# Smart Classrooms in Schools in Sri Lanka: A Case Study on the Design and Use of Smart Learning Space

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## Abstract

The integration of information Technology with the educational process creates smart learning environments that facilitate student engagement, teaching and learning and evaluation through physical and virtual classroom settings. The transformation in classroom settings through the adoption of information and communication technology is generally solicited as a means for improving the educational outcomes. The transformation of learning space from the traditional classrooms to smart classrooms is mainly characterized by the infusion of technology into the pedagogical process of schools. Smart classrooms are expected to address the issues and demands of present context of education that emerge through the changes in the elements of education system: students; teachers; curriculum; available resources for the process and, the social background of the schools. In this context smart classroom were introduced in the schools in Sri Lanka since 2017. This study examined the design and use of learning space formulated by interacting axes of domains of smart class rooms: the architectural layout and ergonomic structure; integration of technology and; appropriate pedagogical methodology in smart classrooms. A collective case study approach is used to investigate the research problem. Four schools belonging to 1AB, 1C, Type II and Type III categories were selected from the Valikamam Education Zone of Jaffna district of Sri Lanka as cases. Interviews, document study and observation were used to gather the data. The findings from analyses of cases indicated that the teachers did not perceive much technology enhanced smart learning space in their smart classrooms, while principals are not fully aware about the key characteristics of the three-interacting axis of domains in design and use of smart learning space. The layout and ergonomic structure of smart classrooms is satisfactory except their interior topology and furniture, which are not conducive for interactive learning. Integration of technology is very limited with the basic digital devices available only for the use of teacher while the students are engaged in the lesson only with their exercise books that impedes student centered learning and interaction with teacher and class through the technological platform. The pedagogical methodology is not suitable as the teachers still follow traditional way of teaching without the innovative and creative use of digital devices and the internet. Thus, an effective smart learning space could not be constructed due to defects in the three axes of domains of the smart classrooms.

*Keywords*: Smart Classroom, Smart Learning Space, Technology Integration, Transformation in Classroom

## Introduction

The unchallengeable impact that the infusion of technology has evidently made in various sectors in terms of the efficiency for improved outcomes and least cost and time for the process has led to the adoption of it in school education also. A new paradigm in education has emerged due to the immense potential of information and communication Technology development in the past few decades. The integration of information technology with the educational process may create smart learning environments that facilitate student engagement, teaching and learning and evaluation through physical and virtual classroom settings.

The transformations in classroom settings and teaching through the adoption of information and communication technology is generally solicited as a means for improving the educational outcomes.

 (Cebrián, Palau, and  Mogas, 2020) defines Smart classrooms as:

> *"Educative spaces endowed with technology in different senses, from the incorporation of digital devices and learning software to the inclusion of sensor networks that help with tracking classroom processes, gathering data and offering insights to help decision making for better and faster learning to provide more convenient teaching and learning conditions for educators and students.*"

Smart classrooms are supposed to be an effective method of using resources to convert the traditional classrooms with the help of information and communication technology knowledge (Mailewa et al., 2020).  During the past two decades they are strong solicitations for the integration of information and communication technology in education in Sri Lanka and consequently the ministry of education of Sri Lanka started the implementation of the plan for constructing smart classrooms in schools, primarily in 25 schools as a pilot project in 2017 (Kugamoorthy, 2020).

Smart classrooms are expected to address the issues and demands that emerged through the changes in the elements of education: students; teachers; curriculum; available resources for the process and; the social contexts of the schools through the changes in the form of a configuration of classroom structure and semantic arrangements, methodologies and the use of information and communication technology resources. The transformation of learning space from the traditional classrooms to smart classrooms is mainly characterized by the infusion of technology into the pedagogical process of schools. The technological integration to education has enabled the teachers to engage an ample array of versatile tools of information and technology resources, methodological options and diverse opportunities in the pedagogical practices in school (Bautista and Borges, 2013).

Smart classrooms steer the perspectives of teachers and the school organization to a new pedagogical paradigm through the change in their conception of learning space from the transmission model of teaching and learning (Bautista and Borges, 2013). Smart class rooms are very different to the traditional classrooms and it would be a misconception to see them as the improved models of traditional classrooms heavily equipped with technology. The learning space of traditional classrooms was confined within their physical space, the learning contents available in the form of hard copies such as books and the teachers' pedagogical methodology based on these fixed resources that had limitations in terms of their contextual boundaries. The technological integration in the learning space demands the changes in

pedagogical approaches of teachers and students in the teaching and learning, the role of learning content and the sources, the management of classroom and learning and resources. Bautista and Borges (2013) conceptualize three interacting axes in the design and use of learning space:
1.  the layout and ergonomic structure of classroom
2.  integration of technology
3.  appropriate pedagogical methodology

These three elements; the physical layout and structure, technological infusion and the pedagogical methodology must be compatible and adaptable with each other to work synergistically as a whole to produce the outcomes of the classroom. Though there are many factors that influence on the three elements and their integration in an optimal way to produce the synergic effect in producing the real outcomes of the smart classrooms in terms of their leaning space. The previous studies on the smart classrooms of Sri Lankan schools have focused on other aspects such as teacher's perceptions, student engagement, and availability of resources (Kugamoorthy, 2019). The design of learning space with the three interacting axes of domains of smart classrooms in schools of Sri Lanka has been an unexplored area. Though, design of an efficient learning space is the core objective of the smart classrooms that determines the effectiveness of them in facilitating the teaching and learning. Thus it is apt to study the setting of smart classrooms combining the three elementary axes and bring out the problems faced in the real settings of the schools in Sri Lanka as the schools have been using them for over five years.

**Objectives**
The main objective of the study was to examine the present state of the design and use of learning space in smart classrooms in Sri Lanka.
The following specific objectives were formulated:
*   to identify the nature of smart classrooms in schools
*   to examine the learning space formulated by the layout and ergonomic structure, integration of technology and pedagogical methodology in the smart classroom
*   to examine the issues faced by the teachers in integrating technology and pedagogy in the smart class rooms in Sri Lanka

# Literature Review

There are many conceptualizations and views forwarded about smart classrooms by different researchers since the first smart classroom was built by San Diego University integrating tools such as clickers, sympodiums, and multichannel audio system to enhance the learning of big number of students in the classroom. (Frazee, Greene, and Julius, 2006).
Xie, Shi, Xu, and Xie, (2001) view smart classrooms as "the classroom equipped with the information and communication technology modules. Smart classrooms are basically equipped with digital devices and internet (Yang, Pan, Zhou and Huang, 2018). The smart class are equipped with high tech devices of information and communication technology (Kugamoorthy ,2020). Smart classrooms are considered to be creating technologically facilitated learning space for the teachers and students to engage in teaching learning more easily and efficiently.
(Huang et al., 2012) has identified the benefits of smart classroom as: effective for presenting the content of teaching; easy for class management; learning resources could be accessed; improved and easy interaction in the instructional process and combined with contextual awareness.

Though all the other aspects of the smart classrooms attracted attention of many researchers there were few studies found on the design and evaluation of smart classroom from the perspectives of pedagogical and technological integration (Yang et al., 2018). While in many countries the layout of the traditional classroom is found to remain unchanged in the smart classroom also. (Yang et al., 2013) found the classrooms in China remained the same in the layout as how when they were invented.

Bautista and Borges (2013) were of the same view and confirms this as "there is an array of sophisticated tools and resources methodological options and possibilities, the classroom management still remained in the traditional set up which is radically opposed to the present-day theories of learning and pedagogy. In this context, Bautista and Borges (2013) have identified nine principles of smart classrooms in terms of the arrangements and pedagogical configuration for the transformation of learning space in smart classrooms. They included: flexibility of physical arrangements; adaptability for diverse users; comfort; multiplicity of resources; connectivity of network and with environment; personalization; order and organization; openness and; safety and security. Palau and Mogas, (2019) have identified three dimensions that coexist in the learning space of the smart classrooms: Technology; environmental factors and; the process carried out in the smart classrooms. These dimensions are almost similar to the interacting axes of learning space design identified by Bautista & Borges: the physical design and ergonomics, technological integration and pedagogical methodology (Bautista & Borges, 2013).

This study explored in to the context of smart learning space of the smart classroom of Sri Lankan schools based on these two perspectives : the three interacting axes of learning space design and use (Bautista & Borges, 2013) and ; the three dimensions of smart classroom learning space (Palau & Mogas, 2019).

## Research Methodology

This study used a collective qualitative case study approach to investigate the research problem. Four schools belonging to 1AB, 1C, Type II and Type III of school categories are selected from the Valikamam Education Zone of Jaffna district of Sri Lanka as cases for the study. Two teachers and the principal of each school were selected to be the respondents. In-depth interviews were held for collection of data from the teachers and semi-structured interviews were used for the principals. A self-prepared observation schedule was used along with the other methods for the collection of data from the smart classrooms. The records of the smart class rooms and the school office were also studied.

The data were mostly qualitative. The responses of open ended questions were analyzed qualitatively using codes and themes. The interviews were recorded and transcribed. The transcripts were corded and brought under thematic analysis. The thematic analysis was appropriate as it reduce the bulk volume of transcribed data into manageable themes. The data was organized according to the research objectives. The themes were formulated according to the three interacting axes of smart classrooms and the learning space designed and used in the smart class rooms as identified through the literature review and conceptualized in the research objectives.

## Results and Interpretations

The case schools selected for this study consisted at least one smart class room with the minimum required technological equipment and internet connection. The Table -1 shows the resources available for smart learning in the case schools.

Table -1: Resources available for smart learning

| Cases | 1AB | 1C | Type II | Type III |
|---|---|---|---|---|
| No of SCR | 05 | 02 | 02 | 02 |
| SCR teacher ratio | 1: 15 | 1:20 | 1: 9 | 1: 5 |
| SCR student ratio | 1: 350 | 1: 200 | 1:180 | 1: 70 |
| Tools available in SCR | Smart board, PC, laptop, audio devices, scanner printer projector, internet connection | Smart board, PC, audio devices, scanner  Projector  internet connection | Smart board, PC, audio devices, projector, internet connection | Smart board, PC, audio devices, projector internet connection |
| Use of SCR by teachers | Rotational schedule | Rotational schedule | Rotational schedule | Permanently used by one class and rotationally used by others |

Table -1 shows the availability technological resources and their usage by the teachers and students. It indicates that all schools have desktops and projectors. Only one school has provided laptops to the smart classrooms which are funded by the school. All schools have interactive boards which is an important and essential component in the smart classroom.

The ratios of the number of smart classrooms to teachers in all case schools are very high which indicate that teachers have limited access to smart classrooms only through a rotational schedule. In Case 1AB, the smart classroom is available for only 5 out of 75 teachers at a time. In Case 1C, only 2 out of 40 teachers could conduct their lessons simultaneously. In cases, Type II and Type III the ratio seem to be comparably low as the number of teachers is small.

Similarly the ratio of smart classroom to the number of students in all case schools is also very high, for example in Case 1AB, it is 1;350 which indicates that only 5 classes of students out of 68 classes could be engaged in smart classrooms. This kind of selective usage of smart classrooms doesn't allow teachers to continue their teaching through a consistent

methodological approach as they have to change it often when they shift to ordinary classrooms.

One teacher from Case 1AB stated "We could use the smart classroom nearly once in three days through a rotational time schedule." When the classes are held in two different setups the teachers are burdened to make separate preparations for their lessons.

Almost all teachers in the four cases stated that " We have to move the students from their permanent ordinary classroom to the smart classrooms for usually one period of lesson and back again to their permanent classrooms after" It affects the learning time and the teachers preparations for teaching in two different classrooms as they have to be more flexible.

Some teachers from the 1AB and Type II schools have their own computers while all the teachers have smartphones. No students from the all four schools bring a laptop to school while the students are not allowed to use smart phones at school premises by the school administration. Most of the smart classrooms were not constructed newly instead the old traditional classrooms have been converted into smart classrooms with the addition of smart board and other equipment .The students are using the same furniture that they used to sit and work on in the ordinary classes.  Lights and fans have been fixed though they are often not used during the class times.  Most of the classrooms have an array of windows that allow adequate ventilation. The tables and chairs of students are placed in the traditional setup facing the teacher and smart board behind. This is more suitable for teacher centered teaching approach. There was only a desktop computer in most of the smart class rooms connected with the internet and the smart board which was for the use of the teacher in the class. As there were no desktops or mobile devices for the use of individual students they have to work on their papers while lacking the exploratory learning through the internet. This limitation impacts the students' self- learning attempts simultaneous to the classroom activities and restricts their search for the knowledge in their own initiatives.

The smart classrooms in these schools have not led to effective changes in the elements of pedagogical process such as innovation in the teaching role, new role of learners and the contents and decision makers in the learning process needed for creating an effective smart learning space. The technological integration is also not complete as the tools are available only to teachers and not to the students. Thus the students are made into passive audience as the teachers inclined to deliver a lecture mode lesson with occasional visual displays on the smart board. Most of the teachers are not well skilled in handling the computer applications and internet as they haven't followed any professional development programs that combine the use of the computer and application software needed for the smart class rooms. In fact many of the teachers are just starting to learn to use the smart boards and the internet for teaching in the new classroom setup.

The teachers are unable to adapt suitable pedagogical methodology for smart classrooms. Many of them are using the smart board as a substitution for the conventional blackboard. Most of the teachers felt that preparation of lessons for the smart classrooms was an additional burden to their routine tasks as they lack the computer skills and not acquainted to or familiar with the information sources that could be used for the preparation of lessons. Thus the lesson preparation for the smart classrooms has become a more tedious task for the teachers which often resulted in teachers preferring the ordinary classrooms.

The teachers have observed increased interest among the students especially when they are admitted newly in the smart classrooms. Though they lose the interest after a few classes. The

students are reluctant to copy down the notes from the smart boards rather than watching pictures and video clips. The principals are not much aware about these problems and most of them are very positive about the use of smart classroom in their schools. They believe the addition of smart class rooms in the schools will increase the quality standard of the school resources and increase the reputation of the school in the society.

The principal of the 1 AB school (case -1) stated "As the teachers have not got formal training to teach in smart classroom it is quite natural to them to have some issues at the beginning stage and in course of time, they will learn the suitable pedagogical approaches to suit the needs." This answer indicates that the principals are also aware about the problem in the integration of appropriate pedagogical methodology by the teachers in the smart classrooms. Meanwhile there were very few initiatives at the school level and by the Zonal department of Education to prepare the teachers for the smart teaching. Though, the teachers do not get much support from the principals for improving the pedagogical skills for technology integrated classrooms.

## Conclusions and Recommendation

The success of smart classroom in producing the expected outcomes depends on the three interacting axes of the smart learning space: architectural layout and ergonomic design; integration of technology and; appropriate pedagogical methodology. The smart classrooms in the chosen cases of schools are not efficiently combining these three interacting domains to create the appropriate smart learning space. The design and use of smart classrooms should be flexible and suit the needs of the students and teachers. Teachers are the most influencing factor in the formulation of the learning space in the smart classrooms who decides the appropriate integration of technology in to their pedagogical methodology. So the teachers' competencies in teaching in the smart classroom setup through appropriate methodology determine the quality of the smart space for learning. Teachers, students and the school principals have positive perception and hope in the outcomes of the smart classroom practices. Their expectations cannot be achieved until a conducive smart learning space is produced by the integration of the three axes of the smart class rooms.

The smart classrooms were introduced in the schools on a partial scale with a few classrooms in each school. The teachers have not been provided appropriate training in information and communication technology and in the application of suitable and flexible pedagogical methodology involving the technology for the smart class. This has led the teachers to face challenges in designing and the delivery of lessons in smart class rooms. These issues can be overcome through teacher training workshops to enable them to use the digital devises more efficiently and integrate the technology to support the classroom activities. The students and smart classrooms ratio of schools indicates the availability of smart classrooms in schools is critically low and the access to the students to the smart classrooms is limited. The lessons are planned to the classes in a selective way according the availability of smart classrooms. The number of smart classrooms in the schools must be increased according to the needs of the schools.

The synergetic effect of the three elements of the smart classroom can only be achieved when the three elements are satisfactorily provided. When one element is found to be defective it invariably affects the entire effectiveness of the smart class room system. Thus, the reasons for the defectiveness in each element should be found out and proper remedies be provided. The number of smart class rooms in schools should be increased according to the student

population of the schools. The schools should provide facilities to the smart class students in the computer laboratories of the schools to   engage in self- learning through internet. The classroom arrangement needs changes in some schools to enable the students to engage in group learning activities. The teacher instruction manuals must include guidelines for smart teaching to facilitate the teachers in planning and organizing their lessons.   These recommendations are very basic and based on the findings of the case studies and by innate nature of the case method research further studies are solicited to confirm the findings in broader scale to ensure the generalizability of the findings.

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