Smart classroom

Technology, Information Technology

To what extent have smart rooms changed the concept of traditional education? Starting from the recent developments in the area of teaching – both in terms of methodology and the technology designed to meet the constantly teaching/ learning needs, as well as the challenges teachers are increasingly faced with, this paper aims to examine the extent to which smart classrooms have led to a shift in the understanding of traditional education. While smart classrooms are designed in such a way so as to improve the students' performance and ability, while providing them with a more effective learning experience, there are, however, challenges that need to be considered. Therefore, this paper aims to take a critical view of the use of smart classrooms, and its effect on the teaching/learning process, highlighting both its challenges, and the possible means to address these.

In order to provide a more coherent discussion of the topic of smart classrooms, the study has a six structure, aimed to fostering better understanding of the topic. Therefore, the first part analyses the issue of smart classrooms from the teachers' perspective, while looking into the benefits brought about by smart classrooms, especially by augmenting collaboration between students throughout the process of learning. The second part of the paper analyses the composing elements of smart classrooms. Furthermore, the possible challenges that are likely to occur while trying to implement smart classrooms are discussed under the final part of the present paper.

Before entering deeper into the field of modern education, and the issue of whether smart classrooms have changed the understanding of traditional education, we will first proceed with explaining what smart classrooms

actually are. According to Huang, Hu, Yang and Xiao (2012) smart classrooms are a sort of advanced technology which is designed to improve the learning experience and the classroom environment, enhancing both the learning and the teaching process simultaneously, by means of the newly introduced learning technology. This technology, as further explained by Huang, Hu, Yang and Xiao (2012), consists of PCs, various programmes, materials, innovative listening gadgets, and audio-visual devices or networks. Following the same direction, other researchers (e. g. Di, Gang and Juhong, 2008) point to the importance that the newly introduced technology acquire, to such an extent that they have turned into a vital device; a tool that plays an effective role in transferring and exchanging information within the IT governed environment.

An important aspect that is worth-mentioning resides in the fact that although the topic of smart classrooms have been thoroughly discussed primarily with regards to the fields of studies business and healthcare, little research has been dedicated to date into the investigation of the behaviour and attitudes of the students, with regards to the instruction carried out by means of teaching technology. This is particularly one of the novel aspects involved in the present research, namely its focus on the experience undertaken by both the students and the teachers, with regards to smart classrooms and teaching technology. This is with a view to account for the extent to which the introduction and use of smart classrooms have led to a shift in the traditional forms of education.

The role of smart classrooms in augmenting collaborative learning

According to McVay, Murphy and Wook Yoon (2008), smart classrooms

involve more than the mere teaching strategy adopted by teachers, who manage to bring the students together, and motivate them to collaborate and be involved in joint tasks. As discussed by Suo, Miyata, Morikawa, Ishida and Shi (2009), the term collaborative learning presupposes the students' active involvement and participation within the learning process as a whole. Furthermore, it could be argued, following the mentioned scholars' lines of arguments that given the fact that these students share the same level of knowledge, they could well benefit from collaboration (Suo, Miyata, Morikawa, Ishida and Shi, 2009). This could lead us infer that each and every student can make a valid and valuable contribution by expressing their own thoughts or by merely commenting upon the others' interventions. Therefore, it could subsequently be stated that collaborative learning moves past the general features of traditional learning.

Smart classrooms – facilitators of collaborative learning

Therefore, several aspects can be discussed under the collaborative learning umbrella, namely sharing knowledge, sharing ability (competence), mediation, and heterogeneity. The first aspect involved is discussed in detail by Tissenbaum, Lui and Slotta (2012) who posit that the sharing of knowledge is generally undertaken by the teachers; the ones who generally possess the knowledge regarding the contents, requirements, and skills involved in a particular course. However, they further argue that collaborative learning presupposes a shift in emphasis, from unidirectional teaching which presupposes that all knowledge is hold by the teachers, to a rather bi-directional approach, in which the students' language, knowledge, and previous experience is equally important.

As far as skills sharing is concerned, the same researchers point to the fact that teachers who undertake collaborative learning approaches are more likely to encourage students to make use of their knowledge and understanding, and, more importantly, share their expertise, previous experience, and strategies of learning. As Tissenbaum, Lui and Slotta (2012) further point out, mutual respect and focus on advanced understanding are key components that need to be considered.

Discussing mediation, Tissenbaum, Lui and Slotta (2012) are indicative of the crucial role played by teachers within the collaborative learning approach. As such, teachers become mediators, and they are in charge of regulating the intensity with which information should circulate. It seems that, mediation is considered as a key component, allowing students to make connections between their previous experience and the newly acquired information. Moreover, Tissenbaum, Lui and Slotta (2012) equally show, with the help of mediators, that students learn how to learn; they learn how to cope with the possible problems that are likely to occur, or they even learn how to explore new areas and broaden their knowledge.

This implies that collaborative learning presupposes heterogeneity, the ability to share in common experiences, perspectives on various aspects, or the various backgrounds of the people involved.

1 Experience of Teachers in Smart Classrooms

The set-up in Smart Classrooms may give the impression that there is no considerable difference between them and several other whiteboard-based tele-education systems. However, the reverse is true. The pleasure of learning in a Smart Classroom lies in the way in which teachers utilize the

system. Shi, Xie and Xu (2002) state that teachers are no longer confined to a desktop computer, mouse and bulky keyboard, and as a consequence, creating annotations on the courseware is simplified and it is as convenient as writing on a regular classroom blackboard. In a Smart Classroom, the teacher simply has to move a finger and the multimedia board displays the stroke and extends it with the exhibited courseware (Shi, Xie and Xu, 2002). In a Smart Classroom, the teacher can also highlight the entity displayed on the media-board while teaching and issue a predefined command to do what is to be emphasized and required (Shi, Xie and Xu, 2002). For instance, in order to follow a hyperlink in the courseware, the teacher can soon point to the hyperlink and convey the message to the students to follow the link by means of the prompt, " follow this link".

It is easy, spontaneous and convenient to ask remote students to converse and interact in the class. It can be achieved through speech. For instance, if the teacher intends to ask a remote student called Peter a question, he or she can directly input " Peter, could you answer this question?" However, Smart Classroom teaching necessitates speaking and the corresponding image will start blinking to alert the teacher whenever a student is about to speak (Shi, Xie and Xu, 2002).

It seems that this system eliminates the boundary between tele-education and everyday classroom education, since teachers can impart knowledge to local students and those from remote locations simultaneously in the Smart Class.

The authors implies that In order to account for the extent to which the emergence of smart classrooms has led to a reconfiguration of the ways in

which traditional education is perceived, one aspect to be taken into account is the perception of the teachers. Smart classrooms allow teachers to move past the confinements of the desktop computer, relying instead on a variety of devices (e. g. multimedia board displays), and even audio facilitators. For example, following a hyperlink in the course can be done by simply pointing to the hyperlink, or by using prompts. Such technology fosters enhanced interactivity, it allows undertaking of mixed classes of on-site and remote students simultaneously.

However, One of the greatest problems with the implementation of smart technology into the classroom is the teachers' readiness to accept such technology (Levin & Thurston, 1996). Whilst western teachers tends to be willing to switch to these methods, it is necessary to look at other cultures, where teachers are less likely to accept such problems (Duffy & Cunningham, 1996).

This shows that despite potential ethnocentrism problems, this may allow us to investigate whether some teachers in our own country have the same issues found overseas. Malaysian secondary school education, in particular, is particularly interesting to consider given its centric and examination oriented approach (Lim & Hua, 2007; Indramalar & Chapman, 2003). Therefore, this approach could be seen as rote learning, rigid and stifles creativity (Beech, 2002). One aspect of smart classrooms, which they may be less inclined to adopt is online collaborative learning (OCL), and this was investigated by Koo (2011).

In the study, Koo (2008) used a survey approach to investigate the readiness of Malaysian teachers for online collaborative learning using a cross-range of

teachers from Malaysia were used, with the teachers having at least five years' experience, but with the majority of them being female and/or Male. The survey questionnaires showed that the majority of teachers were undecided as to whether or not they would introduce such measures in their own classrooms (Koo, 2008). This could be because they do not have much experience in using the internet and are therefore unaware of how it could benefit their classrooms, and are thus are unsure of whether it would benefit them or not. Koo (2008) notes that OCL can be successfully implemented in schools where there is active support from the head teacher of the school, and/or its management. This is because teachers may feel it is worth their time to take the time to learn how to use the technology if there is support from their superiors (Koo, 2011). This point is highlighted by the fact that a significant majority of the teachers felt they needed more education on how to use such technology. However, one major problem of the study was that the teachers were chosen from a very specific part of Malaysian, thereby making it hard to generalise these results across the whole of Malaysia, and indeed the world.

Smart classrooms architecture

As previously stated in the introduction to this paper, an important aspect lies with the components of the smart classrooms. As shown by Pishva and Nishantha (2008) have stated that based on the geographical locations of teachers and students, it is considered that foure basic architectures are essential to complete a Smart Classroom. These architectural delineations provide an understanding of the general and explicit prerequisites of the functioning of Smart Classrooms in terms of the utilization of resources,

types of technology, procedures of broadcasting and propagating information, as well as the kind of interaction between teacher and students. The basic architectural considerations are described below

1. 1 Single Classroom Architecture

This type of architectural consideration involves enhancing a physical classroom with necessities that facilitate students to benefit from improved learning skills. Teachers also benefit from a superior teaching experience compared to a traditional classroom. The requirements involves an array of equipment, such as projectors, multimedia systems, computers, wall-size video displays, etc., which enable the audience to listen and understand the lessons in progress without any barriers, while the acquisition of useful information involving previous lecture tools is just a click away (Pishva and Nishantha, 2008). Consequentially, this kind of architecture provides both the teachers and the students with an enhanced experience. As it is the most convenient and accessible type of architecture, we could also advocate for its introduction in all types of classrooms.

4. 2Scattered Classroom Architecture

In this kind of architectural consideration, students belong to diverse geographical areas and are unconnected. In this context, it is essential that each student possesses a PC. Students and teacher communicate through dedicated networks over the Internet, and these results in the formation of a virtual classroom utilizing audio-visual asynchronous or synchronous information admittance tools that are accessible to each participating student (Pishva and Nishantha, 2008).

If we were to compare the single and the scattered architecture, we could

easily note, the scattered classroom setting facilitates students to learn from a distance without the requirement of a physical presence in the classroom. This setting provides a new paradigm to aid educational environment and student life through flexibility of studying environment available to them from their home setting and workplace boundaries. Through this, at the same time, they can fulfil their family, personal or other professional or work-related obligations. Even so, this intelligent classroom paradigm can be in a scale ranging from a classroom with only a few students to many, thereby forming an entire cyber university.

4. 3Point-to-point involving two-class room architecture

This architectural consideration corresponds to the description of the above architectural considerations to generate a reasonable Smart Classroom paradigm to provide greater educational edification for two teams of students who are placed in diverse geographical locations. This architectural consideration links two geographically-distant classrooms, where the tutor is placed in the real one. Moreover, electronic gadgets in the two classroom architectures utilize refined reserves, for example, high-speed dedicated links and media boards for a better quality tele-presence etc., which individual participants could not afford in a scattered Smart Classroom model (Pishva and Nishantha, 2008).

1. 4. 4 Multiple classroom architecture:

This kind of architectural consideration displays an emergent form of intelligent classrooms that challenges the extension of the two-classroom type, while safeguarding the quality of delivery and maintaining affordability. This architectural consideration interconnects groups of students in a real

classroom by means of elevated speed links (Pishva and Nishantha, 2008). This shows that multiple classroom architecture has emerged as a hopeful solution to the awareness of the need to provide greater quality education across the world.

2 Technological components

Smart classrooms are equipped by set of technologies (components). The technologies involved may include any instrument, machine, plan or structure, inclusion of which results in enhancement of learning environment in terms of efficiency, creativity and learning. The system involves new ways of connecting students toward the technologically rich environment with preparation for dwelling in and maintaining relations with the technological world. This entire structure acquires, maintains and communicates information about a job, task or project in the fastest and most meaningful way. The technological advancements mentioned above may include, pen-based user interface, virtual classrooms, smart cameraman and other programs for management and administration purposes. The technological advancements, however, have not halted yet and the improvements are made continuously at all times. Hence, the idea is to involve all existing and forthcoming technologies in to the system for better results and performance of the students, teachers and other staff. The idea of smart classroom brings in the concept of active involvement of the teacher with the people rather than a robotic image facing desktop due to lack of automation or for the use of input devices like mouse and keyboard. The newer concept is to adopt highly automated and intelligent equipments integrated in the classroom to avoid such distractions that relate to the operating paradigm of traditional

classroom technologies.

2. 1 Pen-Based UI (User-Interface)

In this technique, a media board appears on the screen, which is a touch screen that is commercially available in the market under the brand name of Smart Board (Shi, Qin, Suo and Xiao, 2010). In Smart Classrooms, tutors can immediately manage and manipulate the presence of slides on the Smart board and pens and erasers can be used to scribble on slides or write comments directly on them and teachers can wipe out the strokes. Moreover, the real-time multimedia communication software allows distant students to be as engaged and interacting with the study materials as the students in the physical classroom setting. The Smartboard also allows remote students to make notes and solve questions instantly like other students in the classroom environment. Hence, this technology surpasses the time and distance barriers and allows real-time learning and interactions among the participants of a learning environment (Shi, Qin, Suo and Xiao, 2010).

2. 2 Laser Pointer Tracking

Another remarkable technology is the computer vision module that can be implemented to track the spot shown by a laser pointer on the Student board or the Media board. This is a method whereby the teacher can select an object and steer the cursor or a laser pointer to display the required or selected object, text etc., which ensures better learning (Shi, Qin, Suo and Xiao, 2010). As a result, the laser-pointer tracking allows for more freedom of movement, and, more importantly, it focuses on the visual nature of learning.

2. 3 Virtual Assistant

Since it is evident that the interaction with the dummy room is awkward, a Virtual Assistant picture, which appears on the Student Board, is introduced into the intelligent classroom in order to imitate the classroom opposite the tutor. The Virtual Assistant is a combination of Face- Animation and Text-to-Speech and Speech-identification technology, which enables the system to converse with the teacher when necessary. Moreover, it understands some voice commands or prompts, such as an indication to move to a specific page. The authors imply that the virtual assistant was adopted to present classrooms in order to eliminate the strange felling of the teacher that might be accord during interacting with lifeless classroom. Hence, the system in consideration allows a natural metaphor whereby the teacher remains communicates with a assistant that comprehends and acts upon voice commands with voice notification and responses in real-time.

2. 4 Biometric Feature

To login to the classroom biometric features is adopted. It is a process based on desktop-based Real Time Interactive Virtual Classroom (RTIVC) systems; wherein the teacher is required to enter the identity codes including the ID as well as unique pass codes to access the system. To access Smart Classroom, both speaker-verification and face recognition is used for safer access to personal information. This ensures quick identification of the teacher. It is mandatory that as soon as the tutor makes his presence in the Smart Classroom, the first step desired is to show up in the mirror as a camera is generally installed behind it so as to capture the teacher’s face. On passing the process of speaker-verification and face recognition, the

name of the teacher is announced and the teacher is greeted by the Virtual Assistant. This is an indication that Smart Classroom is ready to provide services (Shi, Qin, Suo and Xiao, 2010).

2. 5 Smart Cameraman- In a real classroom, a change in focus of students is observed with respect to the context of the class. For instance, students focus on formula and their sight remains on formula as the formula is written by the teacher. On the other hand, if the teacher is displaying a model, the concentration of students will shift to the model instantly. In RTIVC, the camera remains fixed as a result it focuses on the teacher side, on the contrary, the context of the class keeps changing, this reduces the efficiency of learning considerably.

In order to overcome such precarious condition of fixed camera in Smart Classroom, Smart Cameraman is introduced in order to differentiate various perspectives of the Smart Classroom. Clues in the classroom are observed and camera is selected as per the appropriate scene on the basis of the context. This is helpful to the remote students as well who observe the video broadcasts. In the present scenario such module involves three diverse contexts-

1) When teacher is writing on Mediaboard- it is the context where teacher writes comments or scribble on Mediaboard. Under such situation camera focusing on Media-board is selected.

2) When teacher displays a Model- it is a context when teacher holds a model in hands to provide the students with an explanation. In this situation camera focusing on teacher’s hand is used.

3) In other instances, the camera that covers and captures entire classroom

is chosen. The indication employed by Smart Cameraman to assess the present context encompasses the upshot of Person-Tracking module. This aids in tracking the location where teacher is standing, while a Gesture-Recognition module enables one to understand the teacher's acts like if the teacher is holding a substance etc. as well as it involves the Mediaboard module Shi, Qin, Suo and Xiao, 2010).

It is observed that synchronized learning grabs the attention of the students or participants and generates a greater interest as compared to the unsynchronized context of teaching. For this reason, RTIVC together with tele-education is considered to be of indispensible implication in the process of remote or distance learning.

Architecture of Smart Platform

Smart Platform or podium works as a multi-agent system. It comprises of network of computers, this network masks the limit of concerned computers thereby provides a homogeneous functioning environment. An extremely structured communication models are provided by smart platforms for running the software modules.

However, the runtime environment comprises of three chief constituents namely-

Agent- it is the unique encapsulation of software modules present in the system.

Container- it is a process where each contributing computer in runtime environment will congregate a dedicated and committed process known as Container. Moreover, it is known to offer and administer system-level services to the agent that runs on the computer. Container efficiently makes

other parts of the system transparent; thereby it gives uncomplicated and easy communication interface for agent.

DS or Directory Service- it is a single global dedicated process in the environment which arbitrates “ delegated communication” amid agents. It gives services such as dependency resolution and directory service. The configuration of DS encompasses three sub-constituents, each offers a dissimilar array of services encompassing-

The Directory Service- grants services like query and agent registration.

The Message Dispatcher- For agents it executes message-oriented communication service in Smart Platform.

The Dependency Manager- it plays vital role for resolving as well as managing the agent dependencies.

In order to increase the usability, a few development kits are provided in the Smart Platform. These are known to be Monitor Agent, which acts as the debugger and monitor of Smart Platform, Custom AppWizard for MS VC++6 and agent development library (for Java and C++ version) to create the skeleton code automatically for a new agent. For MS Windows platform a standard setup program (at present available at website) is developed to alleviate the configuration and installation of Smart Platform.

3 Real –time interaction problems

While the benefits of virtual classrooms are manifold, concerns have been raised in relation to the possible challenges to be faced by such an approach to teaching/ learning process. As pointed out in specialised literature over the past decades, the RTIVC (real-time interactive virtual classroom) is a key component of E-learning. It relies on media-based and real-time type of

interactions, which can easily be hindered by various barriers.

6. 1 Lack of adequate technology

Most schools implement tele-education by adopting video conferencing products as a means of deliverance for RTIVC, when participants are required to be connected to a central Multi-Point Controlling Unit (MCU). In this process, data generated from one user is replicated or mixed before it is delivered by means of the MCU to another client. These systems cannot be scaled because of the limited capacity of the MCU (Shi, Qin, Suo and Xiao, 2010); as a consequence, the majority of tele-education schools are operated by utilising RTIVC classes with only a few students.

6. 2Lack of sufficient technologies for students using diverse networks and devices in one session

Some of the current RTIVC systems are inflexible in terms of different networks and devices (Shi, Qin, Suo and Xiao, 2010). It means that clients with inferior connections are either unable to join the session or are incapable of obtaining a smooth service; conversely, clients with superior conditions are able to derive the full benefit of their additional potential. Since smart devices like Smart Phones, Pocket PCs and wireless that encompass WIFI and GPRS are gaining increasing attention; there is a need for users to be able to engage in enduring learning by means of these devices, which have various network connections and capabilities.

6. 3 Teachers and their likes/dislikes of desktop-based teaching metaphors

Most of the RTIVC systems available today are desktop-based whereby users remain immobile or motionless facing a desktop computer and interact with the class or others by means of a keyboard and/or mouse. In this context,

metaphors are unacceptable to teachers because of the different experience compared to the real classroom in which they can move freely, express themselves and explain to students by means of eye contact and hand gestures, as well as illustrating thoughts and suggestions by scribbling on a blackboard (Shi, Qin, Suo and Xiao, 2010). Therefore, teachers are found to complain about these differences and find tele-education uncomfortable, which diminishes the efficacy of both learning and teaching.

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7Solutions

Some progress is currently being made to overcome these issues and provide adequate technologies for practicing RTIVC, as well as formulating and developing a system that adequately support the next generation’s real-time interactive distance learning, as shown below.

7. 1A supporting platform for significant real-time interactive distance learning is being developed. This work is separated in two broader areas including:

TORM (Totally Ordered Reliable Multicast) protocol; this executes an application multicast protocol on the basis of a schematic grouping of network-layer IP-Unicast and Multicast (Shi, Xie and Xu, 2002). It can extend the number of users who can access a RTIVC by means of the current Internet infrastructure.

AMTM (Adaptive Multimedia Transport Model); this can potentially trans-author or trans-code the transferred substances based on the network capabilities and device of each client involved in an RTIVC meeting, while retaining the stability of the content on a semantic level (Shi, Xie and Xu,

2002). However, this solution would be argued for a number of factors discussed below:

1) the majority of the protocols deduce the presence of multicast fully-enabled network infrastructure, however for the existing internet, it is rarely the case.

2) Protocols that are proficient with multiple concurrent data sources possess a narrow scalability;

3) a smaller number of all protocols apply an end-to-end TCP friendly congestion control policy.

Same View is committed RTIVC software developed for both local and remote students. It runs on a TORM/AMTM platform and encompasses a rich interface of interaction including audio/video communication, an HTML-capable whiteboard, and the ability for students and teachers to chat in the RTIVC class. One of the key features of Same View is its class-experience recording capability, which enables the capture of entire events or activities that take place in a class, including whiteboard activities such as the slides presented and notations made by the teacher. This live audio and video display can be captured (recorded) with the help of a structured multimedia document, and these recorded documents can serve as courseware that can be retrieved and played (Shi, Xie and Xu, 2002)..

The Same View user interface can be utilised in Smart Classrooms. Although teachers are entrenched within the 3D-space of the classroom, they are free to move around and utilise metaphors just as in conventional teaching. Teachers are familiar with this conventional method to teach remote students. Real classrooms can also accommodate local students, thereby

eliminating the difference between Distance Learning and On campus Learning activities, as well as reducing the workload of teachers.

Conclusions

In the present environment, experiencing fast-pace developments governed by competition, high-level education is an absolute prerequisite. As Augusto, Nakashima and Aghajan (2010) argue, technology has influenced our lives in manifold ways, constantly changing and shifting focus. Within this environment, smart classrooms constitute a natural development of technological evolution with applicability in all fields, turning into a modern educational tool. Smart classrooms provide opportunities for providing better and more competitive education, proving to be highly effective for both the teachers and the students. Smart classrooms do not discard the importance of the teachers, on the contrary, relying on them as much as hi-tech devices (smart white board, DVDs, PPTs, etc). In addition to the increased interactivity and improved communication, the use of smart classrooms leads to significantly more enjoyable teaching/learning experiences, while fostering the acquisition of better skills and competences.

Therefore, disregarding the inherent challenges posed by development (in the field of education as elsewhere), evidence points to the increased use, acceptance, and incorporation within the traditional education.