Effective Teacher Training for Tablet Integration in K-12 Classrooms

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Abstract

Tablets are mobile technology that offers students a more stimulating experience with portable, engaging, and interactive tools. Although tablets are increasingly being integrated into K-12 classrooms, it will be impractical if teachers do not apply the right teaching methods for tablet integration into the curriculum. The question of how to create an effective technology training program for teachers to deploy tablets into a K-12 classroom curriculum remains largely unanswered. This research will develop a teacher training plan which explicitly considers teacher's tablet skills and incorporates those skills to help them create a tablet-based course. An action design research study will be used to develop teacher training program for two secondary schools in Thailand. Assessment of trainees' curricula, observation of learning activities during training, and feedback on the training will be used to refine the training plan.

1. Introduction

Mobile technologies, especially smart devices, are rapidly becoming an essential part of the classroom experience [1]. Tablets and iPads are examples of mobile technology that offer students a more stimulating experience with portable, engaging and interactive tools. Moreover, a teacher's use of technology in the classroom can make learners more involved in the subject, decrease learning time, and provide opportunities to learn in non-traditional ways [2]. Becta ICT (Information and Communication Technology) Research conducted a study of the use of tablet PCs in the classroom in twelve elementary schools in the United Kingdom during 2004-2005 [3]. Their findings revealed that use of tablet PCs increases learners' motivation and student engagement.

Tablets and iPads, as well as other smart devices, have been used for education around the world [1; 4; 5]. Many schools in the United States and developing countries are starting to deploy tablets in their schools. In 2011, the San Diego School District improved its classroom technology by purchasing 26,000 iPads for use in its schools [6]. This project improved the school curriculum by using iPads to motivate students with mobile and multimedia technology. In 2012, the Thailand government invested in 530,000 tablets to support K-12 education in the country through a project called "One Tablet Per Child (OTPC)" [7]. So far, the pilot study for this OTPC project has discovered that using tablets for education provides many advantages for teaching and learning, such as individualized learning platforms, meaningful interactivity, shared experience, and flexible and clear course design [7].

Although the use of smart devices and learning management systems is growing quickly, it will not be useful if teachers do not apply the right teaching methods for mobile technology integration into the curriculum. Therefore, teachers need to be trained to properly apply the use of tablets and iPads in their curriculum in order to improve technology teaching skills and to have the effective learning outcomes.

According to the Thailand government project OTPC, all primary and secondary schools in Thailand are provided tablets to use for teaching and learning. In 2012, all elementary schools were provided teacher-technology training to deploy tablets in the classroom. However, there were some problems, such as teachers' reluctance to use emerging technology and their resistance to changing their teaching methods [7]. Although potential advantages exist in training teachers to use technology in their classrooms, including student motivation, student engagement, and knowledge sharing, these benefits must be weighed against the drawbacks of tablet devices (e.g., small screen, limited storage capabilities, and short battery life). Thus, teachers need to adjust their mobile-based instruction design to be more suitable for student's learning initiatives based on the characteristics of mobile devices.

The primary aim of this study is to identify a training method for teachers to utilize emerging technology like tablets and iPads in the classroom

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and appropriately adjust their curriculum to support a Bring Your Own Device (BYOD) policy. The main approach is to offer a teacher training program at two well-known secondary schools in Thailand and to refine it in order to maximize technology training effectiveness. The teacher training program will be designed based on important factors for successful user training, with the goal of increasing teachers' attitudes toward mobile technology, increased teacher motivation about the training, advanced technological competency, and creative pedagogy [2; 8; 9].

This paper is organized as follows. In the next section, we review the relevant literature of theoretical frameworks underlying the research purpose and related research of teacher technology training. Then, the detailed research approach is described in Section 3. Lastly, we conclude with a discussion of future research and conclusion in Section 4.

2. Literature Review

This section reviews some theoretical frameworks underlying the research purpose based on constructivist learning theory [10; 11] and activity theory [11; 12]. Constructivist learning theory can be used to support how teacher training may help teachers to learn by experience and to construct knowledge by expressing ideas and sharing them with others. Activity theory is related to how mobile applications will be chosen to support suitable activities in the classroom. We next review the relevant research related to mobile learning, mobile learning in teacher training, and technology integration into curricula.

2.1 Theoretical frameworks underlying the research purpose

Constructivist Learning Theory. Constructivism is one of the learning theories that focus on student-centered learning and student engagement in the learning process [2; 10; 11]. The principle of this theory is that a learner generates new knowledge from interactions between their ideas and experiences. In addition, the learner can construct new knowledge based on discussion in the classroom [13; 14]. Participation in group discussions allows apprentices to generalize and transfer knowledge gained from classroom learning into daily life and to build a strong foundation for communication of ideas [15]. In teacher- technology training, a trainer plays a coaching role, providing reflective activities that engage trainees in their learning process [16]. The trainer should guide trainees, motivate them to learn, and give them insightful feedback. However, the trainer needs to ensure that new knowledge constructed by trainees is at an appropriate level of understanding.

Teaching tools and learning theory are essential and must come together to make an effective classroom environment [2]. Generally, constructivist teachers are more likely to use and integrate technology in the classroom and they do so more frequently than teachers who follow other learning philosophies [17]. In the proposed study, instructional strategies grounded in constructivist learning theory will be taught. These strategies provide trainees an opportunity to practice skills in communication, social learning, knowledge sharing, and the use of relevant technologies in the classroom context. For instance, students can participate in online discussion forums. Teachers can use content management systems to collaborate with students to share resources and give feedback. Collaborative learning can also be enhanced through the use of blogs and wikis. The trainees can practice their skills by using tablet-based tools or applications for teaching and learning. There are several tools in mobile handheld devices that can be used by teachers to support curriculum development. Examples of these tools are as follows: multimedia tools (e.g., e-books, webpages), capture tools (e.g., camera, video, audio), representation tools (e.g., concept mapping software, composition music software), and assessment tools (e.g., student response system, grade reporting system). As a result, using technology and a constructivist approach offers an opportunity for effective integration of tablets and iPads into the classroom.

Activity Theory. Activity theory is a paradigm that originated from cultural and historical psychology [11; 12]. The theory focuses on understanding human activities and work practices as complex, socially situated phenomena, and activity theory also expands beyond paradigms of cognition, psychoanalysis, and behaviorism [11]. In addition, the theory emphasizes each activity as the unit of analysis. Initially, an activity was viewed only as a goal-directed or purposeful interaction of a subject (e.g., a teacher or a student) with an object (e.g., classroom activity), mediated by a tool/artifact (e.g., a tablet or an iPad) [11]. Using a tool/artifact thus has a potential to enhance the outcome of the activity. Then, the definition of activity theory was extended to include an activity mediated by an organization or community [18]. The community may enact rules that affect the activity. The subject then works as part

of the community to achieve the object. An activity also normally features a division of labor (e.g., relationship among groups or classmates) [11; 18]. Activity theory is depicted in Figure 1.

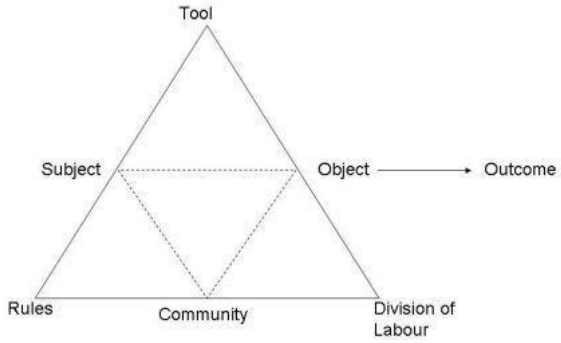

Figure 1. Activity theory (from [11; 18])

In a teacher training system based on activity theory, a subject can be an individual teacher (or a group), who is the key actor to perform a particular activity. A teacher (subject) is trained to use mobile technology for a particular classroom activity (object) by using a tablet, e-book, and/or the Internet (tools) to complete his/her workshop assignment (outcome). In this case, this teacher may be assigned to train in a group (rule) in which the success of his/her assignment can be influenced by his/her team/trainees (community) and the relationship among teachers in the training environment (division of labor). Consequently, applying activity theory into a teacher-technology training system allows teachers to use the right technology with the right pedagogy.

2.2 Review of relevant research

Mobile Learning. Mobile learning can be defined as a mode of learning that uses mobile devices in numerous educational activities. There are a number of studies regarding mobile learning that disclose the impact of mobile learning adoption and implementation in the information age [19; 20; 21]. Successfully developing mobile learning applications depends on the courses, learners, levels of learning, and contexts in which the applications are being used. Some studies present the benefits of mobile learning with respect to three main elements of mobility: convenience (use on the move), expediency (easy access to the Internet), and immediacy (the ability to act immediately) [22; 23]. There are several mobile learning initiatives in the United Kingdom (UK), but an underlying principle for the use of mobile devices in teacher training to integrate handheld devices in the curriculum has yet to be articulated [5]. Therefore, there is a need to study how teachers can effectively integrate mobile devices into the curriculum.

Mobile learning proposes new ways to extend schooling outside the classroom and into the intersections and communications of everyday life. Examples of tools for mobile learning are microblogs [4] and podcasts [1]. Microblogs support informal learning beyond classrooms [4]. Podcasts are a more effective tool than textbooks, and they are more proficient in helping students to learn [1]. Many mobile learning tools are convenient for learners to support learning anytime and anywhere. Therefore, in a teacher-technology training environment, an instructor can conduct class by allowing teacher trainees to learn individually or learn with their training groups, both inside and outside the training session. Teachers may learn through communication channels and collaborative learning tools. Gaining this experience could help teachers apply new information and experiences to their existing knowledge of how to develop curricula.

Mobile Learning in Teacher Training. Training is one of the essential methods for enhancing teacher productivity and improving teaching performance. A group of researchers conducted a pilot study of a mobile learning project which focused on teacher training [24]. They found that the supervising teacher and trainees could discuss and share their ideas related to teaching methods through mobile devices, including the use of a short message service (SMS) and digital photos as part of the training process. Although their results might implicitly include the benefits of mobile learning in teacher training, it is not explicitly clear if teachers can integrate mobile technology into their curriculum.

Past research in the teacher-technology training has revealed consistent results of several success factors for effective training, such as perception, attitude, and motivation [9; 25; 26; 27]. For example, teacher perception for mobile learning may relate to computer self-efficacy for using mobile devices or learning tools in the classroom [27]. Mobile learning systems can also enhance the quality of lessons because teachers can have access quickly to the materials they need by means of mobile technologies. In addition, mobile learning applications can be employed to supplement traditional education. Hence, teachers have to know when and how to utilize mobile devices as learning tools in their traditional classroom curriculum to increase student engagement.

Nevertheless, there is limited evidence of a mobile learning framework that clearly demonstrates effective teacher training for mobile technology integration into a classroom curriculum. Ozdamli [28] suggests that teacher training is one of the key aspects for successful mobile learning outcomes [28]. However, this study does not explain how teachers can integrate tablets or mobile devices into the classroom curriculum. This study also describes the pedagogical framework of mobile learning according to new trends in developing technology [28]. The researcher identifies four key aspects: (1) integration of tools, (2) pedagogical approaches, (3) assessment techniques, and (4) teacher training. While most teachers are concerned with pedagogical approaches and assessment techniques for their teaching effectiveness [17; 29], integration of tools and teacher training are also very important for successful learning outcomes.

Technology Integration into Curricula. Teachers not only need training for using mobile tools and devices in their classroom, but they also require training for incorporating mobile technology into the curricula. An emerging technology, like a tablet or an iPad, can address technological innovations in school settings and also can drive creative instruction [29]. Sometimes teachers are reluctant to use mobile devices in the classroom because they do not want to adapt their curricula [17]. Actually, teachers do not need to create new curricula to go along with mobile learning [24]. They can still use the same curriculum, but they need to teach in new ways to keep students engaged. In addition, a good curriculum has to be rethought and more innovatively redesigned by considering how the mobile device is going to help change the pedagogy [29]. Thus, if teachers receive training in both mobile technology and in curriculum design, they will better understand tablet-based course design practices.

However, there are some reasons for non-integration of technology in school curricula [30]. These reasons are not only determined by individual users or software characteristics, but also by the interaction between an individual, software, and school environment. The school environment includes institutional support and increased social status. All of these factors are essential for the integration of IT and therefore can influence curriculum redesign.

3. Research Method

The research method selected for this study is an action design research (ADR) [31] because the study aims to develop and refine a training method to instruct teachers on how to adjust their teaching method for a tablet-based course. ADR is defined as "a research method for generating prescriptive design knowledge through building and evaluating ensemble IT artifacts in an organizational setting" (p. 40) [31]. ADR combines the concept of design research (DR) and action research (AR). According to Hevner et al. [32], DR aims to develop prescriptive design knowledge by building and evaluating innovative IT artifacts which are intended to solve an identified class of problems. However, traditional DR does not fully recognize the role of organizational context in shaping the design as well as the deployed artifact. Meanwhile, AR aims to connect theory with practice and thinking with doing by combining theory generation with researcher intervention to solve organizational problems [33; 34]. As a result, ADR would be the right research method because it simultaneously follows the concept of DR at building innovative teacher-training program as the ensemble IT artifacts in two secondary schools and learning from the intervention while addressing a problematic situation of how to modify their teaching method for a tablet-based course [32; 34].

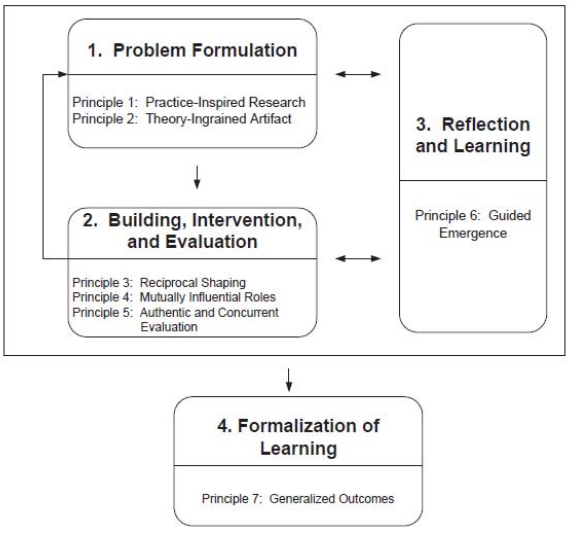

Figure 2. Action design research method (from [31])

This research study follows four stages of the ADR method [31] (see Figure 2): (1) problem formulation, (2) building, intervention, and evaluation (BIE), (3) reflection and learning, and (4) formalization of learning. First, the problem formulation stage includes exploring and defining a problem in its social context. This problem can be perceived in practice or anticipated by researchers. This stage also includes framing the initial scope, specifying the roles and scope for practitioner participation, and articulating the initial research questions. The second stage of ADR is the BIE stage. This stage is an iterative process in a target environment by interweaving the *building* of the IT artifact, *intervention* in the organization, and *evaluation*. This stage involves utilizing problem framing and theoretical premises created in stage one. These premises provide a platform for creating the initial design of the innovative IT artifact which is further shaped by organizational intervention and consequent design cycles. Third, the reflection and learning stage focuses on identifying the contributions to knowledge. This stage moves theoretically from building a solution for a specific instance to applying that learning to wider class of problems. The reflection and learning stage emphasizes that the ensemble artifact will reflect both the initial design generated by the researchers and its continuing shaped by organizational use and by the outcomes of evaluation. The last stage of ADR is the formalization of learning. This stage's goal is to formalize the learning by outlining the accomplishments recognized in the IT artifact and describing the organizational outcomes. The resulting ensemble is an outcome represented as a solution of a problem. This outcome can be represented as design principles and with further consideration as refinements to theories that contributed to the initial design. This derivation follows an inductive step of a qualitative approach by connecting the generalized outcomes in the form of design principles to a class of solutions and a class of problems.

This study follows the ADR approach by working with two secondary schools in Thailand to participate in training teachers to use tablets in the classroom by enhancing technology skills and technology incorporation with instruction design strategies. Researchers will work with teachers who will act as co-researchers. The researchers will design the training based on a plan than is grounded in constructivist and activity theory. The researchers and teachers will work iteratively to develop or revise their courses to feature mobile-based technology. After completing a training session, the researchers will evaluate the effectiveness of the training method, and adjust the method for use in the next training session. The overriding aim is that the participating schools will be ready to include tablets into their classrooms. Table 1 summarizes the ADR process in the teacher-technology training [31].

This study proposes a research model of teacher-technology training (see Figure 3). The proposed model aims to fill the gap of teacher training related to integrating mobile technology into K-12 curricula. This model has two major advantages:

(1) We determine teacher-technology training outcomes by measuring teachers' performance and teaching competencies of both increased tablet technology skills and suitably redesigned curricula with a tablet-based approach.

(2) We conduct teacher-technology training repeatedly by utilizing the feedback to improve the training method.

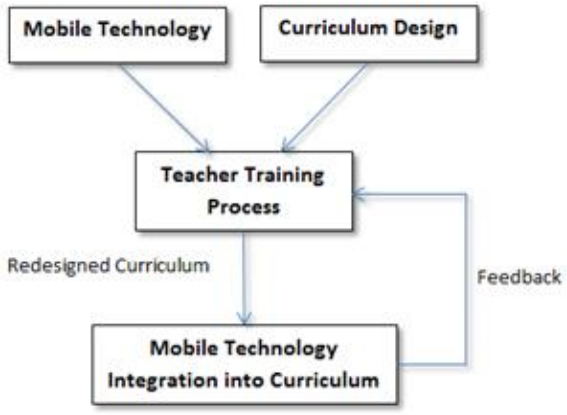

Figure 3. Research model

Teaching competencies for technology integration in the classroom can be determined in various domains. The key domains and teaching competencies that are needed to support the in-service teacher training processes for technology integration in a classroom context are [35]: (1) technology, (2) curricula, (3) methodology, (4) evaluation, (5) communication, and (6) attitude. This research study mainly focuses on teacher training within the curricula or pedagogy domain, which consists of four main steps to achieve implementation: (1) curriculum design: making pedagogical and curricular decisions, (2) mobile technology integration: integrating the technology's application, (3) planning: systematic planning of the technology's application, and (4) implementing: implementing processes for applying the technology.

Table 1. Summary of the ADR Process in the teacher-technology training

Stages	Principles	Tasks	Artifact
1. Problem Formulation	Principle 1: Practice-Inspired Research • Field problems are viewed as knowledge-creation opportunities Principle 2: Theory-Ingrained Artifact • The ensemble artifacts created and evaluated via ADR are informed by theories	1) Identify and conceptualize the research opportunity 2) Formulate initial research questions 3) Cast the problem as an instance of a class of problems 4) Identify contributing theoretical bases and prior technology advances 5) Secure long-term organizational commitment 6) Set up roles and responsibilities	1) Problem: teachers are lacking the mobile technology skills necessary for effective instruction in their tablet-based course design 2) Theory: constructivist learning theory and activity theory 3) Three stakeholders: researchers/trainers, school administrators, teachers/trainees
2. Building, Intervention, and Evaluation	Principle 3: Reciprocal Shaping • The inseparable influences are mutually exerted by the two domains: the IT artifact and the organization context Principle 4: Mutually Influential Roles • Action design researchers bring their knowledge of theory and technological advances, while the practitioners bring practical hypotheses and knowledge of organizational work practices Principle 5: Authentic and Concurrent Evaluation • Evaluation is not a separate stage of the research process that follows building • Authenticity is a more important ingredient for ADR than controlled settings	1) Discover initial knowledge-creation target 2) Select or customize BIE form 3) Execute BIE cycle(s) 4) Assess need for additional cycles, repeat	1) The artifact is perceived as a design idea of "teacher training model." 2) BIE cycle: *B-Building:* create/update training method, strategy for teacher-technology use *I-Intervention:* design instruction to integrate tablet in the curriculum by using suitable tools for the learning activities *E-Evaluation:* evaluate the training by assessing teachers' performance in creating tablet-based courses
3. Reflection and Learning	Principle 6: Guided Emergence • This stage presents the interplay between the two seemingly conflicting perspectives: design and emergence • The ensemble artifact will reflect not only the initial design created by the researchers but also its ongoing shaping by organizational use, perspectives, and participants, and by outcomes of authentic, concurrent evaluation	1) Reflect on the design and redesign during the project 2) Evaluate adherence to principles 3) Analyze intervention results according to stated goals	The evidence collected on teacher-technology training and its embedded design principles will reveal both anticipated and unanticipated consequences. This will help us understand the teacher-training program as "an ensemble"
4. Formalization of Learning	Principle 7: Generalized Outcomes • The generalization is challenging because the nature of ADR outcomes that include organizational change along with the implementation of an IT artifact • This moves from the specific-and-unique to generic-and-abstract	1) Abstract the learning into concepts for a class of field problems 2) Share outcomes and assessment with practitioners 3) Articulate outcomes as design principles 4) Articulate learning in light of theories selected 5) Formalize results for dissemination	Teacher-technology training program is an ensemble of specific knowledge. Also teachers' knowledge is an important contribution to an ADR teacher-technology training project.

3.1 Training design

Our study is in progress. To answer the research question regarding an effective training for teachers to deploy tablets into a K-12 classroom curriculum, this study will investigate teacher-technology training in two secondary schools in Nonthaburi province, near Bangkok, Thailand. The researchers will provide training to as many as forty teachers at the two schools. The exploration of teacher-technology training in the schools will follow the ADR cycle. The researchers will select eight to ten teachers to provide training in a cycle (intervention). Teachers will be selected by considering only those who are teaching in five core courses: Thai, English, Math, Science, and Social Studies. The decision to focus on these courses was based on the mandatory core courses of K-12 curriculum in Thailand. Then, the training will be investigated in chronological order (see Figure 4).

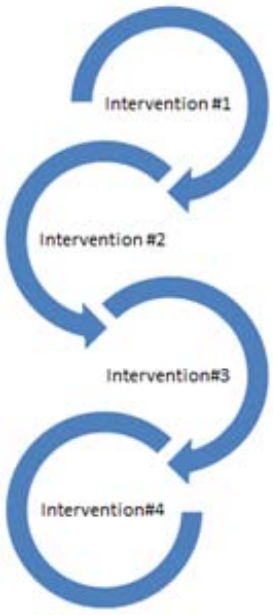

Figure 4. Research design

In the first intervention, the researchers will conduct training by helping teachers understand tablet technology and guiding them to create their tablet-based course design. Trainees will be required to develop a tablet-based curriculum for one of the courses they teach. After the intervention, the researchers will analyze the teachers' curricula and their training evaluations. The evaluations regarding the effectiveness of teacher training will be measured in terms of learning outcomes [8; 25; 36] such as knowledge and skills, user satisfaction and self-efficacy, and performance in designing a tablet-based course. The researchers will modify the training method based on this feedback as per the approach used by Nicolas-Rocca [37]. The researchers will repeat all these steps three more times. In addition to providing effective training for the two schools involved in the research, an additional goal is to provide an effective teacher training method for use by other trainers in other schools.

In order to design teacher-technology training, it is important to select suitable training methods. There are several types of training methods, such as instruction-led, self-learning, and behavior modeling [26]. Each type of training has different characteristics and is appropriate for different purposes. Instruction-led or formal classroom training usually is conducted face-to-face and is suitable for business software training [38]. Self-learning (e-learning) allows trainees to utilize technology-mediated learning (TML) and group support systems (GSS) [39]. E-learning can increase end-user satisfaction since it can be done anywhere and anytime. For the behavior modeling training, trainees observe the instructor as a role model, then perform the target behavior and participate in practical exercises [25]. This kind of training can increase learning performance, motivation, and self-efficacy. Training methods and end users' psychological states (e.g., self-efficacy and personal relevance) can affect the acceptance of IT [25; 30].

The first intervention method will be the instruction-led classroom and will include applications-based hands-on exercises that are selected by the trainees [40]. However, the training method in the next session may be changed based on the evaluation. If schools provide technology training methods that work best with their teachers, it will help teachers to learn and motivate them to use tablets in their curricula.

Measurement of teacher training effectiveness will be integrated and adapted from several sources [2; 8; 9; 27; 36]. As noted above, the teacher-technology training that will be conducted in each intervention has three phases (see Figure 5): (1) pre-training, (2) teacher training, and (3) post-training. The pre-training phase is the preparation stage of teacher-technology training. This phase includes assessing trainees' needs, identifying their training goals (e.g., choosing a unit of classes to use in training hands-on exercises). The training method and the make-up of trainee groups (for face-to-face

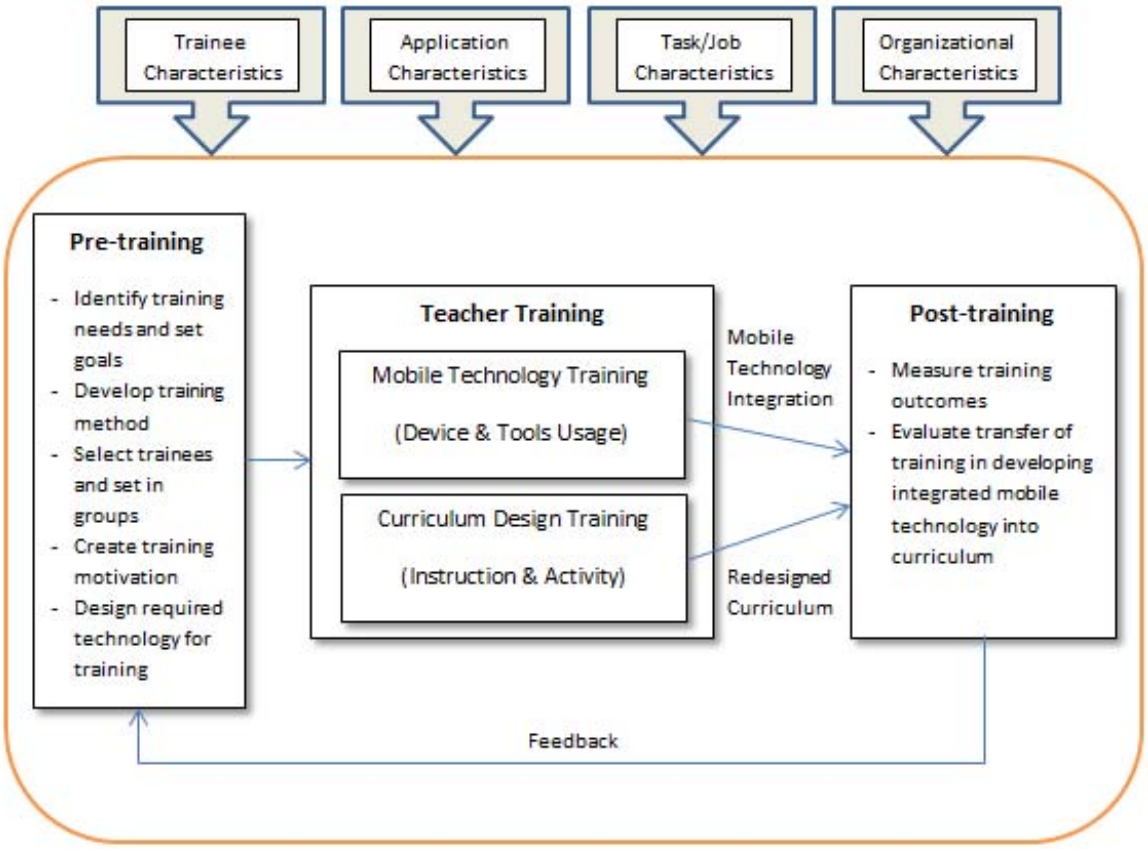

Figure 5. A framework for teacher-technology training proces (adapted from [36])

training) are also clarified in this phase. In addition, creating training motivation and designing required technology for training is necessary. At the teacher training phase, teachers will be trained in both mobile technology usage and curriculum design. At the post-training phase, an evaluation is required to ensure that the teacher training meets its objectives and teachers can appropriately revise their curriculum with tablet integration. Lastly, feedback from the measuring training outcomes in the last phase will be used to improve the next teacher training session. All these steps can be affected by several environmental factors, such as trainee, application, task/job, and organizational characteristics.

The evaluation of the teacher-technology training effectiveness will be derived from the analysis of collected data. The data collection will be in three forms: interviews, observations, and tablet-based course design produced by teacher trainees. Interviews will be conducted face-to-face, by telephone, or by Skype. The researchers will take field notes during training sessions when they see trainees having difficulty learning the subject matter. The researchers will review the trainee's tablet-based course design practices to determine to what extent the training influenced them. The data analysis process will be iterative. That is, a full analysis will be conducted after each training intervention, and results will be used to revise the next program.

4. Conclusion

The expected findings of this study will contribute to our understanding of the effective design of the teacher training program based on successful factors for user training and influence teacher's tablet technology use in the classroom. However, there are some risks of this study in terms of the likelihood that it will not make a contribution to knowledge. The risks may come from rapid change of emerging technologies, willingness to share

knowledge among the teacher community, teachers' resistance to change in their technology usage and technology integration in the classroom curriculum, and teacher's technology perception towards mobile technology such as tablets and iPads. Due to the individual differences of teachers, if the effective teacher training program derived from this study does not contribute to knowledge, at least it will be of heuristic value for conducting teacher-technology training and can be used as a reference for future research.

Teacher-technology training is considered to be necessary for teachers to learn mobile technology usage and to integrate it into course design. K-12 schools in Thailand are faced with a problem when their teachers do not fully utilize tablet technologies that have been purchased as a result of OTPC's government policy. The problems of incorporating the emerging technologies into fundamental K-12 courses are challenging. The proposed study utilizes a model of teacher training effectiveness to conduct action design research to create an effective mobile-based technology training method. The method will be used to train teachers in designing innovative curriculum to integrate emerging technology like tablets and iPads into their classes. Moreover, the findings may enable other schools to provide better technology-supported learning and may establish teacher training sessions for integrating technology into other schools.

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