SHARING EXPERIENCES AND CREATING KNOWLEDGE ON THE WEB FOR U-LEARNING

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ABSTRACT

The development of information technology is transforming Japan's uniform society into an ever-changing and diversified society that requires ceaseless learning to maintain the qualities of our profession at high standards and our daily lives at appropriate levels. Universal and ubiquitous learning has the capacity to overcome information technology divides between the haves and the have-nots. Inexpensive devices such as mobile phones and PDA are powerful tools to satisfy the learning needs of anyone, anywhere and at any time. This u-Learning venture requires lessons gained from experience and new knowledge for implementing autonomous and effective learning. This paper discusses ways of transferring and accumulating a wide range of knowledge, from tacit to explicit and different types of knowledge representations.

KEYWORDS

instructional design, ubiquitous learning, u-Learning, knowledge creation, empirical approach, technology divides

1. INTRODUCTION

The remarkable development of Japanese education in the last century now faces new challenges: a drastic demographic decrease in young students, a decline in academic motivation and curiosity and the bureaucratic rigidity of educational systems. The educational system introduced from Occidental countries about 130 years ago functioned well in the last century but is not effective for our current, rapidly changing and diversifying society. Japan is now struggling to reform its educational system and recover its vitality for enhancing educational potential. Our rapidly changing society makes our professional knowledge soon obsolete, requiring us to renew it ceaselessly. In this sense, there is no substantial difference between developed and developing countries, or industrial and agricultural societies, as all require new knowledge to keep professional competence at a high level in an ever-changing world. Industrial restructuring and organizational change have made employment unstable and professional careers uncertain. It is indispensable that we renew professional competencies to keep our lives more stable and dependable. Lifelong learning for acquiring knowledge is therefore not a special requirement for so-called enlightened people only, but necessary for every citizen. Recent developments in ICT enable us to explore an

entirely new framework for teaching and learning, from teacher-led to learner-centered instruction. Universal and ubiquitous learning, or u-Learning, which can accommodate large audiences seeking professional expertise as well as incorporated into daily life, needs to be explored urgently.

2. THE TEACHER'S NEW ROLE: FROM KNOWLEDGE PROVIDER TO LEARNING DESIGNER

The present educational system in our schools has effectively contributed to cultivating and disseminating a school-based, academic knowledge centered on the traditional styles of lecture and memorization. Higher education follows conventional teaching styles, but it also aims to introduce new disciplines that will surely contribute to strengthening culture, science, technology and economics. Knowledge has been provided through formal institutions, such as schools and universities, but its cost is becoming higher and higher due to the shortage of expertise and expensive human resources. In spite of such high cost, people still pursue knowledge acquisition from well-established institutions competing to enter a limited number of top institutions to acquire prestigious degrees. The teaching-oriented framework showed in Figure 1 has lasted for a long time and is quite familiar to teachers. The Japanese national government fixes the educational goals and instructional content, and local governments follow these standards in providing educational facilities that seek to achieve these goals equitably in different localities. Teachers make efforts to provide quality teaching and satisfy the demands of their occupations. They accumulate empirical knowledge about teaching in a tacit but rarely explicit form. The presumption of this system is that the educated can efficiently teach the uneducated in these well-established institutions. This framework of instruction has functioned well in a stable or slowly changing society. The situation, however, has changed drastically since Information and Communication Technology (ICT) was introduced as instructional media in every institution, including at the elementary, secondary and higher levels.

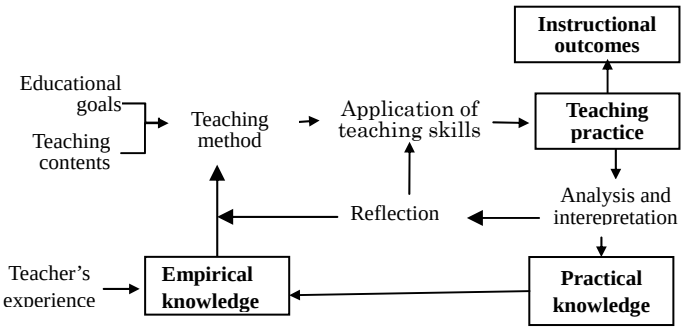

Figure 1. Framework for Teaching-Oriented Instruction

Recent developments in ICT are expected to provide more and better opportunities for learning and to promote a general knowledge revitalization. ICT enables us to provide large audiences with effective instruction while at the same time responding to personal needs, and to cultivate stronger interest in learning and a deeper comprehension of our surroundings. Television programs introduce us to entirely new worlds, strange and remote from our daily lives. Computer simulations open new horizons in our recognition of the world. These high technologies contribute enlightenment to our world views and enrichment in our lives. We thus also look forward to the development of a vast educational establishment for life-long learning and educational opportunity to renew a range of professional expertise in a Web-based educational society. Nevertheless, we are still concerned about the equality of accessibility to knowledge acquisition necessary for renewing our professional competencies, due to the lack of experience in distance learning as well as technological divides between the haves and the have-nots. The learning-oriented instruction shown in Figure 2 requires us to create an entirely new environment to realize

autonomous learning among students. In this type of learning, project methods or a problem-solving approach are effective in keeping learners' interests and involvement at a high level. When we try to initiate new solutions to problems or produce visible outcomes, we start from imagining them, to drawing sketches and making drafts, to actualizing them and to constructing the final solutions and/or products. In this process, we utilize paper and pencil, even large sheets of paper for presentations and chalk and blackboard if necessary. In the refining process of new ideas, discussions, critical reviews and consultations with peers and specialists are indispensable means for realizing productive and fruitful outcomes. This kind of learning has traditionally been provided in the small-group learning environment located only in conventional educational institutions. Thanks to the development of ICT, Internet access, e-mail and software for collaborative work are very powerful tools to accompany such discussions and consultations in our information society. In this working and learning situation, ubiquitous devices such as mobile phones, PDA and mobile computers are effective and efficient technologies to facilitate such interactive communication review. In particular, technological developments in the area of mobile phones have been very rapid, and they now provide access to television programs and Web sites. In this context, these devices, available to everyone, can be used to share knowledge for developing universal learning and overcoming educational opportunity divides. This is the rationale for forging a Web community among those engaged in universal and ubiquitous learning, or u-Learning, for everyone, at any time, and anywhere. Table 1 shows the different types of knowledge expected to be utilized for developing u-Learning.

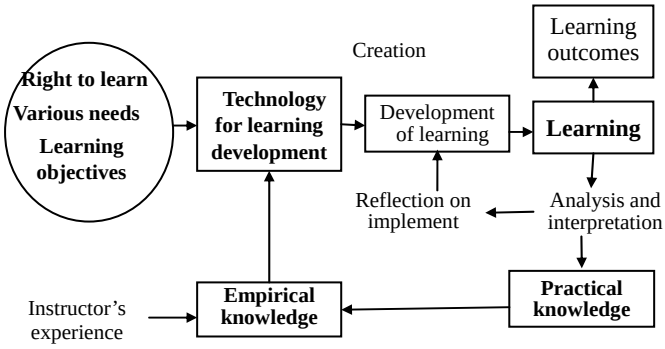

Figure 2. Framework for Learning-Oriented Instruction

3. KNOWLEDGE FOR DEVELOPING U-LEARNING

The broad introduction of technology in education often depends heavily on sophisticated ICT, especially multimedia and broadband. In a Web-based and computer-mediated learning project, most developmental trials start from the implementation of ICT, especially multimedia and broadband technology in the conventional classroom situation. In this case, the designers' attention and interests tend to focus solely on the technology, not on the learning itself. If we approach universal education purely from a high technology standpoint, it is almost impossible to overcome the ICT divide facing economically deprived people. These high technology and low technology concepts are not a dichotomy, but two extremes which should be linked seamlessly for disseminating universal education. In this context, we should take into account the potential of ubiquitous, inexpensive information technology and take a first step from the standpoint of knowledge creation and problem-solving to overcome technology divide issues. In our u-Learning project, we started instruction mainly with printed materials and mobile phones. Textbook-based instruction helps us focus our efforts critically on instructional design technology for students' active and creative involvement in learning. Adaptation of simple hardware helps make clear the essential and appropriate

Table 1. Types of Knowledge for Developing u-Learning*

	Tacit knowledge	Explicit knowledge		Characteristics of approaches
		Figurative and iconic knowledge	Formal knowledge	
Scientific approach (recognition oriented)	intuition, cognition, images	figurative models, figures and tables, symbols, pictures	numerical formulae, recognition statements, explanatory propositions	universal, reliable, deductive, analytic, systematic
Technological approach (action oriented)	hunch, intuition, empirical laws, proficiency, senses	images, models, figures, tables, symbols, pictures	empirical statements, judgmental propositions	individual unique, physical, inductive, synthetic
Characteristics of knowledge	difficult to express in language empirical intuitive subjective personal emotional and analogical knowledge at the workplace specific to locality, objects, person and time sharable by collaborative work requiring specific experiences; possible to propagate and develop	expressible in figures, symbols, pictures and behaviors; intersubjective; unique, digitized knowledge transferable through network; reusable, sharable and editable	linguistic knowledge; systematized knowledge; knowledge about the past lexicographical structure for understanding methods, procedures and objects; objective, societal, organizational, rational, theoretical, digitized and encoded knowledge transferable through networks; reusable, sharable and editable	

*This table was initially developed by NONAKA and KONNO(1990) and expanded by NISHINOSONO.

technology for critically effective and inexpensive instruction. In our instructional developments, we are trying to work out a premise for an autonomous learning suitable to distance learning. This approach requires a well-thought-out strategy in order to develop appropriate instructional materials. At the same time, if we start from discussion and communication with peers and fellow instructors in institutions or at remote workplaces, we find that ubiquitous communication devices such as mobile phones, PDA and portable computers are also useful tools to enhance knowledge creation and refinement inside and outside the classroom, even at distant homes. New trials often require entirely new, innovative solutions unfamiliar to our own and others' experiences. Even if we adopt ubiquitous facilities, instructional development should follow a systematic and scientific procedure to make the development more effective and acceptable to other experts in instructional development.

Figure 3 shows four possible approaches to designing novel instruction: practical syllogistic derivation from educational norms to actions, application of scientific findings, learning from others' experiences, and intuitive and creative ideas enhanced by tacit knowledge accumulated from our previous experience. We start to generate intuitive and creative ideas by referring to the tacit knowledge emerging from our past experience. The concern in this paper is to develop a research method for formulating explicit knowledge in the forms of figurative and iconic representations, as well as statements and propositions as formal knowledge for accumulating our experiences in the form of knowledge easily communicable, systematically

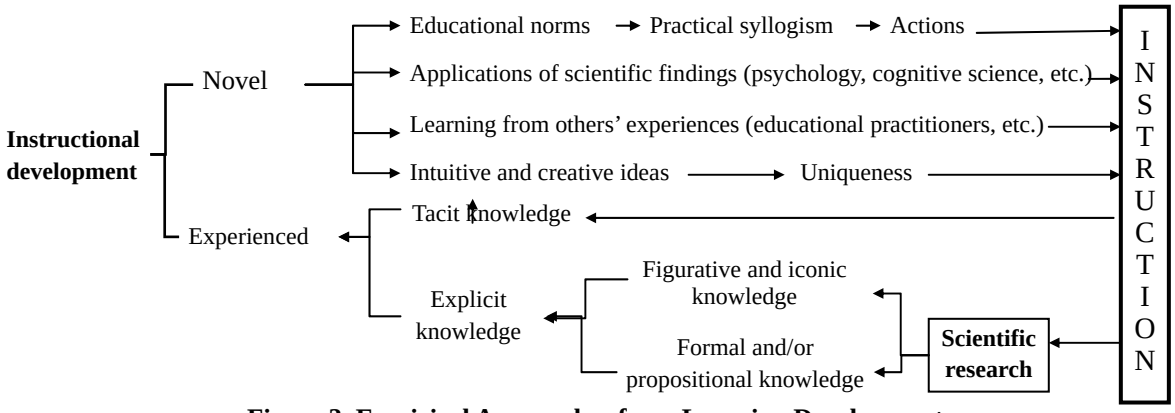

Figure 3. Empirical Approaches for u-Learning Development

revisable and sharable with other experts.

Figure 4 shows the procedure used to conduct instructional material development and research on u-Learning, mainly depending on an empirical approach rather than a scientific-application approach. There are two possible approaches: one from synthesis and another from analysis. Novice teachers prefer to start by making images and then refining them into figurative and/or iconic models. In this process, discussion and critiques are essential to improve their initial ideas and clarify feasible plans. On the other hand, experienced teachers are strongly recommended to start by analyzing their own teaching. They may be strongly accustomed to teaching via unilateral lecturing and may find it difficult to transform their teaching style from being teacher-dominant to learner-centered instruction. After several trials, however, they will begin to express recognition about the lessons and describe their empirical laws in the form of statements and judgmental propositions, sometimes after having conducted lessons by themselves. The authors make a greater effort to develop instructional design technology than information technology in education, believing strongly in the potential for fruitful and creative outcomes from collaborative teamwork.

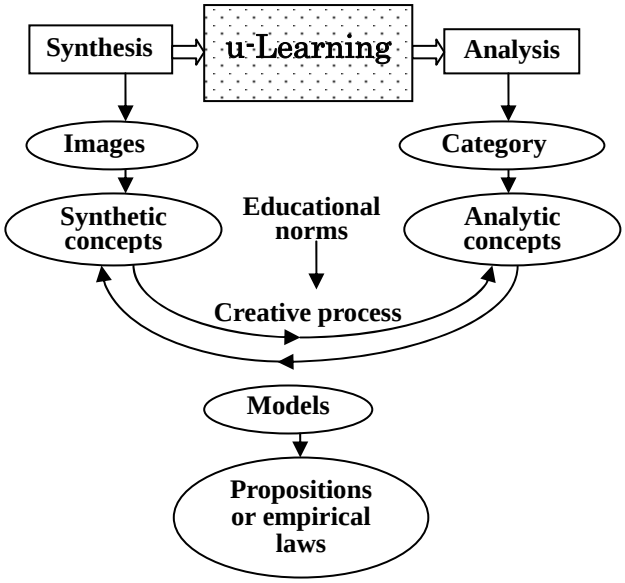

Figure 4. Empirical Research on u-Learning

Collaborative teamwork is essential to ensure fruitful and creative outcomes from u-Learning. The Japanese educational system is still sharply competitive among candidates aiming to go from elementary to secondary to higher education stages. Their learning heavily deviates towards exam preparation and forced competition with their peers. Collaborative teamwork is not fostered and difficult to realize yet, even at the university level. To overcome such a distorted and dissuasive attitude, five principles are emphasized in classes as an example of educational norms: Autonomous learning, Collaborative work, Contributions to teamwork, Responsibility to the team and Respect for other people. Universal education rather than selective streaming, and a smooth articulation between different stages of educational life are urgent issues to be tackled in our rigid schooling system. Ubiquitous ICT and collaborative work are expected to be very effective for solving these problems.

4. PRACTICAL IMPLEMENTATIONS AND TWO HYPOTHESISES

Active learning can be realized by integrating structural models of instruction rationally. The structural model MACETO (Figure 5) consists of six components: Meaning, Activities, Content, Environment, Tools and Outcomes. The six components are classified into internal and external conditions for autonomous learning. The major aim of instruction for universal education is to provide autonomous learning for enhancing one's competence and knowledge despite differing conditions in the learning environment. Instructional design starts from understanding the learners' interests and intentions, while taking into account the meaning of learning; it then proceeds to planning learners' activities and anticipated learning outcomes.

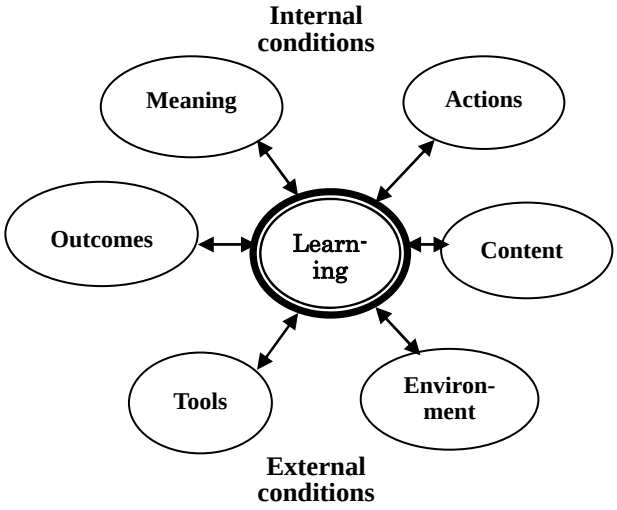

Figure 5. MACETO Model for Instructional Design

Hypothesis: If we can arrange internal conditions meaningfully, learners can overcome externally difficult conditions and work hard autonomously.

Why should we specify and realize the meaning of learning before deciding instructional content? Current education in schools, even in universities, emphasizes the importance of instructional content, deviating towards a teaching crammed with factual knowledge. If we start from the analysis of instructional content, it is almost impossible to reach common agreement among educators on the range and scope of the content. On the other hand, our information-rich society provides us with the most up-to-date knowledge on the Web, requiring us to ceaselessly renew our professional competencies in order to fulfill our responsibility as members of society. Autonomous learning proceeds from asking the meaning of learning, then moves to specifying the problems, planning learning activities and clarifying outcomes in the first stage, and then working out the content in the second stage. In this context, we start by identifying students' competencies to be cultivated, providing authentic themes relevant to our current, rapidly changing society, and stimulating intuitive and creative knowledge to solve problems rather than letting students absorb factual knowledge easily accessible through the Internet.

Innovation in school and university education is urgently needed to change education from teacher-led instruction to student-planned learning to meet the needs of our ubiquitous ICT society. The outcomes from autonomous learning are also the products of institutionalized education; they result in individual satisfaction as well as serving national interests as their ultimate goals. It is crucial that we find an authentic theme able to enhance students' interests and motivation while contributing to solving problems in society. After clarifying those internal conditions, designers proceed to the arrangement of external conditions to encourage students and enhance their learning. This model is utilized to describe instructional design in its initial stages and thereby to clarify the whole structure of the course.

The second stage of instructional development is to produce modules that provide learning events which are equally accessible for every student. Printed materials, mobile phones and PDA are the most convenient and economic media for students in this information age. Printed materials are highly portable and convenient for reviewing content. The mobile phone facilitates student communication with each other at any time, anywhere. PDA can display documents, videos and simulations showing natural actions

and color. A software product named ‘C-learning’ developed by Netman Co., provides us with instructional functions such as storage of instructional materials, bulletin boards, tests, exercises and consultation by e-mail by mobile phones as well as PCs entirely compatible with each other (except the attachment of files in mail via mobile phones).

In this circumstance, teachers are expected to develop their professional expertise, accumulate experience and communicate with their colleagues and professionals, even at a distance.

Hypothesis: Our experiences with instruction are accumulated tacitly as well as explicitly, of which explicit knowledge can be described in a set of iconic and figurative representations and formal propositions to be easily communicated among instructional professionals for enhancing the Right to Learn.

We try to develop learning events utilizing printed materials, and then confirm their validity by observing students’ activities and products through testing, discussion on bulletin boards, consultation by e-mail and reading submitted reports. Such judgmental reasoning is described in the form of figurative and iconic representation and judgmental propositions, and stored in a database with the intention of being referred to later or accessed by others. Therefore, the outcomes from those lessons based on the MACETO model are four-fold: visible products such as reports and/or work, students’ enhanced competence, instructional materials for the course and empirical knowledge concerning instructional development.

Article 26 of Japan’s Constitution and UNESCO’s 1985 Declaration of the Right to Learn provide a philosophical background for realizing universal and ubiquitous learning, or u-Learning. Our national constitution maintains that all people have the right to receive education equally corresponding to their ability. Despite this declaration supporting equal access, Japanese education has developed based more on national interests and less on individual abilities and needs. But we cannot waste the talent of any child within the national education scheme. Changes from a selective and competitive educational system to a universal cooperative learning system are urgently needed for our future society.

Instructional development requires very complicated considerations and thought-out decisions aimed at producing realistic instruction. Conventional theories already conceptualized and well-established are not necessarily applicable to a specific situation or target population, especially in the case of adopting innovative ICT into the conventional framework of instruction. In these circumstances, we have to start from an ad hoc theory and continually refine it as the project progresses. The basic philosophy of u-Learning is to enhance universal and ubiquitous learning with or without electronic technology. Even in Japanese society, which is affluent with information technology, there is still some reluctance to introduce technological gazettes into classrooms. The u-Learning project aims to introduce ICT in education where a large number of students are studying on and off campus with a limited number of PCs but an ample supply of mobile devices and with the most convenient medium of printed materials.

5. CONCLUSIONS

In the process of developing educational courses, there are four possible approaches for applying a rational procedure for instructional development; practical syllogistic derivation from educational norms to actions, application of scientific findings, learning from other’s experiences and refinement of intuitive and creative ideas. There is heated discussion among instructors about the validity of instructional design based on behaviorism and constructivism. Actual instruction is too complex to manage from a single concept: it is impossible to cover the whole process according to only one specific scientific standpoint. Learning from other designers and practitioners is always very fruitful. At the same time, we often face many entirely unfamiliar situations, but nevertheless have to conduct our instruction. We cannot wait for knowledge

emergence from scientific meetings or information from others' experiences. In many cases in daily teaching, we start from our intuitive ideas and confirm their validity empirically. Can we theorize this process for scientific investigation?

As shown in Table 1 and Figure 3, the authors start from the intuitive and creative ideas referring to tacit knowledge hard to express verbally but certainly embedded in their own experiences. We may express them in the form of figurative or iconic representations easier than in trictly logical statements. Young students are quite familiar with expressing their ideas in non-linguistic ways. Taking advantages of such familiarity, students start expressing their original ideas, discussing the issues and refining them towards final concrete outcomes, or products of instructional materials, models representing the instructional situation, and logical statements and propositions convenient to revise later or to communicate with their peers in written form. In this process, ceaseless communication and critiques among students through the Web with ubiquitous devices are indispensable to encourage their active involvement. The authors collected their experiences from the abovementioned courses in the form of statements or judgmental propositions or empirical laws.

Mobile phones so familiar to students are still out of bounds as educational instruments. Mobile phones, however, have become an important part of their daily lives. They never forget them at home or anywhere else. On the other hand, instruction has become too difficult to tackle by teachers working alone. They need to help each other, obtain public support and communicate personally with students, colleagues and the citizens in the community. Ubiquitous equipment is a very powerful tool to facilitate mutual communication and, in this sense, to contribute to a truly universal education. However, it requires us to become more imaginative and creative, and to develop scientific procedures in pursuit of a rational reasoning for instructional development in our professional discipline. Starting from ambiguous but intuitive and creative ideas, we can refine them and express our ideas rationally and then contribute to the scientific development of instructional design technology. Thanks to recent technological developments in qualitative and quantitative analysis, we can easily investigate the validity and relevance of empirical knowledge during real classroom instruction. For this purpose, we need to develop a scientific procedure to clarify our experiences and refine them to be able to communicate with each other around the world.

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