Online Learning Process Management and Learners' Motivation: A Case Study of University of Yamanashi Virtual Academy Programme

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Abstract: *This paper presents a computer-based online learning strategy to assist in introducing and teaching hydrological modeling to different stake holders (Basic degree holders to postgraduates and also practicing engineers). As part of the online learning strategy, an interactive computer-based instructional aid was specifically developed to assist distance learners to set up, run and analyze the output from a hydrological model developed by University of Yamanashi, Japan for prediction of river discharge and other hydrological outputs relevant to a river basin. The online learning strategy comprised with an internet based course lessons which include helpful text, graphics, and links to publicly available relevant data resources. An anonymous after lesson questionnaire survey was introduced to assess participants' perceptions towards the adopted online learning strategy. ARCS (Attention, Relevance, Confidence and Satisfaction) principles were used to gauge participants' learning motivation based on the questionnaire outcomes. Alterations to the online programme are underway to enhance the quality of the programme based on lessons learned through the feedback.*

Keywords: *ARCS principles, Learning motivation, Online learning, YHyM-BTOPMC.*

1. INTRODUCTION

The benefits of using hydrological models as an aid in understanding the catchment response for hydrological cycle and its components have been recognized within the water-related professions for more than two decades. Hydrological models can be used to find the best answers to both existing and potential hydrological problems. Additionally, they have also been resourceful in demonstrating solutions at high level meetings by way of interactive graphics and animations, educating the most inexperienced of observers. An online structured learning programme has been developed to enhance the understanding of hydrological modeling while preparing prospective participants for the type of problems they may encounter in the workplace and assisting them in the teaching/management of their educational and research activities. This paper presents a description of the online learning programme including the model used and results of a formal anonymous questionnaire survey undertaken to gauge participants' perceptions towards the effectiveness of the program.

1.1. Hydrological Model

The Block-wise use of TOPMODEL and Muskingum-Cunge method (BTOPMC) is the core module of the University of Yamanashi Distributed Hydrological Model (YHyM); here after refer as YHyM-BTOPMC. This model has been developed by the University of Yamanashi, Japan (Takeuchi, Ao & Ishidaira, 1999), (Ao, Takeuchi & Ishidaira 2000), (Zhou, et. al, 2006) and (Takeuchi, Hapuarachchi, Zhou, Ishidaira, & Magome, 2007) and introduced to this online learning programme. This model has already been successfully applied to many basins, large to small, temperate to tropical throughout the world (Hapuarachchi et.al., 2004), (Shrestha et. al., 2007) and (Silva, Magome & Ishidaira, 2010). YHyM-BTOPMC includes four main sub-models (topographic, runoff generation, flow routing and parameter identification). The structure and

parameterization of the model lead to the advantage of both lumped and distributed approaches in hydrological modeling process.
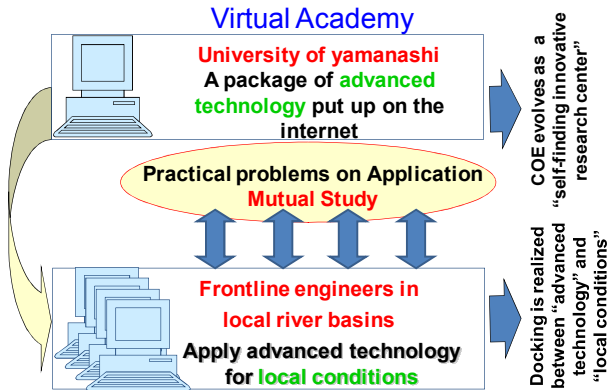
1.2. Virtual Academy

Figure 1 Purpose and Goal of Virtual Academy

The University of Yamanashi, Virtual Academy (VA) was inaugurated in 2004 as one of the main educational features under 21st Century Center of Excellence programme and presently continuing under the Global Center of Excellence programme. The objective of the VA is to encourage international collaboration in research and exchange of information and expertise relate to river basin management with mutual study (Figure 1). VA programme guide the participants with theoretical and practical expertise necessary for local applications, through a structured curriculum offered via internet. Here, an advanced Learning Management System (LMS) has been used. All lesson contents, grades, reports, Q&A and bulletin board are managed and opened to participants and instructors through LMS.

The prime focus of present VA programme is on YHyM-BTOPMC distributed hydrological model simulation to obtain hydrological outputs at a given watershed. The VA course lessons consist of basic theory as well as all necessary procedural steps including supplementary software tools that are developed to extract various data from publicly available information. These tools help enrolees to prepare the input datasets for YHyM-BTOPMC model application in their chosen river basins. The lessons comprised many figures, tables and web links in addition to traditional text-lessons to enhance effective learning. The curriculum provides all necessary expertise for basic theory, setup and execute of the model, and interpret the output (Figure 2), using the Fujikawa river basin, Japan as an example application. Over the years, the number of participants who apply for VA programme has been increasing and the composition of participants becomes more diverse. In year 2007, about one third of the registered participants were from public institutes. About a half of the total applicants were postgraduate students and the rest of the applicants were from diverse status. Therefore, since 2007 VA started to offer two courses (Beginners Course and Advanced Course) to cater to different levels of participants. Also these two courses are designed with quarter system and the end quarter assignments to further enhance the learning efficiency.
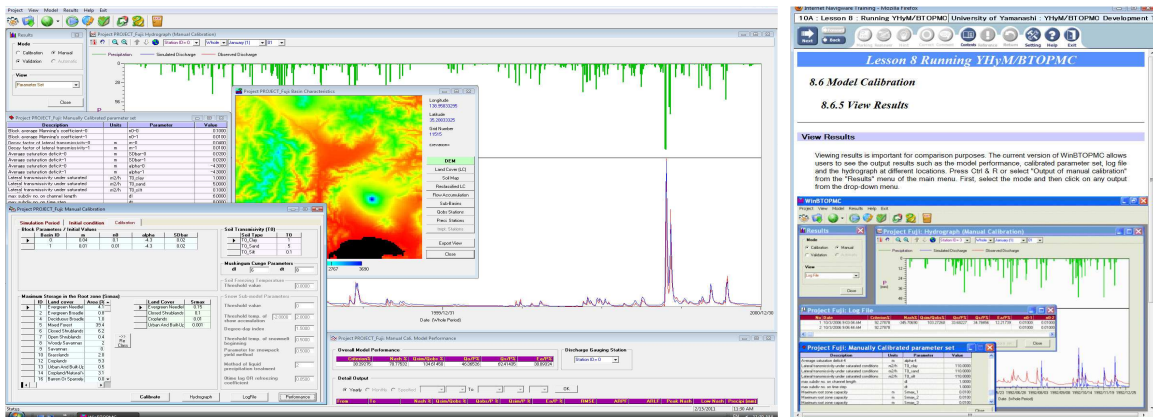

Figure 2 Graphical User Interface for YHyM-BTOPMC model and sample lesson page of VA

2. LEARNING MOTIVATION

Motivation is a complicated psychological attribute, basically classified as extrinsic (coming from outside the learner and target on final grades) or intrinsic (genuine interest in learning originating from within). Extrinsic motivation more closely associate with traditional class-room learners. Intrinsically motivated learners have several strengths including sustain desirable learning behaviours. Hence, intrinsic motivation is identified as much relevant with distance (online) learners (Patricia, Nancy & Brian, 2002). Keller, 1987 presented four key principles namely Attention, Relevance, Confidence, and Satisfaction (defined as ARCS model) for planning and implementing distance learning courses if learners are to stay motivated. In the current study, ARCS principles have been investigated through an online course evaluation questionnaire, which is designed to gauge participants' perception towards the VA programme. The questionnaire results presented in this research article are from 20 highly motivated VA enrolees (2007 - 2009) who had responded at the end of 13-week VA course. Table 1 summarizes the used and evaluated ARCS principles under different strategies. The last column gives the arithmetical mean and standard deviation for each investigated learning motivation strategy based upon responses from VA participants. Figure 3 illustrates Likert scale radar-plots for course and instructor evaluation by VA participants which clearly demonstrate the level of participants' agreement to each target aspect. Most of the aspects have been positively agreed upon with a satisfactory level and the details of each are discussed in the next section.

Table 1 ARCS principles for evaluating learning motivation

| Key principles	Principles used	Principles evaluated	Mean ± SD
Attention Strategy			
Enhance enthusiasm	Lessons were prepared to introduce both modeling principles and applications.	Written materials were of high quality and suitable for the course.	4.5 ± 0.7
Communication support	Interactive communication was expected through Bulletin Board facility.	Opportunity for interaction among participants.	3.4 ± 1.3
Diversity	Learners were encouraged to research on different case studies.	NA	
Relevance Strategy			
Control and relevance	Participants were guided through level based learning.	Contents were appropriate to the allocated time.	4.5 ± 0.7
Confidence Strategy			
Minimize anxiety	Instructor showed enthusiasm and empathy.	Instructor has a thorough knowledge of the subject.	4.5 ± 0.7
	Enrollees are provided with clear, organized and effective instructions.	Instructor was organized and prepared.	4.5 ± 0.7
Challenge level	Lessons were planned according to pre-defined course goals.	Contents had adequate, clearly identifiable goals.	4.8 ± 0.4
	The assignments were designed to increase the level of challenge as the course progressed.	Assignments were appropriate.	4.7 ± 0.6
Satisfaction Strategy			
Effective evaluation	Learners are provided clear, encouraging feedback.	Instructor used effective teaching strategies.	4.3 ± 0.7
Multidimensional tasks	Multiple skills were tested through case studies.	NA	
Notes: 5 = Strongly agree to 1 = Strongly disagree; SD = Standard Deviation; NA = Not assessed			
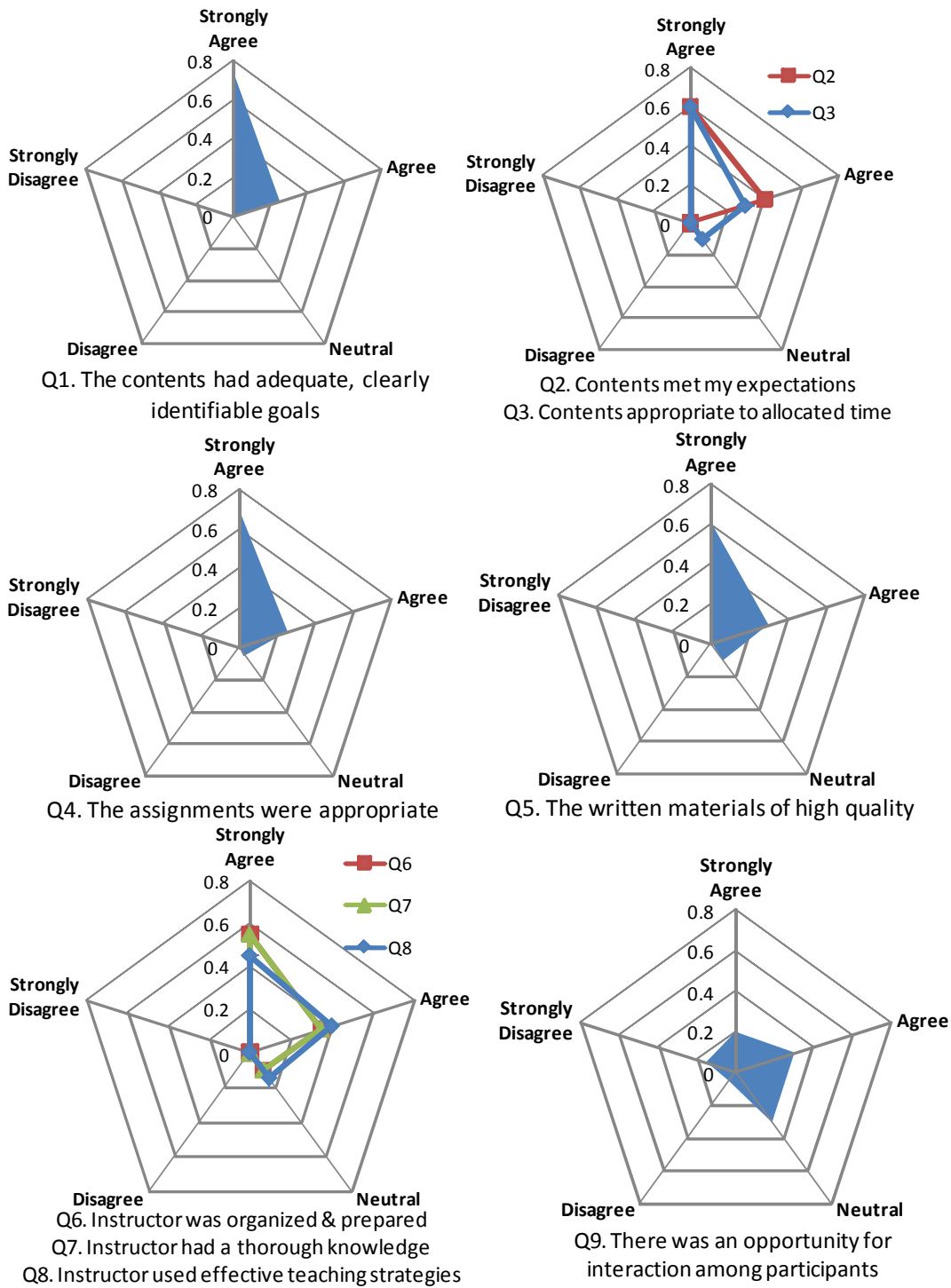
Figure 3 Summary of course and instructor evaluation by VA participants

2.1. Accomplished ARCS principles

2.1.1. Attention strategy

Enhance enthusiasm: VA lessons include introduction of YHyM-BTOPMC model as well as governing hydrological principles pertaining to modeling. The Lessons are presented through well structured level

based learning from which learners would be able to extract the essence of hydrological modeling. Enrolees found that the lesson contents were of high quality (Figure 3-Q5 and Table 1).

Communication support: When designing assignment, choosing technology, and providing feedback, interaction among participants should be considered. In VA, Bulletin Board facility (Figure 4) was provided from which participants can either post a question or search for a similar inquiry previously posted. Through this facility, it is expected that participants can exchange issues related to different lessons within the programme. In VA, participants seldom read others' posting and found the Bulletin Board moderately useful (Figure 3-Q9 and Table 4).
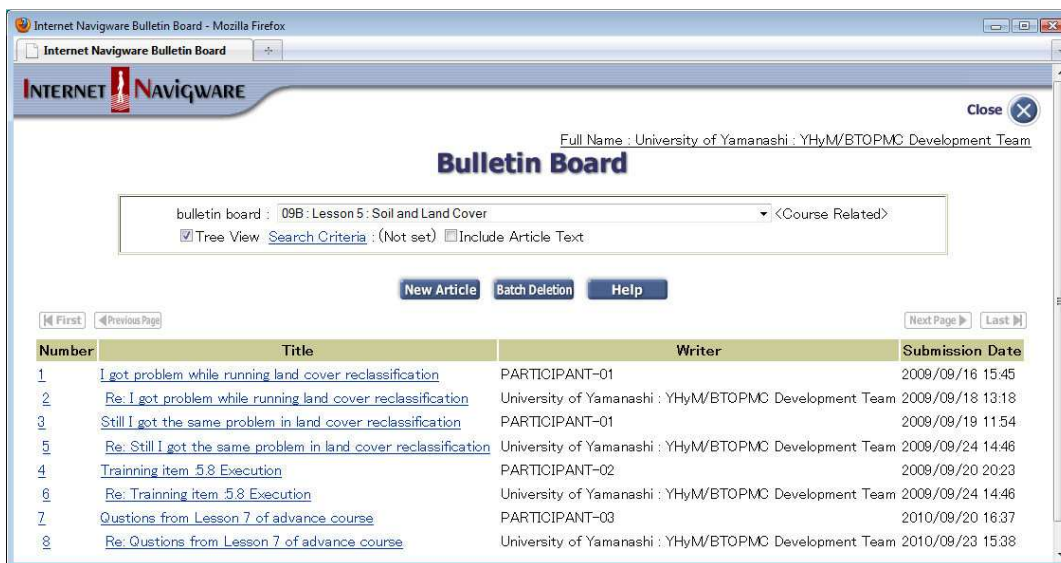
Figure 4 Bulletin Board

Diversity: Stipek, 1993 warns against predictability, in repeatedly using the same teaching method. Instead, diversity is recommended to maintain participants' curiosity. However, in online learning it is understood that predictability in different lesson contents may optimize course organization and clarity while decreasing anxiety of participants. VA has been designed to balance the need for consistency without sacrificing diversity. The present course evaluation questionnaire does not cover this aspect and it will be included in future programmes.

2.1.2. Relevance strategy

Control and relevance: Another strategy to enhance intrinsic motivation is to let participants choose activities that are personally meaningful and relevant. In this programme, enrolees can choose their own target river basin for their application. Except precipitation and discharge data sets, the YHyM-BTOPMC model can be set up and simulated with publicly available datasets. This promotes participants to select any basin according to their desire, interest, and enthusiasm. Thus, participants may feel that they have more control over learning application. VA offer flexibility in how participants completed their assignments. Although due dates are needed to ensure coherence in the overall programme, participants are given ample time to post reports as the assignments questions are made available at the beginning of each quarter. Participants found that the time allocation for different lessons were adequate (Figure 3-Q3 and Table 1).

2.1.3. Confidence strategy

Minimize anxiety: Participants new to distance learning may feel a level of anxiety different from that felt in the traditional face-to-face classroom. Concerns about assignments, motivating themselves without a designated meeting time and place, and interacting with classmates at a distance may generate anxiety which can hamper effective learning. VA instructors use communication strategies to continue to minimize participants' anxiety by adopting careful, specific, informative, and frequent feedback (Figure 5). At the end of each quarter, an encouraging comment and feedback are posted along with the assigned grades for the assignment. When the enrolees work is past due, the instructor makes a gentle reminder which is

appreciated by many participants. Praising participants for successful progress and avoiding strictures in communication enhance confidence. While communicating, instructors composed clear, respectful messages to demonstrate knowledge, understanding and enthusiasm. The tone of any messages should be friendly and humour has been used appropriately. Enrolees felt that VA instructors effectively cleared up points of confusion (Figure 3-Q7 and Table 1).

Challenge level: The challenge level of course assignments is designed in order to enhance intrinsic motivation, and to complement the extrinsic motivation associated with grades. Moderately challenging course materials are accepted more enthusiastically than difficult, easy, or repetitive materials. Structuring course lessons with increasing difficulty and attainable challenges helps build confidence of participants. VA course contents at the first quarter are simpler, specific, and directed than those used in later quarters. The first quarter assignment is based on participants' experience rather than new knowledge. In midcourse assignments participants are directed to download and process public domain datasets using data-extraction tools developed by University of Yamanashi. Participants are also expected to obtain pre-processing model outputs related with topography, precipitation, discharge, evaporation, snow melt, and other hydro-meteorological parameters. Quarter-4 assignment is more challenging with the full model set up and parameterization for their chosen basin. Enrolees rated the lesson contents useful and the course assignments moderately challenging (Figure 3-Q2 and Table 1).
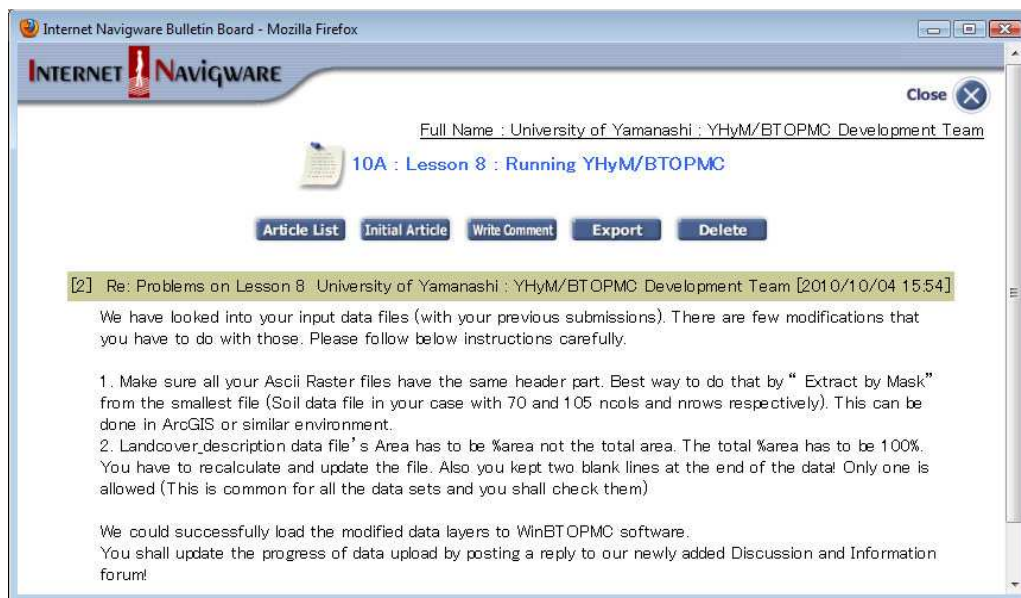
Figure 5 A typical VA feedback

2.1.4. Satisfaction strategy

Effective evaluation: In the ARCS model, personal attention, informative feedback, and praise are examples of techniques that increase participant satisfaction. During VA evaluation, in addition to final marks, enrolees received clear, encouraging feedbacks (Figure 6). Stipek, 1993 recommends that distance learner evaluations not be made public. Evaluation marks for VA are uploaded to the system and automatically generated e-mail notifies each participant. Individual participant can have access to his or her own evaluation page which is protected by own password. Participants rated instructor feedback useful (Figure 3-Q8 and Table 1).

Multidimensional tasks: Intrinsic motivation is also enhanced by multidimensional tasks, which use sustained effort over time, require more than one skill, and produce a tangible product or achievement. In quarter-4 report, VA participants are expected to use knowledge and critical thinking skills gained during the course to set up the YHyM-BTOPMC model using public domain and local data.

Subsequently, they are guided to prepare a comprehensive report combining the entire study outcome in a standard research article format.

Figure 6 Sample evaluation sheet

3. CONCLUSION

This paper discusses the use of a structured approach to provide training for theoretical and practical expertise on distributed hydrological modeling for distance participants. An interactive online learning system was specifically developed to assist participants to set up, run and analyze a hydrological model which is introduced through the VA distance learning programme. The system comprises multi-lessoned modules and quarter system that support learners a good foundation to expand their knowledge and experience relevant to principles and applications of hydrological modeling. Level based teaching and evaluation are arranged with basic exercises with an example river basin and more detail and self oriented applications based on the participants' chosen river basins.

The computer-based teaching and learning strategy for distributed hydrological modeling was evaluated using an anonymous questionnaire to assess the participants' perception towards the developed approach. Adopted strategy was found to be successful for most of the strategies in relation with ARCS principles. A new VA-communication-space is developed to enhance participants' interaction as an improvement for present VA system (Figure 3-Q9). After completing the programme on-site workshops are conducted (4 times during last 7 years) for invited participants from on-line distance learning programme. These workshops have been designed to enhance the participants' understanding towards the hydrological modeling and also to improve the quality of the VA programme. These follow-up activities

have been mutual beneficial for all VA stake holders to enhance and expand VA network. Use of advanced information technology to hold workshops online catering to a much wider audience is under consideration. The VA with YHyM-BTOPMC model is available for training at http://www.gcoe.yamanashi.ac.jp/e/va.html.

4. ACKNOWLEDGMENTS

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