

Learning Activity Design on Mobile Learning Device: using ESL Reading Comprehension as Example

Abstract

Using information and communications technology in education has changed the learning process from the perspective of student, teacher, activity, and evaluation. This paper reports a design method to achieve the goal of the curriculum studies — optimum curriculum design, which means that the curriculum will be evolutionary with the learning technology. This paper focuses on “product” technologies (i.e. learning devices) of learning technology evolution, such as mobile phone, laptop, tablet PC, PDA (Personal Digital Assistant), etc. Hence, a teacher can directly use the digital contents for various learning devices to begin a learning activity on any accessible learning device, such as a PC or a PDA. The reading instruction of ESL (English as Second Language) is selected to demonstrate operations of the adopting methodology. The design method for creating digital contents adopts existing curriculum materials as a basis to develop fundamental activities for cross-platform reusability, denoted as activity-based design. Hence, teachers must be familiar with the digital contents in the fundamental activities. Then, the digital contents can be directly installed on various learning devices that are available in real-school environments. In the example of ESL reading instruction, the required learning activities are identified and encapsulated by an activity template for various learning devices to demonstrate the analysis method of activity-based design. Based on the template of fundamental activities, a teacher may plan an advancement activity. Most important of all, the activity-based design of digital contents makes the existing curriculum feasibly evolve toward an optimum curriculum with progressing learning technology.

Introduction

Curriculum design is a continuous process. Henson (2001) says, ‘Through the years, curricula have been tailored, modified, and shaped to fit the needs of a changing society.’ Information and communications technology (ICT) makes many changes in the education system. For instance, some students bring laptops with wireless accessibility into the classroom. Some publishers of textbooks provide teachers with digital content, slides, and assessment materials. Although the role of ICT in curriculum design is considered, a more fundamental consideration is that students’ learning processes involve more ICT, such as the Web, laptops, online encyclopedias, electronic dictionaries, etc. Furthermore, many researches indicate that the process of curriculum change is very complex and difficult because of the requirements of teacher involvement, funds, plans, adequate time, and other supports (Kirk & Macdonald, 2001; Slaughter, 1997). Consequently, it is necessary to review existing curriculum and its design models by adopting an ICT perspective (Koh, 2002).

The major changed aspect of ICT in learning processes can be considered from four viewpoints (Chan, 2002). First, there are changes in the student aspect. We can anticipate that more and more students will bring their learning devices into the classroom. Learning devices are defined as various computing products in this paper, such as mobile phone, laptop, tablet PC, PDA (Personal Digital Assistant), etc. Second, there are changes in the teacher aspect. Although publishers provide teachers with digital contents of textbooks, teachers need real digitalized curriculum, which is learning activities integrated with digital contents on learning devices, rather than only digital contents for a desktop computer. Here, curriculum denotes ‘a plan for learning’ including aims, objectives, contents, activities, and evaluations (Taba, 1962). Naturally, there are changes in both aspects of activity and evaluation. Third, many types of learning activity in a technology-enhanced model were investigated, such as drill and practice, tutorial, simulations, computer-supported collaborative learning, intelligent tutoring systems, etc. (Roblyer, 2002). Finally, computer-based tests, classroom response systems, and portfolio management become feasible for the evaluation aspect. However, existing curriculum design models do not represent these issues of the reality with which ICT should be concerned.

To fit the changing needs of the aforementioned four aspects, many studies indicate that the activity aspect should be first considered when involving learning technology (Chang & Chen, 1997; Gifford & Enyedy, 1999). Along with the popularization of the wireless network, mobile learning activities are proposed when involving mobile learning devices in a classroom (Wang, Liu, Chou, Liang, Chan & Yang,

2004). From the standard perspective for Learning Design Specification of the IMS Global Learning Consortium, a learning unit equals to IMS Content Package plus IMS Learning Design (IMS, 2005). Generally, it is impossible to implement learning activities without teaching materials. Hence, a new learning activity coming with the learning technology needs new teaching materials for it. In general, a teacher should develop new teaching materials for a new learning activity. However, a teacher prefers a well-prepared learning unit, which means learning activity plus teaching materials, to a new learning activity. Consequently, this paper concerns how to use existing teaching materials on available learning devices. In other words, the proposed design method enables existing curriculum to be evolutionary with learning technology, called *optimum curriculum design*.

The word 'optimum' needs further explanation. This word relates to two issues, evaluation and fast evolution of curriculum creation. With regard to the first issue, evaluations vary, depending on the values of those who conduct evaluations. For example, a CIPP model can evaluate context, input, process, and product (Stufflebeam, 2000); nevertheless, Stake's countenance model and Scriven's meta-evaluation checklist for evaluation have different focuses (Stake, 1967; Scriveren, 2002). With regard to the other issue, digital contents, most of them based on ICT, will even speed up this evolutionary process of curriculum creation and destruction. Nevertheless, learning technology is still progressing with ICT. Hence, efforts should be directed towards improvement of the current design on an integrative level for existing curriculum, rather than on a creative level for new teaching materials. However, this study is not proposing a curriculum standard or designing a methodology for exchanging contents, which is the goal of SCORM (SCORM, 2004). Instead, the work proposes guidelines for constructing a learning management system to integrate with learning technology-enhanced curriculum, such as SCORM-based digital contents, from a learning technology perspective. Consequently, a teacher can directly use the digital contents for a course to begin a learning activity on students' learning devices, such as a PDA.

The following criteria determine the subject for developing activity-based design (ABD) of digital contents and its infrastructure. First, the subject is an obligatory course in the ninth grade with some pilot digital classrooms in one pilot school. In other words, we should choose a subject from among ESL, Chinese, Mathematics, Science, and History. Second, our research partners in other countries should be able to contribute into the curriculum infrastructure on the selected subject. Hence, English, Mathematics, and Science courses are more suitable than others. Third, the materials of the selected subject can be digitalized more easily than others. Furthermore, the digitalized materials can be conformant to SCORM 1.2 or 2004. Hence, we can focus on developing activity software on learning devices to fulfill a typical digital content, which is *activity plus material*, in the learning enterprise. Consequently, this team selected ESL reading instruction for junior high schools as an example in the construction of an optimum curriculum.

The work will also develop, in addition to the curriculum design infrastructure, a curriculum example for ESL reading instruction for the ninth grade. The curriculum example will provide various learning activities based on the technique of reading instruction through learning devices. Consequently, a teacher can install the required curriculum in learning devices to begin activities of reading comprehension for individuals, groups, or classes that are learning. There are seven stages, illustrated as the first column of Table 1, of the development of curriculum in Taba's model (Taba, 1962). This study is not trying to criticize advantages or disadvantages among traditional curriculum development models. Instead, this study focuses on how to integrate learning or instructional technology with a specified curriculum model and curriculum.

Table 1 illustrates the relationships among curriculum models, existing curriculum, and activity-based design, which can recall and relate to teachers' experiences by keeping parts of the material and evaluation. Moreover, the argument of this study differs from learning object, which is a reusable unit, such as SCO (Sharable Content Object), of instruction for e-learning (IEEE P1484.12.3/D8, 2005). This study emphasizes on adopting materials from existing curriculum rather than on reusing use them in different contexts. In the following sections, this paper surveys traditional curriculum design models, introduces some activities for language learning, and demonstrates how the ABD operates. Finally, discussion about other technologies involving design and a summary of ABD are given. Most important of all, the study shapes the curriculum design model to fit the changing society with a learning technology-enhanced perspective.

Table 1: Activity-based design for existing curriculum

Traditional curriculum model		
	Curriculum of ESL reading instruction	Activity-based design
Define target students and their needs		
Identify instructional objectives		
Select the scope of subject content	Material	<i>Recall to teachers' experience.</i>
Organize sequence and structure		
Select learning experiences	Activity	Technology-enhanced learning activity
Organize learning activities		
Evaluation	Evaluation	<i>Relate to teachers' experience.</i>

Activity-based Design and Development

Although ABD is not a new idea, previous studies focus on system framework for Web-based environment. Dalziel (2003) implemented the Learning Activity Management System (LAMS) to describe sequences of collaborative learning activities. Furthermore, the sequencing and navigation book also defines an Activity Tree as a conceptual structure to manage learning activities (SCORM, 2004). Recently, similar efforts were made for mobile learning environment. For instance, Wang, et al. (2004) presents a three level framework of learning activities as learning flow, learning episode, and learning function in a wireless technology enhanced classroom. Our design guideline is proposed based on our experience in the wireless technology enhanced classroom because learning activities in existing curriculum are first concerned to be constructed in various learning devices. Hence, this section first reviews curriculum development models. Then, theory and activity for reading instruction are surveyed. Finally, an example of ABD for reading instruction is demonstrated.

Traditional Curriculum Models

No curriculum model is perfect, and no curriculum theory is adequate for all users. Nevertheless, researchers will continue to explore a variety of curriculum models and benefit from them. There are many curriculum models proposed in the literature, such as Taba's inverted model, Tyler's Ends-Means model, Oliva's model, Macdonald's model, and Zais's eclectic model (Henson, 2001). However, most of them only report their strengths and weakness instead of their effects on student learning and instructor teaching (Wang, Haertel, & Walberg, 1998). This study is not trying to propose a new curriculum model. Instead, this study proposes a design method to reduce both students' and teachers' additional burden when involving ICT in learning. Ideally, the design method should work within any curriculum model.

Although the curriculum models vary, each model shares some common features. There are four common features in various curriculum models, including teaching/learning materials, learning activities, evaluation standards or methods, and plans. For ESL reading instruction, the teacher may already have existing materials and evaluation standards that have been used for years, such as basal reading programs. For the plan, it must be dynamically determined according to students' status. Hence, the works only focus on how to enrich the learning activities of reading instruction on advanced learning devices. Indeed, given the large number of variables affecting the design of a piece of curriculum, an evolutionary design for a curriculum model is required to integrate learning technology with learning activities. Although there are always improvements triggered by creative thought for each curriculum feature, they may refine existing materials, change evaluation methods, or innovate plans. However, improvements of learning activity feature are often critical to learning performance (Hwang, Chang, & Chen, 2004). Hence, this paper proposes the novel design of learning activity from group size, learning type, and available learning technology viewpoints for developing curriculum without changing the reading texts in existing curriculum infrastructure. Hence, current curriculum can be directly replaced by a better design.

Theory about Reading Instruction

A theory of language learning is an account of the psycholinguistic and cognitive processes involved in learning a language and of the conditions that need to be met in order for these processes to take place.

There are many possible theories about language learning based on different views of the nature of language, such as a structural view, communicative view, interactional view of language, etc. There are two theories of language learning: process-oriented and condition-oriented theories. A process-oriented language learning theory is built on describing learning processes, such as habit-formation, induction, inference, generalization, etc. (Orwig, 1999). In contrast, condition-oriented language learning theories emphasize the human and physical context in which language learning takes place. Furthermore, models of SLA (Second language acquisition) focus on various aspects of SLA, such as Schumann's acculturation model, Krashen's monitor model, and Long's interaction hypothesis so on. Whatever models of SLA are used, ICT can support social interaction in SLA (Naidu, 2003). Some studies show that CALL (Computer Assisted Language Learning) benefits (ESL) reading comprehension and speed (Tozcu & Coady, 2004; Ariew & Ercetin, 2004). However, the factor of integrating curriculum and various learning devices for CALL still need deeper investigation.

To investigate the factor of integrating curriculum and various learning devices for CALL, this study first looks for and refines existing techniques of language learning to transcend existing curriculum design models by the supports of learning technology. The techniques of language learning is defined as Anthony's (1963) model with three levels of language learning (i.e., *approach, method, and technique*). This model has been widely accepted and refined by other researchers (Brown, 2000). According to the researcher's view of the nature of language, various language-learning approaches have been developed. For instance, the oral approach, structural approach, natural approach, and communicative approach are often cited in the literature of language learning. Based on a selected language learning approach, one may determine the required method and techniques to accomplish a particular language-learning objective. Then, the study should focus on supporting one of the language (English) abilities, including listening, speaking, reading, and writing ability. The selection will take advantage of recent developments in learning technology. The team does not choose speaking and listening abilities as focuses because they will involve a great deal of multimedia that is not a recent innovation in the learning technology domain. The hand-writing input method in a mobile learning device seems related to the writing ability in an ESL course. However, developing writing ability is often involved in reading comprehension activities for a ninth grade student in Taiwan. Furthermore, researches indicate that the use of writing to assist reading comprehension comes when the writing is built into the reading instruction (Craig, 2003). Although research in reading comprehension has been rich in both quantity and quality, the usefulness of learning technology in reading comprehension for the classroom teacher may be promoted by this study.

There is no one definition of reading comprehension that is accepted by all researchers, educators, and instructors in reading education. Although there are many definition attempts, one's definition of reading comprehension is determined by the purpose of the application (Klein, 1988). However, there are some agreements about the reader's mental processing:

1. Background knowledge is a critical factor in determining comprehension of a text.
2. Reader's metacognitive knowledge of language structure plays important roles.
3. One's conception of the context and purpose of the reading plays an important role..
4. Knowing the structure of expository text, narrative text, and grammar of stories helps in the comprehension of those texts.
5. Vocabulary development is concerned with establishing a rich, meaning-based learning context.

However, there are different emphases in the area of ESL reading instruction. "After a great deal of controversy concerning the extent to which reading instruction should emphasize either a bottom-up or top-down approach, the current literature has suggested that an interactive approach which features neither prior knowledge nor graphophonemic information exclusively is most effective" (Bello, Fajet, Shaver, Toombs, & Schumm, 2003). For an ESL learner, English reading comprehension is more like the interactive process between reader and text, using semantic knowledge, prior experience, knowledge of letters, syllables, and words, rather than an entirely top-down or bottom-up process (Au, 1998). Consequently, the study uses advanced learning technology to support reading for an ESL learner by constructing highly interactive learning activities.

Learning Activity for Reading Instruction

There are many classroom-teaching strategies for reading comprehension in the literature. Buehl (2001) summarized useful classroom teaching strategies through indexing them by student activities. Buehl used the following categories to index forty-five classroom strategies by student activity: developing vocabulary, brainstorming of ideas, learning cooperatively, promoting discussion, interactive reading, encouraging writing, representing information graphically, and building study skills. Furthermore, Buehl also proposed another way to index forty-five classroom strategies by cognitive process. Although

those indices can support the teacher's using effective classroom strategies, it is not appropriate to apply learning technology to them. For instance, the student activities in the 'representing information graphically' category could be individual learning, small group learning, or whole class learning activities. While implementing a classroom strategy on learning devices, the size of the group should first be determined before developing the software.

In order to review previous researches on comprehension instruction, the learning activities for reading are categorized as individual, small group, and whole class activities by the number of readers (Ruddell, 2001). The following illustrative example uses some activities to demonstrate the categorizations of activities designed in a curriculum. For individual instruction, the designed activities may include:

- I1. Selecting and reading appropriate materials. In this activity, the learner can select books and read at his own pace. After he/she has completed it, he may report on the story to the class or teacher.
- I2. Practicing word attack skills and other reading skills through games. This activity may activate learners' motivation for learning vocabulary and improve the metacognitive knowledge for reading.
- I3. Oral reading and conferencing with the teacher. The child discusses his story with the teacher by reading key ideas aloud in the book or answers questions.
- I4. Writing experience stories. The advanced learner can dictate his story and write it down by scaffolding. After completing the story, he/she can share it with a small group or the whole class.

For group instruction, the designed activities may include:

- G1. Discussing stories. Learners who have read the same story will be heterogeneously grouped and discuss it in this activity.
- G2. Introducing reading skills. Learners with different reading skills can be heterogeneously grouped. Hence, a learner may play the tutor role in a reading skill but play the tutee role in another.
- G3. Project work. Learners who have common interests work together after discussion with the teacher about their study plans.
- G4. Writing experience stories. When learners have shared a common experience, like a field trip or viewing a film, they discuss and write a report about the experience.
- G5. Dramatizing stories. Learners select parts of a story and dramatize it after they have read it.
- G6. Sharing stories. Learners who have similar reading interests share favorite stories related to that interest in the activity.
- G7. Pupil-partner groups. Learners are paired for oral reading and discussing in the activity.
- G8. Introducing new vocabulary. Unfamiliar words in a story are generally explained by the teacher, but are discussed in a group. The purpose is to enable learners to learn new reading vocabulary.

For entire class instruction, the designed activities may include:

- C1. Dictionary skills activities. The teacher should introduce the use of the dictionary to the whole class. To reinforce these skills, this activity can follow up small group activities or games.
- C2. Reading of stories by the teacher. The teacher should choose a story that appeals to the class and read it, or parts of it, to the class every day.
- C3. Planning activities, field trips, and other group learning experiences. Learners should discuss with the teacher about group study plans and participate in determining the location, date, and purpose of field trips to maintain their learning motivation.
- C4. Viewing films. The teacher selects a film, which is shown to the whole class, as source material for discussion in small groups. The teacher should prepare leading questions to support the initiation of the discussion.

The aforementioned list of reading activities provides a practical support for an instructor to plan a reading course. However, some of those activities, which could be viewed as language learning techniques, use the same language learning *method* as their basis. If we categorize methods for reading comprehension, there are sixteen types of instruction in the literature, according to the report from the National Reading Panel (Report of the National Reading Panel, 2000). Among them, seven instruction types for improving comprehension are widely accepted, according a firm scientific basis. The seven instruction types of English reading comprehension include comprehension monitoring, cooperative learning, graphic organizing (including semantic organizers, such as story maps), question answering, question generation, and summarization. In addition, "multiple strategies," the seventh type, can integrate other useful instruction types of reading comprehension.

The following section briefly introduces the aforementioned six types of text comprehension

instruction:

- Comprehension monitoring: This method teaches learners to identify what they do not understand and use “fix-up” strategies to resolve problems in comprehension. Examples of the “fix-up” strategies are: “Identify where and what the difficulty is,” “Look back or forward through the text,” and “Restate the difficult sentence in learners’ own words.”
- Cooperative learning: This method enables learners to gain more social interaction with peers by constructing a learning environment with heterogeneous groups, interdependence, and accountability features. The major benefit of this method is to make learners’ interpersonal development possible.
- Graphic organizer: Graphic organizers are known by different names, such as concept maps, semantic maps, or semantic webs. Graphic organizers use diagrams to illustrate interrelationships among concepts in a text. There are three major benefits for reading comprehension by using graphic organizers. First, it supports learners’ focus on text structure. Second, it is a visual tool for learners to figure out relationships in a text. Third, learners can write a well-organized summary by using the overview picture on a graphic organizer.
- Question-answering: This method encourages learners to read to answer a question. Hence, learners will learn more as they read. For instance, learners may need to look back in the text to find answers to questions. In other words, this method gives learners a purpose for reading that is to answer questions. Consequently, learners will think actively and review content to monitor their own comprehension.
- Question generation: Encouraging learners to ask questions effectively improves their comprehension. Before generating a question, learners should be aware of whether they can answer the question and ask themselves whether they understand the text or not. Furthermore, a learner will be motivated by his/her own queries, rather than by questions asked by the teacher.
- Summarization: In this method, learners should determine what is important in a text and extract that information by using their own words. Hence, summarizing can support learners to remember what they read by identifying main ideas and eliminating unnecessary information.

By putting practical activities and language learning methods together, the curriculum design for the fundamental parts becomes clear. To integrate with existing reading materials, this study uses and digitalizes them as reading material sources, which are familiar to most ESL reading instructors. Then, learning activities for routine instruction will be implemented to support instructors using this compelling curriculum. The teacher will attempt to innovate instruction only after both learners and instructors are familiar with this curriculum on learning devices. Consequently, the design method can support the teacher’s attempt at reading instruction innovation without his facing uncertainties. That is why we term this approach to create digital contents as an ABD from existing curriculum.

Table 1 illustrates the relationships between learning methods and the fundamental activities that are promised to be implemented. Although some activities use more methods than are illustrated in a broad sense, the belonging methods are selected based on their core features. Furthermore, Table 1 is also a check table of activities designed for every episode to demonstrate the available technology-enhanced activities for this episode. Our research partners may contribute their activities for an episode without worrying about replication. For instance, there is no activity for the whole class based on the graphic organizer method. Relatively speaking, one may read a similar overview of curriculum before developing a new curriculum episode. Furthermore, the curriculum could be updated or added if a better episode or activity is developed. Hence, we fulfill the rapid evolution of content creation in optimum curriculum design.

Table 2: A check table for group size and learning method dimension

Type Size	Question answering	Comprehension monitoring	Cooperative learning	Question generation	Graphic organizer	Summarization
Individual	I3	I1, I2		I3	I4	I1, I4
Group	G1	G5, G7, G8	G1~G8	G1	G4	G1, G4
Class	C2, C4	C1	C3	C4		
LT example	EduClick		Jigsaw II		PicoMap	

The example of optimum curriculum covers every size and learning method by sophisticated selection. For individual learning, the study uses a graphic organizer to support summarization. For group learning, the study uses cooperative learning to support question generation. For class size, the study uses question-answering to support comprehension monitoring. Hence, the example can demonstrate how to use various learning methods for various sizes. Furthermore, many resources are available to do that. For example, a classroom response system, such as EduClick (<http://www.cyc.com/educlick.htm>), can be used in the activity of question-answering for monitoring comprehension. Many collaborative learning strategies are available, such as Jigsaw II, study groups, content reading, and mirroring so on. Another example is PicoMap (<http://www.goknow.com/>), which is like graphic organizer, for improving learners' summarization.

Learning Technology Implementation for Activity-based Design

One of education's responsibilities is to prepare students for the future. The best way is not only to teach our students to use technology, but also to teach them by technology. To provide an optimal learning condition, researches of learning technology widely explore issues for enhancing the potential of learning, such as readiness level, motivation, sequencing and pacing, feedback, reinforcement, social interaction, etc (Lewis, 2003). If we categorize those researches by the number of learners in the learning method, we may roughly classify the research areas of learning technology as following:

- Traditional computer-assisted learning/instruction (CAL/CAI); some of current CAL/CAI researches and the intelligent tutoring system (ITS) based on artificial intelligence could be classified to support individual learning.
- Computer Support for Collaborative Learning (CSCL), learning through computer-mediated communication (CMC), and portfolio assessment to measure every learner's contribution in a group could be classified to support small group learning.
- Classroom response systems, handheld learning devices, and wireless Internet learning devices (WILDs) could be classified to support entire class learning.

From the categories, it is obvious that the learning devices have progressed from supporting individual learning to class instruction. In other words, it is possible to implement CSCL or CAL systems on WILDs.

Meanwhile, the learning technology has progressed in the area of computer-assisted language learning (CALL) adopted ICT. The common CALL implementation includes simulation, tutorials, worldwide software, computer-mediated communication or discussion, authoring, corpora, concordance, response feedback, adaptivity, problem-solving, branching, and autonomous learning (Doughty & Long, 2003). Although CALL research community has adopted learning technology for language learning, the progress was made slowly, compared with the abundant results in the learning technology domain. For instance, reports of using WILDs for reading instruction are very rare in the CALL area. Consequently, another purpose of the study is to benefit both the CALL and learning technology research community by applying advanced learning technology to the language learning domain.

In another perspective, the ABD really does not mean to use very advanced learning devices as the only implementation platform. The design method was proposed by considering most instructions' ability and accessibility of ICT. Furthermore, the infrastructure of ABD intends to integrate existing resources of learning devices in elementary schools, such as laptop PC, handheld devices, Internet access, and even wireless devices. Hence, the calibration along the learning technology dimensions are roughly labeled as LD (for learning devices without Internet access), ILD (for learning devices with Internet access, but without wireless ability), and WILD. Suppose the learning technology dimension is set as the technology-axis; the size of the group is set as the size-axis; meanwhile, the type of learning method is set as the type-axis. Figure 1 depicts a basic unit in the architecture of activity-based design. The type-axis is particularly noteworthy because one may wonder why we do not choose learning theory, approach, method, and technique as the calibrations of the type-axis. The major reason is that the study, while transcending from "dream-based" research to "adoption-based" research, will put most of its efforts into constructing learning activities on various learning devices. Hence, the space of the activity-based design basic unit will be full of practical activities for reading instruction.

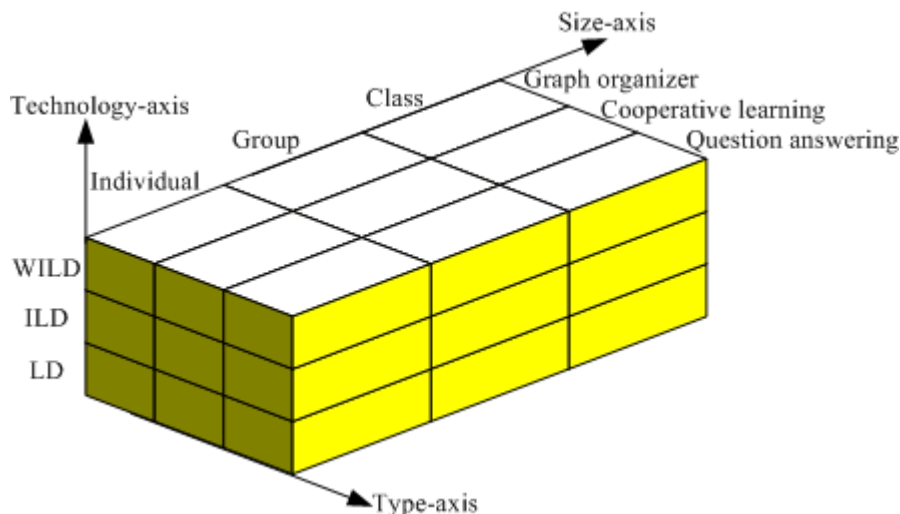


Figure 1: Basic unit in the architecture of activity-based design

Example of Activity-based Implementation

Now we come to the part about how to combine materials with the basic units. The ideal situation is that there is at least one learning activity for every grid in the space of a curriculum infrastructure unit. For instance, there should be at least one learning activity for the LD*Group*(Graphic organizer) grid. In other words, every grid in (LD, ILD, WILD)*(Individual, Group, Class)*(Learning methods) should provide activities for teachers' plans. As a realistic example, the classroom response system that instantly collects and aggregates every student's response is an excellent activity for the WILD*Class*(Question-answering) grid in an infrastructure unit. Product examples include: EduClick, eInstruction (<http://www.eInstruction.com>), and Discourse (<http://www.ets.org/discourse/>).

Figure 2 illustrates an example of implementing an ESL reading activity for LD, ILD, and WILD. First, a pair-annotation client was developed to support learners to read an ESL essay collaboratively, illustrated as two windows in Figure 2. Hence, the activity can be applied to any PC with wired Internet access, that is ILD. Then, a client for remote control was installed on Pocket PCs with wireless Internet accessing ability, which is WILD. Thus, learners can use the same application on PC to carry out the pair-annotation activity on their WILDs. Of course, the annotating client for ESL reading can be used for individual learning. Consequently, this example demonstrates the part of (LD, ILD, WILD)*(Individual, Two)*(Cooperative learning) in the conceptual architecture, illustrated in Figure 1.

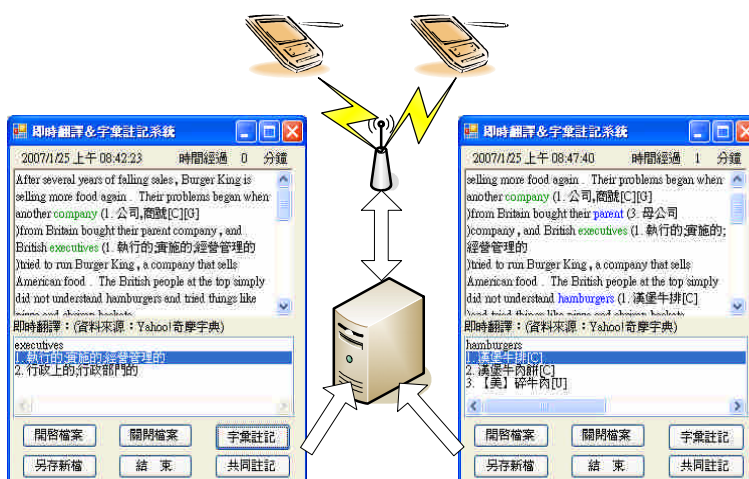


Figure 2: Implementing example of activity-based design

Discussion

There are many remaining questions about how the learning technology can best assist language

learning for an ESL learner. Although many researches have been done and success stories exist, only a handful of them can be widely adopted by most teachers. There are three important challenges in widely adopting learning technology for reading instruction in the future, including budget considerations, professional development, and use of technology (Leu & Kinzer, 2000). From the challenge of using technology, an additional challenge may come in the form of concerns of equal access to information and to the networked technology for every learner. In other words, the challenge is the “personal information accessibility” problem, which means a user’s information connectivity, device accessibility, and personal affordability (Soloway, Norris, Blumenfeld, Fishman, Krajcik, and Marx, 2001). For instance, fewer than 20% of the schools meet the following criteria: “one Pentium or Power Macintosh CD-ROM-equipped computer for every six students”. The ABD method should be more widely adopted than others because it concerns realistic and “personal information accessibility” situations in the classroom.

Another major reason is because that teachers demand curriculum which evolves from familiar materials or textbooks into a digital format in learning devices. Furthermore, the curriculum should be ready for at least one semester course to change the way of teaching and learning. This study proposes a design method based on existing curriculum infrastructure for ESL reading instruction as the first step to construct a compelling and critical content example to demonstrate how the ABD method works on a very specific learning domain (i.e. ESL reading instruction). The developed curriculum can simultaneously evolve by replacing activity design in the basic unit of the ABD architecture. Therefore, it may finally stop evolving at an optimum situation.

Conclusion and Future Directions

ICT has changed the ESL learning processes from various perspectives, such as the student, teacher, activity, and evaluation dimensions. For instance, more and more students in Taiwan use electronic handheld English-Chinese dictionaries, which can be viewed as one type of learning device, to scaffold their English learning. However, the instructional potential of learning devices for English learning is not fully educed. This study selects ESL reading instruction to demonstrate operations of integrating ICT with existing curriculum toward an optimum curriculum. There are two major research issues reported regarding the role of ESL reading instruction in this paper. The two research issues are concerned with curriculum design and illustrated examples of digital contents. The two major research issues are depicted as following.

1. The first research issue focuses on using an ABD to analyze all aspects related to existing contents of English-as-second-language (ESL) reading instruction. Although the explored aspects are extensive, the most important aspect for ESL reading instruction is the activity model aspect. Because there are many classroom activities for reading instruction in the literature, the forty-five reading activities proposed by the International Reading Association are studied to construct technology-enhanced fundamental activities. Those activities are categorized as six types. Finally, three types are selected for implementation of ABD.
2. The second research issue develops a curriculum example for ESL reading instruction for the ninth grade besides the curriculum design infrastructure. The curriculum example provides various learning activities based on the technique of reading instruction through learning devices. The design of the curriculum example is based on the ABD analysis of existing contents for ESL reading instruction. Consequently, a teacher can directly install the required curriculum (i.e. existing contents and required activities) into learning devices to begin activities of reading comprehension for individual, group, or class learning, according to his/her instructional plan. Furthermore, the curriculum example will evolve into an “optimum curriculum” by continuously revising the activity template for existing contents for ESL reading instruction.

For the future direction, the study will fulfill the idea of an integrative advancement approach (IAA) on the curriculum example for ESL reading instruction. The basic idea of IAA is simple: putting equivalent emphases on both fundamentals and advancement by carefully designing curriculum so that fundamental activities and advancement activities can be integrated in a dependent and interleaved way. The study will design a series of projects, with the later ones as the sequels of the previous ones in order to progressively reinforce the sense of achievement of the students. In addition, each of these projects demands some concepts or skills as prerequisites in order to be able to conduct the project. Prior to conducting the project, learners have to be involved in some fundamental activities to acquire those prerequisite concepts and skills. In other words, these projects provide opportunities for students to apply what they have learnt from the fundamental activities in an integrative way in the process of conducting the project. Furthermore, the concept of an interdisciplinary curriculum will be applied to design the advancement activities. For instance, a series of ESL reading projects about math or science learning is

feasible. Although some vocabulary in these projects may be too difficult for ninth grade students to learn, this study will develop sophisticated scaffolding to solve the problem. Most important of all, the study will continue to explore opportunities for students to apply their reading skills, which they have learned from the fundamental activities in ABD curriculum.

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