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# A Local Time Calculating Courseware for Geography Students: Does it assist Teachers?

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Abstract— In learning geography, most students have problems in a particular topic, which deals with the calculation of the local time based on a given longitude. This problem is further compounded when some of the teachers lack the necessary learning aids to help solve the problem. Against this backdrop, the authors carried out a study to examine prevailing problems in the learning of this particular topic. A qualitative research method was used involving a semi-structured interview. Four teachers (who were selected from a secondary school in Perak, Malaysia) were recruited as the interviewees. Findings of the research showed that existing teaching approach was ineffective as calculating the required local time was tedious. Moreover, the interviewees professed a strong need for a new approach, which could ease the calculating process. Together, these two important findings underscore the imperative to introduce a new teaching approach, preferably aided by a novel application, which can help geography teachers explain the calculation process more effectively. In this paper, the authors propose an instructional design model for the intended application to guide the development of such a learning too.

Keywords: local time; calculating courseware; geography students; instructional design model.

## I. INTRODUCTION

Since the introduction of the new curriculum called Kurikulum Bersepadu Sekolah Menengah (KBSM) in 1989, geography has become a compulsory subject at the lower secondary level in which all students have to learn. However, at the upper secondary level, the subject is offered as an elective. The main aim of learning this subject is that Malaysian students will be able to gain sufficient knowledge pertaining to geographical concepts, principles, and phenomena at the regional and global scales. In addition, students are expected to learn unique geographical attributes and conditions of Malaysia's geographical landscape. More importantly, students must be able to explain different physical and cultural aspects of other countries by contrasting these differences with the local context [1]. This aim is not easily achieved because, according to Abdul Hamid and Mohamadisa [2], students are reluctant (at best) or terified (at worst) to learn geography at the upper secondary level. Their lack of interest may be attributed, among others, to the stereotype of a difficult subject this particular subject (i.e., geography) is painted with. This negative stereotype is further compounded when many students tend to view the subject as having too broad a scope, involving too many facts.

The curriculum of geography covers several topics, and the teaching and learning of this subject relies almost entirely on the textbooks provided by Malaysian Ministry of Education (MOE). Teaching aids are very limited — only maps are available — which limits the efficacy of the teaching process. Several researchers have cautioned the sole dependency on this type of teaching aids. For instance, Habibah [3] asserts that teaching using these aids can make the fulfillment of some of the learning objectives unattainable because some topics are based on an abstract concepts. For example, the topic "Calculate the Local Time Based on Longitude", which is the most challenging topic (as frequently complained by most students), consists of concepts that they find difficult to understand. The lack of proper teaching aids furthers exacerbates the problem, making teachers dependent on ineffective teaching tools. Provision of novel, effective teaching aids is desperately needed by teachers, which according to Habibah, 92 percent of the teachers surveyed agreed that computers, as a teaching aid, could help them teach better. These teachers also argued that, like science and mathematics teachers, they too should be provided with laptops to teach in the classroom. Evidence to support this contention for computers provision is based on a research finding involving 50 geography teachers from six secondary schools in Kulim, Kedah who indicated a strong need for such a requirement.

Using computers in teaching and learning has many benefits — both for teachers and students. For example, Zhang and Chen [4] claim that using computer-based applications, especially courseware, as a teaching aid can motivate students in learning. In addition, it can expose them to teaching and development practice/method of life. However, computer-based applications (i.e., courseware) are merely a learning tool created in digital form, which only makes its presentation to audience quick and attractive. What is more important is the design of its contents to promote better learning. Thus, the design of the courseware has to be guided by contemporary learning principles, models, or theories. Moreover, the use of well-designed courseware should be carefully embedded into learning activities, and this could only happen when teachers develop well crafted lesson plans. When all these requirements are fully addressed, only then computer-enhanced teaching can bring in intended benefits such as increased motivation and better comprehension [5].

The related literature is replete with numerous definitions for learning and training that is aided by computers, and the terms normally used include 'Computer Based Learning (CBL), 'Computer Based Training (CBT)', and 'Computer-Managed Instruction (CMI)'. Irrespective of the diverse terminology, many researchers have shown that computer-based learning and training can make an immense impact on understanding, motivation, and engagement compared to conventional method [5 - 12]. According to Mohd Aris [13], gaining these benefits would entail the design of training applications that is guided by cognitivist principles. Firstly, the design must take into consideration the cognitivist principle of learning as a process of constructing knowledge instead of receiving or giving knowledge. Secondly, the principle that learning process involves building new knowledge from prior knowledge must be emphasized. Lastly, the design must acknowledge that learning process also depends on an environment that promotes meaningful experience.

From the above discussion, several themes emerged, leading to the formulation of the three research objectives as follows:

a) to examine the current teaching materials used by geography teachers in teaching the topic of calculating the local time,
b) to examine the problems associated with the current teaching technique, and
c) to examine geography teachers' perceptions for the development and implementation of a courseware to overcome the current problems.

The following three research questions were formulated to address the research objectives.

d) What are the current teaching materials used by geography teachers in teaching the topic of calculating the local time?
e) What are the problems encountered by students in learning the topic?
f) What are perceptions of the geography teachers with regard to the development and implementation of a courseware to overcome the current problems?

## II. METHOD

This research used a qualitative research method using a semi-structured interview wherein four geography teachers were recruited. Through the interview, relevant information and data were gathered and analyzed, which helped the researchers conceptualize the appropriate model for the development of a learning application.

*Participants*

Four geography teachers were randomly selected as the interviewees. These teachers work at two different schools, which are located in the district of Kinta, Perak. The mean age of these teachers was 35, and their teaching experience ranged from two to 29 years.

*Instruments*

The research instrument of the study consisted of a set of questions for the interview, which was divided into two sections. The first section helped gather information pertaining to the current teaching aids used by the teachers for the particular topic; the second section dealt with the recommended features of courseware deemed important by these teachers. Information obtained from the teachers encompassed their responses, opinions and ideas, which transpired during the interview session.

*Procedure*

Based on Robson's [14] guideline, the researchers developed a protocol for the semi-structured interview, covering important aspects that were to be followed during the interview. Furthermore, to conduct the interview in a smooth progression from the top-down point of view — beginning with general questions and ending with specific ones — a funnel analogy was adopted in constructing the questions. To ensure the research instrument is valid, an expert judgment was solicited from an experienced research group and an expert geography teacher. Having established the soundness of the research tool, the research proceeded in two phases as follows:

Phase 1: Obtaining written permission for the interviews from the Malaysian MOE and the principals of the selected schools.

Phase 2: Interviewing the geography teachers of the selected schools where their responses were recorded and then transcribed accordingly. The interview sessions lasted not more than an hour.

## III. FINDINGS

From the interviews, important interviewees' demographic such as their designation, gender, age, and working experience were recorded. There were two female and two male teachers. Of all the teachers interviewed, there was only one expert geography teacher. These teachers' ages ranged from 37 to 52 years, and their working experiences spanned a range from two to 29 years. Table 1 summarizes the demographic of the interviewed geography teachers.

TABLE 1. TEACHERS' DEMOGRAPHIC

| Interviewee ID | Pseudo nym | Designation | Gender | Age (years) | Work experience (no. of years) |
|---|---|---|---|---|---|
| 1 | Noor Aini | Geography Teacher | Female | 37 | 2 |
| 2 | Aminah | Geography Teacher | Female | 38 | 5 |
| 3 | Ahmad | Geography Teacher | Male | 40 | 15 |
| 4 | Shahril | Expert Geography Teacher | Male | 52 | 29 |

Table 2 shows the information pertaining to the current practices as indicated by the geography teachers, in particular when they were teaching the difficult topic (i.e., local time). The first question identified the type of teaching aids used, and the second question asked whether these aids were provided by the Malaysian MOE or otherwise. All the teachers reported that the only teaching used were textbooks and maps, which had been provided by the MOE. Likewise, most teachers also reported that they also used reference books, but not as often as the textbooks. In contrast, they reported that they had never used any type of courseware in teaching. Apparently, computer-based materials for geography had not been provided to schools thus far. The third question sought the teachers' opinions on the degree of difficulty in teaching the particular topic. Clearly, these teachers overwhelmingly agreed that teaching the particular topic was difficult, which is partly due to limited teaching aids that are available.

Getting information of the current problems faced by the geography teachers was also carried out during the interview based on the second set of questions. This part of the interview session helped the researchers to collect information pertaining to main teaching problems, critical aspect of the problems, and suggestions to improve the existing practice. Altogether, the teachers reported that their students had problems in the calculations for determining correct longitudes and time conversion. The teachers also emphasized the needs for a specific courseware (preferably, to be supplied by MOE), computer-based training, and greater collaboration among geography teachers. Table 3 summarizes the responses obtained after the end of the session.

TABLE 2. CURRENT TEACHING PRACTICES OF THE GEOGRAPHY TEACHERS

| Question | Interviewee ID | | | | Supportive data resources |
|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | |
| What are the teaching aids used by you to teach the topic? | | | | | |
| *i) Textbooks* | √ | √ | √ | √ | 4 |
| *ii) Maps.* | √ | √ | √ | √ | 4 |
| *iii) Computer Courseware* | × | × | × | × | 0 |
| *iv) Internet Resources* | √ | √ | × | × | 2 |
| *v) References books* | √ | √ | √ | × | 3 |
| Are these teaching aids provided by MOE? | | | | | |
| *i) Textbooks* | √ | √ | √ | √ | 4 |
| *ii) Maps* | √ | √ | √ | √ | 4 |
| *iii) Computer Courseware* | × | × | × | × | 0 |
| *iv) Internet Resources* | √ | √ | × | × | 2 |
| *v) References books* | √ | √ | √ | × | 3 |
| Is the topic difficult to teach? | | | | | |
| If the answer is 'Yes', why? | | | | | |
| *i) I have to make proper preparation in selecting appropriate teaching techniques.* | √ | √ | √ | √ | 4 |
| *ii) I have to cope with limited teaching aids.* | √ | √ | × | × | 2 |
| *iii) I believe this topic is not easy for the students to learn.* | √ | √ | √ | √ | 4 |
| *iv) I believe some students do have misconception with this topic.* | √ | √ | √ | √ | 4 |

In addition, teachers' opinions, thoughts, and ideas on the needs and suitability of a proposed courseware were elicited. More importantly, they were queried on the special features and functionalities that are desirable in such a learning material. As expected, all the teachers indicated that they desperately needed computer-based materials to improve existing situation, in particular, special courseware was deemed highly needed. In addition, they stressed that the contents of such courseware should be both relevant and carefully crafted, lest it becomes ineffective. Table 4 summarizes the opinions and suggestions of the teachers.

TABLE 3. PROBLEMS ENCOUNTERED IN THE CURRENT APPROACH

| Question | Interviewee ID | | | | Supportive data resources |
|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | |
| What are the main problems encountered in the current approach? | | | | | |
| *i) The students get confused with basic mathematical operations (addition or subtraction) to determine the longitudinal difference between two places.* | √ | √ | √ | √ | 4 |
| *ii) The students do not know how to convert the time from hours into hours and minutes.* | √ | √ | √ | √ | 4 |
| *iii) Others:*<br>- *The students are confused as to why the time in the eastern places are ahead than the time in places in the west.* | √ | x | x | x | 2 |
| Are the above problems so critical that a new teaching method have to be introduced? | | | | | |
| *i) The students get confused with basic mathematical operations (addition or subtraction) to determine the longitudinal difference between two places.* | √ | x | x | x | 1 |
| *ii) The students do not know how to convert the time from hours into hours and minutes.* | √ | √ | √ | √ | 4 |
| *iii) Others:*<br>- *The students are confused as to why the time in the eastern places are ahead than the time in places in the west* | x | x | x | x | 0 |
| Do you have any suggestions to improve students' understanding of the topic? | | | | | |
| *i) All teachers should attend Technology Pedagogical Content Knowledge (TPCK) training.* | √ | √ | √ | √ | 4 |
| *ii) MOE should supply relevant materials or courseware to help the teachers.* | √ | √ | √ | √ | 4 |
| *iii) All teachers should collaborate by sharing ideas and expertise.* | √ | √ | √ | √ | 4 |

TABLE 4. TEACHERS' PERCEPTIONS OF THE PROPOSED COURSEWARE

| Question | Respondent | | | | Supportive data resources |
|---|---|---|---|---|---|
| | R1 | R2 | R3 | R4 | |
| Do you agree that computer aided learning (CAL) can improve students' understanding in learning this topic? | | | | | |
| *Yes* | √ | √ | √ | √ | 4 |
| What type of CAL that do you think is/are suitable to be used? | | | | | |
| *i) Courseware* | √ | √ | √ | √ | 4 |
| *ii) Web 2.0 applications (Facebook, Twitter etc.)* | √ | √ | × | × | 2 |
| *iii) Online resources* | × | × | × | × | 0 |
| What type of modules do you think are appropriate to be included in the courseware? | | | | | |
| *i) Concept description* | √ | √ | √ | √ | 4 |
| *ii) Example (learn how to calculate the local time)* | √ | √ | √ | √ | 4 |
| *iii) Tutorial* | √ | √ | √ | √ | 4 |
| *iv) Self-paced exercise* | √ | √ | √ | √ | 4 |
| What type of elements do you think should be integrated in the courseware? | | | | | |
| *i) Appropriate learning theory* | √ | √ | √ | √ | 4 |
| *ii) Motivation elements* | √ | √ | √ | √ | 4 |
| *iii) Critical thinking skill* | √ | √ | √ | √ | 4 |
| Do you foresee the proposed courseware as an important solution to solve the current problems, which is applicable to schools nationwide? | √ | √ | √ | √ | 4 |
| Could the proposed courseware be pilot-tested for its effectiveness, which will involve your geography students? | | | | | |
| *Yes* | √ | √ | √ | √ | 4 |

## IV. DISCUSSION

One of the main important findings of this study clearly shows that the geography teachers have so far relied on the textbook and maps exclusively in the teaching of the topic of

local time. Students alike are also using the same textbook. Hence, the total reliance on these materials could hamper effective learning, as teachers do not refer to additional information such as online materials and recent reference books. Furthermore, the absence or lack of use of new, novel teaching tools available to the teacher exacerbates the current situation. There are several reasons as to why these difficulties are persistently faced by most teachers; invariably, these problems are intricately intertwined. The MOE has spent millions of ringgit to equip all public schools nationwide with ICT technology, including computer labs, servers, LCD projector, as well as internet connection. In spite of this provision of computer facilities, many teachers are not utilizing these facilities as expected. However, these facilities are not fully used for some reasons that need attention. Many reasons have been highlighted in studies, indicating that teachers' excessive workload, defective hardware, slow internet connection, and poorly maintained labs are the primary source of the problem. Apparently, it will take a special effort by teachers to gain access to online materials as indicated in this study where only two teachers have actually done so in their teaching. Moreover, most of the computer applications (i.e., teaching courseware) that have been provided do not have proper contents and well-designed features to engage students. Given these shortcomings, certain topics (e.g., the topic of local time) could be difficult to teach because concepts and steps in solving geometrical problems become too overwhelming. Prolonging the problems in teaching difficult topics without due remedies would eventually lead to poor attendance, motivation, and performance, running in counter to the aspirations of producing competent students, who are well equipped with geographical knowledge. Based on the situation highlighted, it is incumbent on all concerned – teachers, instructors, and school administrators – to seek ways to remedy the current scenario immediately. Notably, computer use should be made more frequent and intensified as some studies have shown that students' understanding in any particular subject depends partly on teachers' method of delivery, namely the computerized instructions and teaching aids [12, 15 - 16].

Addressing the second research question revealed that there are three major problems encountered by students in this particular topic. Firstly, some students are not conversant with the mathematical operations that are appropriate to determine the longitude between two places. The application of addition and subtraction, which forms the basis in any calculation, has not been carried out in proper contexts dictated based on locations and positions. The lack of detailed explanation on the function of the Greenwich Meridian in the textbook worsens this misconception. Explanation on the function helps students to apply the proper mathematical operation based on either the addition or the subtraction that is dictated by the presence or absence of the Greenwich Meridian, respectively. Secondly (and surprisingly), some students grapple with the basic conversion operations such as converting hours into minutes or vice versa. Apparently, this problem lies in the wrong interpretation of results such as converting minutes into hours and minutes. For example, converting 408 (i.e., a number representing a measurement in minutes) into hours and minutes (i.e., 408/60) using the calculator produces 6.8 on the calculator screen. Mistakenly, some students have wrongly interpreted that this decimal number refers to 6 hours and 8 minutes; actually, the correct answer is 6 hours and 48 minutes. Obviously, this misinterpretation is due to absence of a clear approach in the textbook, detailing the conversion calculations in a more systematic manner. In other words, solving the problems through a step-by-step approach can improve students' logical reasoning better. Thirdly, some students are lacking in spatial knowledge because they cannot explain as to why the time in the eastern places is always ahead in relation to the western counterparts. Thus, better teaching aids, preferably that contain visual and spatial elements, could help explain the underlying principles that give rise to the differences in time of these places.

Undisputedly, experienced teachers have good content knowledge and pedagogical skill, but the same cannot be said with regard to their technological expertise in using the proper technology for teaching purposes. This expertise encompasses their ability to search suitable materials and teaching tools from various sources (which are invariably available online) and to utilize the appropriate strategy that is effective in teaching a particular topic. Performing this task can no longer be viewed as an option anymore as teachers need to be on a par with their students – the latter, with a good reason, are referred to as the digital natives. Students are continually being exposed to a wide spectrum of applications, notably those based on the web technology, which has transformed from static Web through Web 2.0 to Web 3.0. With this technology, teaching could be made more collaborative through educational blogs where teachers could share materials, teaching techniques and lesson plans among peers. In view of this fast changing learning landscape, teachers should make a paradigm shift from the mundane 'chalk-and–talk' perspective to a technology-informed worldview [12, 15 - 16].

Despite the many opportunities that this emerging technology can provide, there are certain constraints or limitations that have to be dealt with. In particular, internet bandwidth has been a major problem faced by schools that limits wide adoption of the technology. In addition, many schools in rural, remote areas lack the necessary technology due to limited funding, and teachers also lack the technical know-how to apply the technology. As one of the alternatives, the use of special courseware, which runs on personal computers, could be a practical, easy solution to enhance the teaching and learning process [5, 17]. The potential to improve learning is great as most courseware provide appealing and interactive features, such as animation, video and graphics, which could help students in many innovative ways. For instance, abstract concepts that are difficult to learn could be made manageable through proper graphics and animation, helping students to visualize the underlying principles with ease; thus, students' understanding could be greatly improved [10, 5].

Invariably, a majority of the courseware available have been developed with scant attention to proper guidelines, notably the instructional design principles. After all, the courseware is only a medium to deliver the learning contents in various formats (i.e., multimedia elements). The use of these elements could be rendered less effective if these elements are used without appropriate design principles, which are informed

through contemporary learning theories, namely multimedia learning and constructivist learning theories [18]. Multimedia learning theory bases a claim that humans have limited working memory and process information using dual channels (i.e., verbal and visual channels) [19]. On the other hand, the constructivist learning theory posits that humans engage in active learning by attending to relevant incoming information, organizing selected information into coherent mental representations, and integrating mental representations with other knowledge [20]. Besides these cognitive constructs, motivational principles also play an important role in learning, namely to engage students. Having these motivational elements in the courseware could help students stay focused and engaged; thus, learning becomes more meaningful, which leads to better performance [5, 21-24]. Learning could also be boosted when students learn inductively, enabling them to synthesize relevant knowledge in various contexts and situations. To help realize this type of learning, the researcher propose the following components to be used in the development of the courseware: (i) concept description, (ii) provision of examples, (iii) tutorial and (iv) self-paced exercises. More importantly, the adoption of these components in the design of courseware is not only desirable but also critical to the development of high order thinking skill (HOTS) of students. This skill, as reflected by independent thinking, personal autonomy and reasoned judgment, could help students confront any problems with great finesse and rigor. Moreover, the Malaysian MOE has made it clear to all concerned that developing HOTS of students is one of its top priorities as the nation marches forward.

## V. RECOMMENDATIONS

As a whole, the findings of the study based on the input from the practitioners themselves provide several important insights. Current teaching practices seem not in harmony with today's teaching demands, learning tools and applications are seldom used at best, or are not available at worst, and in cases where these tools are available they lack proper instructional design elements. Given these drawbacks, it is naturally understandable that the teachers who were interviewed had cautioned the prevailing problems and emphasized immediate solutions such as using computer applications, tutorials, and other forms of materials. More revealing, the geography teachers have highlighted the learning principles that they believe should be adopted in the design of such learning tools. Synthesizing the information from the literature and firsthand knowledge learned from the study has prompted the researchers to propose a courseware called 'My-Longitude' as a teaching aid to improve the teaching of the topic Local Time. Figure 1 below illustrates the proposed instructional design model, which is deemed relevant to the development of the intended courseware.

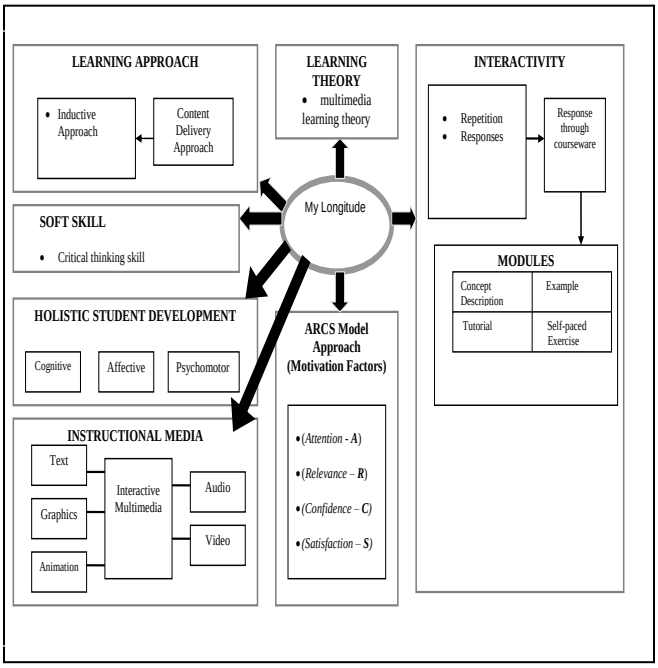


Figure 1. Instructional Design Model of the My-Longitude

Conceptually, the proposed model highlights the various design components, namely the multimedia learning principles, elements to support student interactivity, motivational elements, and learning approaches to foster critical thinking skill. More specifically, as learned from the findings, the learning tool My-Longitude will be designed and developed into a working prototype to perform the important tasks. Firstly, to show the appropriate technique based on addition or subtraction in determining the differences of longitudes and (ii) to show the correct conversion steps in converting time measured in hours into hours and minutes (and vice versa). With proper development and deployment, the proposed courseware could serve as an important showcase for wider adoption of computer applications for geography teaching in Malaysian secondary schools.

## VI. CONCLUSIONS

Through this study, several issues pertaining to the teaching of geography at the secondary level have been identified, in particular the topic that deals with local time. A host of problems, arising from the total reliance on the conventional method of teaching, has compromised students' understanding of this specific topic. Mundane conventional teaching method continues to prolong the above issues, ultimately resulting in poor performance of the subject matter. Premised on this poor teaching backdrop, the researchers propose an instructional design model based on well-established learning principles to help guide the design and development of the proposed courseware. The effort to improve geography learning will not stop here, but it will be continued into another phase, namely the testing phase to evaluate the effectiveness of the proposed courseware.

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