the extra knowledge to those previously acquired in school.
- (5) U-learning as active learning – students conceptualize themselves as enquirer of knowledge, and u-learning is a beneficial way to assist their open-ended, question-answer mode of learning.

Apart from identifying the five categories of conceptions of u-learning, the results also indicated the students' mixed conceptions of it. For example, a student would simultaneously express u-learning as a "timely guide" as well as "a platform for attaining information."

By uncovering and mapping the main categories of conceptions of u-learning, this study establishes a basic understanding of the students' idea toward u-learning. All of the students could identify it as a new form of technology being applied to their study.

Study 7 – Taiwanese high school teachers' conceptions of mobile learning (Hsieh and Tsai, 2017)

After conducting a series of students' conceptions of learning or technology-enhanced learning, it is also important to explore these conceptions from the teacher side. This study interviewed 15 Taiwanese senior high school teachers, covering their experience in applying mobile learning to the classrooms. Using the phenomenographic approach, it examined the categories of teachers' conceptions of mobile learning. In the interviews, the following questions were asked:

- (1) What makes you decide to integrate mobile learning into your teaching?
- (2) What do you use mobile devices for in your teaching?
- (3) How would you portray your ways of teaching since you started using mobile devices to teach?

- (4) Please describe a lesson incorporating mobile learning activities in your classroom that you considered as successful/unsuccessful, and why you think they are successful or unsuccessful?
- (5) If you were to give an official definition of “mobile learning,” how would you express it?

From the teachers’ responses, six categories of their conceptions of mobile learning were identified as follows (Hsieh and Tsai, 2017):

- (1) Mobile learning as meeting student preferences – teachers regard the implementation of mobile learning is to “keep with the trend.” The adoption of new technology could capture the students’ attention and arise their interest in learning.
- (2) Mobile learning as conducting classes with efficiency – teachers regard mobile devices as a convenient tool to make the class proceeds smoothly, as they eliminate the limitations of time and space, and boost interactivity in the class.
- (3) Mobile learning as invigorating and enhancing learning – teachers consider mobile learning as a vehicle to invigorate and enhance learning. Mobile devices serve to promote student engagement and also as cognitive tools to concretize knowledge, consolidate learning, and showcase student learning.
- (4) Mobile learning as parting from traditional teaching – as mobile devices can promote different modes of learning, such as exploratory learning and contextual learning, teachers in this category consider mobile learning as a break through from traditional learning. Teachers are no longer the only source of knowledge in the classroom, but instead students can also tailor their learning for their needs.
- (5) Mobile learning as focusing on student ownership – in this category, the classroom authority in the use of mobile technology shifts from teachers to students. The students can explore freely on their own regarding the knowledge they want to obtain, or devise their own learning with the teachers’ assistant. In other words, the students start to adapt to a more individual, self-initiated mode of learning.
- (6) Mobile learning as extending learning beyond school – teachers no longer confine their views on mobile learning within the school context. Instead, they consider it as a powerful tool to grant students freedom to acquire knowledge beyond the school. Thus, learning becomes an activity that can happen anywhere at any time.

Based on these six categories, Hsieh and Tsai (2017) further discussed teachers’ conceptions of mobile learning in terms of some key aspects, which are illustrated as follows:

- (1) Attention locus – attention locus refers to the teachers’ attention given in the classroom, whether the attention is paid to the mobile device (machine) or the learners. The attention loci of the first three categories of conceptions of learning are mainly machine based, while the latter three are learner based. Moving onto the categories 4 and 5, the presence of mobile devices in the classroom lowers, as the technology has already been used seamlessly in the learning process.
- (2) Instructional design thinking – instructional design thinking reveals teachers’ orientation in the learning process, either toward their teaching plan or to the learning outcomes of the students. Of the six conceptions of mobile learning, the role of mobile devices in categories 1 and 2 is a tool to facilitate the instruction. When moving onward to category 3-5, the students’ learning outcome starts to become a concern of the teachers, for the enhancement of the students’ knowledge by utilizing the mobile devices. In category 6, the mobile technology is fully integrated to the learning process as to promote self-learning outside the school.

- (3) Classroom power dynamics – classroom power dynamics refers to the degree of control and power in the classroom with relation to the use of mobile devices. In categories 1 and 2, the power of using mobile devices inclines to the teachers, in which they have total control of when and how to use the technology in the classroom for carrying out their pre-established planning. Categories 3 and 4 reflect the corporation of the teachers and the students in empowering the latter to use the devices on their own. In category 5, the power shifts to the students for their decision of how to use the technology to gain the knowledge that interested them. In category 6, the students possess total control of the mobile devices beyond the school context to enhance their personal development in terms of learning.
- (4) Process-product emphasis – process-product emphasis reflects the teachers' orientation either toward the obtainment of learning outcome or their emphasis in the learning process. Among the categories, only category 1 does not belong to these both, as teachers of this category only follow the general trend to employ technology in class. Categories 2 and 3 relate technology to the improvement of students' learning outcome, while category 4 gradually shifts education from its end to its process, which is completely realized in categories 5 and 6 to give students opportunity to use technology in their own active learning.

The findings show that the teachers' conceptions of mobile learning are in parallel with that of the students' conceptions of technology-assisted learning. Lower levels of conceptions show that technology does not add much to the learning experience, but only provides a new yet rudimentary means to display text-book knowledge. Only with the higher levels of conceptions, the teachers allow the students to have the freedom of technological usage to search for their personal interest topics. Also in those higher levels of conceptions, mobile learning attains a state of "normalization" (Bax, 2003) that technology becomes "maximally useful." The mobile devices can be used unconsciously by the students on their own with greatest efficiency. As a result, if "normalization" of technology in the classroom is the ideal state to be reached, educators should focus on how to cultivate the teachers' more sophisticated conceptions of learning, so that they could assist the students' in their awareness of using technology for the development of their own sophisticated, inclusive conceptions of learning.

Study 8 – learning illustrated: an exploratory cross-sectional drawing analysis of students' conceptions of learning (Hsieh and Tsai, in press)

How students may change their conceptions of learning by the years of schooling? This study gathered a group of 1,067 Taiwanese students from Grades 2, 4, 6, 8, 10, and 12 for the task to illustrate their learning experience, according to the following questions:

- What is learning?
- What is it like when you are learning?

The form of study 8 is thus similar to that of study 1, except in here the particular foci are on:

- (1) the presence of technology devices in the students' drawing, to see to what extent do they are aware of technology as a tool in school learning and
- (2) the development of the students' conceptions of learning in terms of context, human agencies, as well as their emotions and attitude toward the learning experience.

Figures 7-10 are examples of drawing showing the presence of technology devices. Of the over 1,000 drawings obtained, technology only appeared at a percentage as low as

Source: Hsieh and Tsai (in press)

Figure 7.
A drawing by a 12th grade student showing different contexts of learning experience, including text-book, computers, classrooms, and natural environment

Source: Hsieh and Tsai (in press)

Figure 8.
A drawing by a 10th grade student showing different channels to obtain knowledge, including text-book, technology, and nature

around 5 percent. Although some students did realize that technology could be integrated into their learning process for knowledge acquisition (Figures 9 and 10), the others only considered it as a replacement of textbooks (Figure 9) or simply an entertainment device (Figure 10). In other words, in general the students still considered their education contexts to be traditional, where classroom was still the dominant place for education and the learning mode is presumably passive.

Figure 9.
A drawing by a
6th grade student
showing a mobile
device for reading
e-books

Source: Hsieh and Tsai (in press)

Figure 10.
A drawing by a 6th
grade student
showing a mobile
device playing music
with a text-book at
the side

Source: Hsieh and Tsai (in press)

Figures 11-16 are examples of drawings showing various learning situations by students from different grades. From the drawings, three major developmental trends in their conceptions of learning can be observed, as follows:

- (1) Context dependency – for the lower grade students (Grades 2 and 4), the learning situations they involved in were mainly episodic, such as the depiction of a classroom activity or a chance to learn a particular skill (Figures 11 and 12). Their conceptions of learning have the obvious elements of who, where and how, which

Source: Hsieh and Tsai (in press)

Figure 11.
A drawing by a 2nd grade student showing herself drawing pictures in the classroom

Source: Hsieh and Tsai (in press)

Figure 12.
A drawing by a 4th grade student showing her asking her mother to teach her sweeping

are highly contextualized. On the other hand, for the higher grade students (Grade 6 onward), they could relate more to a more “traditional” way of learning, such as devising a strategy in preparing the examinations (Figure 16).

- (2) Appearance of human agencies – in general, students of higher grades would show more autonomy in learning. They would see themselves as the only agent involved in the learning process (Figures 14-16), comparing to the lower grade students who saw learning as a collective activity in the classroom, where all students passively received

Figure 13.
A drawing by an 8th
grade student
showing his
perception of a
traditional classroom

Source: Hsieh and Tsai (in press)

Figure 14.
A drawing by a 12th
grade student
showing himself
facing a wall of books

Source: Hsieh and Tsai (in press)

- knowledge lectured to them (Figure 13). This may be due to the former's realization of the public examination as an ultimate goal of education, thus the students emphasized the importance of individual effort devoted in the study process.
- (3) Emotional development – the drawings also show a negative development in the students' emotions when they are moving onward from lower grades to higher grades. The lower grade students tended to remain a positive attitude toward learning, such as delightfully drawing a picture (Figure 11) or to learn a new thing

Source: Hsieh and Tsai (in press)

Figure 15.
A drawing by a 6th grade student showing a deminish figure with the word "English" on its forehead haunting him

Source: Hsieh and Tsai (in press)

Figure 16.
A drawing by a 10th grade student showing her approach to prepare an examination

(Figure 12). However, the higher grade students maintained a generally negative attitude toward learning, for instance they expressed the helpless feeling facing the countless amount of textbooks (Figure 14), or more explicitly the fear of getting low marks in examinations (Figure 15).

Figure 17 summarizes the above findings of the presence of technology, together with the presence of tests in the students' drawings. For the percentage of technological presence in the Taiwanese educational context, the figure reveals a slight increase of the trend from

Figure 17.
Technology and
testing in children's
drawings

Source: Based on the data analyzed from Hsieh and Tsai (in press)

kindergarten to Grade 4, and then a gradual decrease onward, while the overall percentage remains relatively low (less than 8 percent). On the other hand, for the presence of testing elements, it shows a constant increase of trend – which is correlated to the increasing learning autonomy and negative emotion as the students grow up, showing the overpowering role of public examinations in their educational experience.

The descriptive nature of this study provides insight into the developmental trend of students' conceptions of learning. It serves as the basis for further study on determining the difference among the key aspects of the conceptions, as well as the ways to foster the effective cultivation of the more sophisticated conceptions, and to develop the students' advance learning strategies and approaches.

Study 9 – exploring in-service preschool teachers' conceptions of and approaches to online education (Yang and Tsai, 2017)

The last study aims to explore adult learners' (or teachers') conceptions of online learning. It interviewed 91 Taiwanese in-service preschool teachers who had enrolled in various online courses. The contents of the courses include video lectures, tests, assignments, and discussion through video conferences. The purpose of the study is to identify the categories of conceptions and approaches of online education, and to investigate the correlation among these categories.

The interviews took the form of open-ended written essay with the following essay questions, where the first two questions regard the categories of conceptions, and the last two are about the approaches taken for online education:

- (1) Why did you take online education?
- (2) Based on your own experience, what do you think online education is?
- (3) What sort of things did you do to engage in online learning?
- (4) When you were learning through online programs, what strategies did you use and why did you use them?

Based on the interviewees' responses, four main categories of conceptions of online education were identified:

- (1) online education as a way of course completion;
- (2) online education as a way of online shopping for knowledge or courses;
- (3) online education as a way of self-paced learning; and
- (4) online education as a way of life-long learning.

Same as the previous studies, the conceptions of online education are hierarchical. The first two categories represent the students' less advanced conceptions toward their learning. Either they only wanted to fulfill the course requirements so as to obtain the diploma, or they saw it as a form of "online shopping" of knowledge that did not develop into the higher aspiration of life-long learning. On the other hand, the latter two categories represent more adaptive and self-initiated conceptions toward online education. The students knew how to make good use of the convenient online materials and forums for revision and discussion, they also considered online courses as a creditable addition to their routine lives for life-long learning.

The study also identified five approaches to online education:

- (1) I engage in online education to interact with people.
- (2) I engage in online education to manage my time.
- (3) I engage in online education to do multiple tasks at once.
- (4) I engage in online education to explore more online learning channels.
- (5) I engage in online education to get involved in the community of sharing.

The approaches follow the same vein developed from other studies. The first three represent the surface approaches, where the students only realized the functional convenience of online education in making the time more manageable or the communication easier. In this case, they still retained a conventional attitude that education means the fulfillment of set requirements, such as participation in an online forum. The latter two represent deeper approaches to learning. For example, the students would initiate to explore alternative online channels for relevant resources, or even actively engage in peer-sharing of personal insights.

Further analysis also shows the association between conceptions of learning and their respective approaches. It shows the more or less predictable less advanced conception/surface approach relation and more sophisticated conception/deep approach relation.

Summary of conceptions of learning

The nine studies reviewed in this paper serve as a thorough overview regarding the Taiwanese students' and teachers' conceptions of learning in general and technology-enhanced learning in particular. For the educational contexts from elementary schools to colleges, the conceptions of learning (or learning science) mainly include the following categories:

- (1) learning as memorizing;
- (2) learning as preparing for tests (or a better career);
- (3) learning as calculating and practicing tutorial problems;
- (4) learning as the increase of knowledge;
- (5) learning as applying;
- (6) learning as understanding; and
- (7) learning (science) as seeing in a new way.

It was found that many students who participated in these studies tended to remain as passive learners to receive instructions, and considered examinations as a short-term goal for their studies. That is, the students developed less advanced conceptions of learning and shallower approaches to the learning activities. This situation is especially prominent in cram schools, where knowledge is atomized and mechanical training is emphasized. Following the surface learning approaches, students would rely on rote memorization and practice as the major ways to study (study 1-3).

When technology is employed as a means to assist learning, students would develop more sophisticated conceptions and deeper approaches toward learning. For example, the flexibility and resourcefulness of the internet allow students to search efficiently anytime and anywhere for the materials that interest them. The increased interaction with peers through online forums also boosts the students' initiative to share their own ideas or to explore more on a topic (studies 4 and 5). Besides, Study 7 took the perceptives from the teachers to determine their conceptions of mobile learning, to act as the foundation for future research to see how their conceptions can be promoted to encourage the utilization of technology in the classroom. For studies 6 and 9, they explored conceptions of learning in other contexts such as u-learning and distance/online learning.

Conclusion

The studies show that technological-enhanced learning holds high potentials to cultivate the Taiwanese students' conceptions of learning and their learning approaches. It is also important to develop the teachers' understanding toward the convenient and rewarding advantages of technology, so that they can assist the students to apply the technology on their own. On the other hand, the studies also show the challenges regarding the use of technology, such as the discrepancy between sophisticated conceptions of learning and shallow learning approaches as shown in the study of online education, which does not fully realize the students' original intention to extend their scope of study through online learning. Future studies thus need to examine the authentic contexts of internet-assisted learning and online courses to pave the way for the creation of a more accessible and gratifying online learning platform.

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