

Identification of a framework for implementing ICT in Sri Lankan secondary education system

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ABSTRACT

This research work was focused on finding the affected indicators on the barriers to use Information and Communications Technology (ICT) in Sri Lankan Secondary Education System. It also explores a framework to implement ICT in schools overcoming these barriers. In particular, it examined the viewpoint of teachers and principals on the integration of ICT into the schools' policy in the Western Province of Sri Lanka. Interviews were conducted for 60 secondary school principals and a questionnaire base survey was conducted for 500 teachers of several schools selected from the above pool. What materialized from the analysis showed that, infrastructure facilities, any policies related to the school, Planning and usage of ICT in teaching and learning, Current views held by principals as well as teachers regarding their ICT competencies, Teacher's fluency of ICT, the perceived viewpoint of teachers and principals regarding the influence and subsequent function of ICT in education has an influence on the magnitude of ICT usage in schools. According to the analyzed data, a framework was designed to make readiness and maintain smooth Teaching & Learning system in secondary schools. Finally, the research has collected feedback from involved parties during the implementation process to evaluate competency of the suggested framework.

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1. INTRODUCTION

The Government of Sri Lanka has prioritized Information & Communication Technologies (ICT) through the Information and Communication Technology Agency of Sri Lanka (ICTA) which was established in July 2003. Under the ICT Act No. 27 of 2003, ICTA [1] was empowered to compose and administer strategies and programs in the Government as well as the private sector. Although many industries have compiled their master plans for the development in ICT, the ICT integration into the education system of Sri Lanka has shown some alteration from this rapid growth.

The National Policy on Information Technology in School Education (NAPITSE) assures the dedication of the government in delivering the latest knowledge in ICT to the younger generation of Sri Lanka, enabling them to confront the challenges of the 21st Century. NAPITSE will provide guidance to a complete insight and path-forward in making this effort a reality, accompanied by an action plan as a 6-year strategic plan from 2002 to 2007 [2]. This action plan was aimed on both the ICT usage in Education (Teaching & Learning) as well as incorporation of ICT in the Management aspects of the Education System.

Although school management has shown progress, the incorporation of ICT for teaching and learning activities of the certified curriculum in school education has not indicated any progress. Studies related to ICT in education revealed that the scope has deviated to observing how technology is merged into education setting from inspecting various technologies and their impact on student learning.

2. STATE OF THE ART

The extent of ICT usage in schools has been examined, to obtain the view of students with experience in ICT at their school and to obtain the principals' and teachers' competencies and opinions related to ICT in education. Throughout this study, the effect of ICT on the processes of teaching and learning was evaluated and it has made recommendations for policy development [3]. Multiple researches have based on estimating the impact of variables such as computer attitudes at class level, of both teachers and students [4]-[6], computer experience [7], and gender differences [8]. Additionally, both pre- and in-service teachers required to be specially trained to incorporate ICT in their teaching. The government of Kenya has developed the ESP – ICT project focused on providing infrastructure facilities to 1050 schools and capacity building of teachers to enable ICT integration [9].

A study conducted in Nigeria to estimate the availability and the utilization of E-learning facilities in the teaching of physics in senior school revealed that although the resources were available it did not make any significant effect on the teaching of the subject [10]. The teachers' qualifications nor experience also had no effect on the utilization of the e-resources. The outcome was to provide training to the teachers on the effective utilization of e-resources. This is a significant problem when considering the teaching of any subject including ICT. An analytical framework for measurable and portable degree programs was suggested to develop a workforce for cyber security field at the higher education level which allowed students from general ICT area to specialize in cyber security [11]. However, the authors have not considered the impact of school level ICT education and how it impacts the higher education.

Bloom's taxonomy of educational objectives was used to create a bottom-up flipped learning model. It was implemented using a Learning Management System (LMS) where pre-class resources were shared [12]. The authors emphasize the importance of the model for improving students' cognitive domains and self-learning skills. An inclusive teaching model was proposed by studying the current problems and conditions [13]. The study revealed that students and learning itself is a problem and students and learning as well as management are most important factors to be considered when incorporating such models. However, in both above studies the impact of the models in real-world has not yet been revealed.

A structural equation model has been proposed to explore the relationship between usage of ICT in teaching practice and teachers' ICT competency [14]. The study has revealed that the teachers' ICT proficiency is significantly linked to organization skill and the ICT usage in teaching practice, has the greatest impact. A study was conducted to explore the elements that hinder the implementation of ICT policy in secondary schools [15]. It revealed that only a small number of schools and teachers are incorporating ICT to develop the quality and effectiveness of in-class learning. The study has attempted to reveal the hindering factors and provide guidance to develop an approach to successfully implement ICT policies for secondary schools. It was found that social and cultural hindrances also play a key role, however a framework for stakeholder interaction has not been discussed.

The UNESCO has developed an "ICT Competency standards for Teachers" to enhance and standardize the teacher skills in ICT incorporation into delivering education [16]. It proposes Teacher Competency Modules to plan appropriate ICT training, while only focusing on one stakeholder in the school education. Other national ICT education policies suggests hierarchical organization structure as well as present the envisioned interaction requirements for planning and management of ICT in education [17], [18]. It focuses on infrastructure and resources, management, training and monitoring of policy implementation. A strategic plan for policy implementation which spans over five years is represented as well [17].

Further studies have aims to evaluate ICT implementation in academic education colleges which focuses on the needs of teacher education [19]-[21]. These studies examine the parameters of ICT usage within the training as viewed by teaching staff in such colleges, their viewpoint towards the contribution of ICT for teaching and learning, training teachers for ICT integration into the curriculum and provide topics or questions that describe concerns teachers may have.

Studies were also carried out regarding the accessibility of ICT tools to certain subject areas of education [22]. The questionnaire-based surveys revealed the lack of difference in the viewpoint of lecturers and students on ICT tool accessibility. The survey participants recommended the governments to supply adequate ICT tools for teaching and learning. Another survey was conducted to reveal the hindrances associated with ICT incorporation in primary education [23]. Findings revealed that the ICT utilization was at a low rate, basic ICT skills were lacking and infrastructure deficiencies were amongst the main hurdles for adoption and utilization of ICT in the primary education system.

Other studies though not directly linked to ICT adoption, emphasized the importance of quality assurance and basic education goal achievements where the government intervention through a policy framework [24]. This study highlighted the importance of providing teacher and principal training in quality assurance mechanisms. Performance assessment of students also plays a key role in education. However, teachers may have different beliefs about performance assessment [25]. The outcome showed that there was variance between a teacher's words and actions. The variance was apparent due to the theories learnt, teacher's own knowledge and experiences in teaching itself. In the latter two studies, it is highly attractive to use ICT for quality assurance mechanisms as well as students' performance assessment which will support all stakeholders in education to monitor and resolve issues to enhance education. It was anticipated that the prevailing pandemic situation and future findings will introduce the essential infrastructure, expertise and viewpoint necessary to stimulate ICT incorporation in teaching and learning in schools.

3. METHODOLOGY

According to the research problem, this study explores a framework to transform the school system by integration of ICT and freeze the education system as a long-lived implementation until they adapt to the changes. So that, prior to proposing the framework, this research required to identify the backdrop to find the reasons why the previous projects has failed until today.

Here, mainly two personnel in the schools were requested for an interview, they are teachers and principals. The first 60 schools were selected randomly to interview the principal's perception about the ICT integration in their school and to check their readiness to the educational changes. A nomination form collected from principals at the awareness program organized for 60 principals were the access card to the next pool of 50 schools to implement the project plan. Factors identified from the principal's feedbacks and the principal's perspectives were used to select this pool of schools. The nomination form collected quantitative data of the resources that has been allocated for the schools and how it is utilized by the school process and the limitations within the school regarding the ICT usage. Other than that, it is designed to gather qualitative data of principals' contribution and attitude on ICT implementation in the school.

The data collection instrument has provided space to express their impression related to effective use of ICT tools in teaching process. Descriptive analysis was used to identify the next step to be implemented. Since the responds from principals are not enough to outline a framework, randomly selected 10 teachers from 50 selected schools were interviewed to gather feedback from their perspectives as well. Blends of quantitative and qualitative proof were obtained from teacher-trainees through Likert-scale type questionnaire. Participants of the surveys were given the chance to reveal their views on their individual experiences on the use of latest technologies.

Disregarding the quantity and quality of technology supplied to a classroom, the important point is how those tools are utilized by the teacher. Here, the teachers are required to have the capability and the right outlook with regard to technology. This research also inspects the impact of ICT incorporation into teaching practices and how teaching practices interact with diverse contextual elements. When considering ICT incorporations as an operation of relations amongst implementers and their circumstantial elements with a perception towards aimed changes in teaching and learning, this study has bridged the knowledge gap by proposing a framework to eliminate affecting factors when changing teaching and learning practices.

3.1. Data collection and analysis

The answered questionnaires submitted by principals represent the current situation of technology usage in teaching process of this selected pool. When the research considers above results shown in Figure 1, as a whole, the amount of ICT usage in schools is ignorable. It emphasizes the neediness of a new transformation method to schools.

Nevertheless, the amount of usage is lesser for some of the teachers who have been attracted to use ICT as their teaching method within the school. Therefore, the research decided to determine the limitations arising within the school environment to not having any ICT implementation while some schools are doing much less. With the use of the collected data from principals, a regression analysis was done to identify the affected factors as shown in Table 1. To evaluate the impact and relation between those factors, significant value coefficients and the collinearity were used by fitting a model.

The significant values given by the coefficient table depicted in Table 2, discuss the relation between the dependent and independent variables. According to that, the VAR2, VAR4 and VAR5 has not shown considerable impact on the dependent variable. Simply, having an email account for communication at the school, being a rural/urban school and the student: computer ratio are not the indicators to measure the ICT usage in teaching process in school.

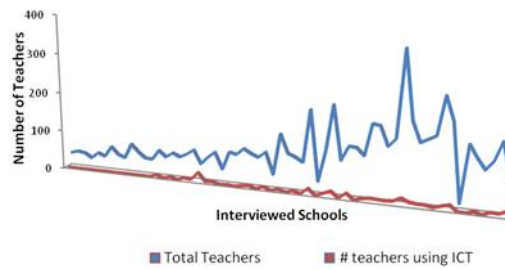


Figure 1. Number of teachers using ICT vs. total number of teachers

Table 1. Independent variables

Variable	Variables entered	Method
VAR1	Having school feedback page	Manually enter
VAR2	Being a rural/Urban school	
VAR3	Internet connectivity	
VAR4	Stu:Com ratio	
VAR5	Having email account user at school	
VAR6	Principal's perception	

Table 2. Coefficients

Model		Unstandardized coefficients		Standardized coefficients		
		B	Std. Error	Beta	t	Sig.
1	Constant	-0.578	0.248	-	-2.331	0.024
	VAR6	0.186	0.082	0.276	2.266	0.028
	VAR4	0.039	0.041	0.114	0.969	0.337
	VAR3	0.287	0.134	0.223	2.149	0.036
	VAR5	0.009	0.082	0.014	0.114	0.909
	VAR2	0.141	0.109	0.140	1.294	0.201
	VAR1	0.227	0.134	0.278	2.059	0.044

Then considering the beta values, they imply the volume of the impact of each factor. The research used this coefficient values for ordering the variables which have a large impact on usage. After sorting, it gives higher value for VAR1 and VAR6. Then respectively VAR3, VAR2, VAR4 and VAR5 have taken places.

The collinearity matrix depicted in Table 3, interpret the correlation of independent variables. This analysis data also represents only a little collinearity according to the Table 3. If the Eigenvalue is small and the corresponding condition index is large then it indicates multicollinearity. Therefore, the research concludes that having a school Facebook page depends on the principals' perception.

Though the above analyzed data indicates the factors which consider the school culture and principals' perception, these are not adequate to make a conclusion. Other than that, the most significant point might be the teachers' beliefs and attitude towards the technology and their awareness of ICT. Hence, second questionnaire was focused on 500 teachers selected randomly from the pool of schools.

The tool used for data gathering provided both quantitative and qualitative data, which described the theme to confirm the research problem.

Table 3. Multi-collinearity table

Dimension	Eigen value	Condition index	Variance proportions						
			Constant	Perception	Machine ratio	Internet	Email	Rural/Urban	Facebook
1	5.821	1.000	0.00	0.00	0.00	0.00	0.00	0.01	0.01
2	0.409	3.773	0.00	0.00	0.00	0.00	0.01	0.25	0.46
3	0.350	4.079	0.01	0.00	0.00	0.10	0.00	0.60	0.10
4	0.197	5.432	0.00	0.00	0.14	0.06	0.49	0.01	0.09
5	0.135	6.569	0.01	0.01	0.34	0.65	0.00	0.12	0.03
6	0.064	9.557	0.10	0.19	0.50	0.15	0.47	0.02	0.11
7	0.024	15.617	0.87	0.79	0.01	0.03	0.02	0.01	0.22

Research Question 1: What method do you use to access technology?

Here, Likert type questions were used to understand who has no knowledge to use, who has not used or no method even if they have experience to use and who has day-to-day usage access to technology by three types of methods mentioned.

Summarized data in Table 4 says that teachers who are new to all devices are only around 10% while there are 90% of teachers who have experience and knowledge. But from this 90% of experienced teachers, there is only less percentage used to work with computer/laptops while Smart phone usage is higher (63.2%). Accordingly, we can conclude that large percentage of teachers are familiar with technology, but the reason might be either the low resources or the unnecessary of usage.

Next the research focused on having teachers' personal experiences with ICT depicted in Table 5. These questions also had provided the same conclusion as above.

Table 4. Teachers' access methods

Access method	Unaware	No use	Use often
School computer	10.6%	69.2%	20.2%
Personal computer	10.8%	58.2%	31.0%
Smart phone/tablets	13.6%	23.2%	63.2%

Table 5. Personal Experience

Content/Usage	Unaware	No use	Use often
At least two software tools in MS office package (Word, PowerPoint, and Excel)	10.6%	67.4%	22.0%
Internet search (browsing, surfing)	15.4%	50.0%	34.6%
Email	26.0%	58.0%	16.0%
Skype	52.6%	40.8%	6.6%
Social media (Facebook, Twitter)	41.2%	58.8%	39.4%
Entertainments (Music, movies, games)	8.8%	39.4%	51.8%

Lastly, a questionnaire was prepared for finding answers for the question; what are the teacher beliefs and attitudes towards integrated teaching with ICT. Therefore, the questionnaire focused on what are the reasons not to use ICT in teaching by giving choices.

Survey Question 1: *I have no idea how to integrate ICT into teaching.*

Under X-axis No. 1 in Figure 2, it is described as responses received, where 50% of teachers fall into this category while 30% has an uncertainty regarding their competency.

Survey Question 2: *I am not an expert in ICT.*

Here, researchers recognized who has the perception as they needed to be experts in ICT to deal with it. According to the graph more than 50% of respondents have stated this as a reason not use ICT.

Survey Question 3: *Useless extra effort.*

This choice categorized negative persons unwilling to commit to changes. Fortunately, around 60% of teachers have given positive responses here.

Survey Question 4: *No need to change my teaching technique.*

Most people are hard to unfreeze from their routines which they form for a long time. They do not want to move on to latest technological improvements. But here it shows some favorable situation since there is 25% of teachers who agree with the statement.

Survey Question 5: *Students using technologies are disciplinary implausible.*

Because of this wrong attitude, students are restrained from using technologies. The best thing is guiding them to use ICT in correct way than prohibition. Similarly, both questionnaires indicated several numbers of most critical points faced when integrating ICT at schools requires to be solved at initial stage.

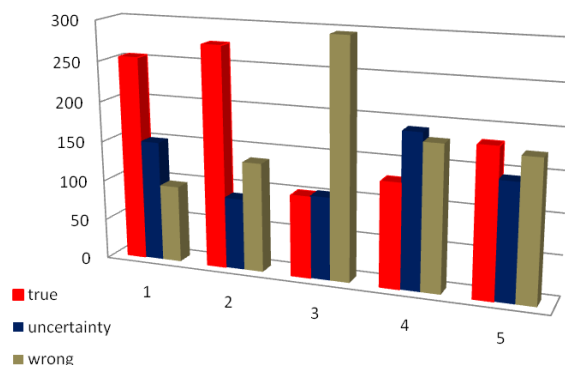


Figure 2. Teacher attitude

4. RESULTS AND DISCUSSION

Along with this logical argument, the scale measured the capability of ICT implementation strategies in the school in two categories: 1) *Improve ICT knowledge sharing amongst peers*; and 2) *Improve the mobilization of resources*.

Investigating identified factors from principal's perspective is based on two domains to select the schools into the pool: 1) *The ability to establish a shared vision*; and 2) *The potential of supporting innovations in teaching practices*.

Using known factors of teacher's views, the framework could be sketched out with the interactions among the construct of the ICT implementation in schools and the way out to overcome the hindrances by changing these pedagogical constructions. This framework extends beyond models which only consider teaching component [13], [16] or teacher education [19]-[21] and adheres to findings that indicated teachers' ICT capability is significantly linked to the usage of ICT in the practice of teaching [14].

Leadership; Conceptualization of leadership aligned with the direction of transformational leadership in establishing a common vision and inculcating the capacity for innovation. The implementation of the project requires strong partnerships with various industries to collaborate when accessing government school policies, expanding existing resources, deployment of software platforms, providing continuous follow-ups etc. from all contributors. Government policy is required to step in and ensure adequate ICT resources are available for teaching and learning [22]. External Leadership takes preliminary place to impulse the internals and invests on them, they are the Department of Education, Digital Ministry, and 3 private sectors. Under the leadership construct the expected four domains are: 1) *The capacity to initiate a shared vision*; 2) *Skills to access universal knowledge flow*; 3) *Skills of externally reinforce new thinking in classroom operations*; 4) *Skills of experience sharing*.

School Climate; School's educational environment has been expressed as the character of a school that inspires teacher's creativeness, interest and resources needed, in particular the collegial ICT integrated relationships. According to the view of leadership, school climate is needed to be adjusted fulfilling basic requirements. The expectations in school climate change by this research: 1) *Collaborative relationships through the network between teachers & learners*; 2) *Spirit to strive progress*; 3) *Effective communication platform*; 4) *High quality, creative and innovative learning materials & teaching methods*.

Teaching Practices; this building block was harder to make since trainers have to turn teachers from their traditional framework, even someone who does not want to unfreeze. It was learnt that availability of resources alone will not change teacher's perspective [10]. In this respect, analyzed inspections were used for identifying their weak points and provide solutions. The curriculum of any teacher training program should include the pedagogical perspective, with examples of educational applications in the specialty discipline of participants— in other words, the final goal of the training should essentially target the transfer of learning attainments into everyday teaching practice, facilitating it as much as possible. In reality, especially if the time allocated is scarce, the pedagogy is left aside, sometimes assuming that participants would figure out an even a better way to manage with specific challenges encountered in their classrooms. When building up this block, the research focused on four domains indicating changes in pedagogy: 1) *Pool of high-quality learning materials*; 2) *Classroom practices, online Quizzes & assignments, distance learning*; 3) *Updating and refreshing new technologies*; 4) *Capability to training colleagues and build up professionals*.

Learning Practices; the learning process quantified the viewpoint on whether students have engaged in a more creative approach to re-learn previous practices. Also, it was suggested that the learning ability, students' attitude in learning and the learning process play a key role. Hence the variance in learning scale

focused in quantifying the activities of learning, where the capacity to learn and related viewpoint were both examined. Henceforth, the changes perceived in student learning has identified the areas of: 1) *Capacity to learn*; 2) *Attitude towards learning*.

Building blocks were designed according to the research findings which suggested that the formation of a shared vision has a deep impact on the successful ICT incorporation. It is worth noting here that this research investigated only teachers and principals' viewpoint in relation with the components of the ICT school plan was taken into consideration. But, the perception of students who have significant impact and who is going to be beneficiaries of the plan was not taken into consideration. As a consequence of poor shared vision of principals as the person who had the first impression at the awareness session, few schools still do not come-up with correct attitudes. The outcome revealed that the communication between principals and teachers was insufficient.

Other important determinant is limited ICT infrastructures influence when implementing in real situations. The government has to make significant contribution in this regard [9]. The findings encourage to increase the efficiency of using the currently available ICT resources while planning for resource improvement. It was also revealed that maintenance, technical support and computer obsolescence bares a large portion of the schools' budget in relation to ICT resources. The findings also revealed that phase of ICT incorporation in schools is hindered by difficulties in finding technical support and maintenance. Therefore, a mechanism must be established for ICT resource maintenance and technical support for schools.

According to the findings and evaluations, the government surely need to create policies and determine the best way to ensure that students inculcate skills, knowledge and attitudes required to gain the advantage for the future prospects. The interactions amongst the constructs of ICT implementation in a school is depicted in Figure 3 [26].

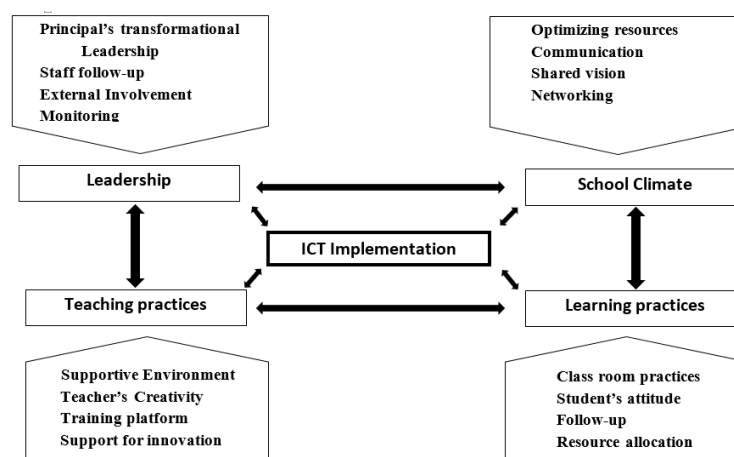


Figure 3. The interaction among the constructs of ICT implementation in school

5. CONCLUSION

The integration of ICT into all possible avenues of the school curriculum must be encouraged. This process can be enhanced by the peer and self-reviews by the school as a whole and teachers as individuals. A regular review process of ICT usage in teaching will support the teachers to improve its usage. This will in turn help the teachers in self-development and improvement to support the students in achieving their goals. The use of the broadest possible range of tools and resources available should be included and encouraged. As an example, Presentation and Education software, specialized hardware components such as programmable circuit boards, e-mail and other social platforms and the Internet. Further, the ICT resources can be used to inculcate necessary skills such as presentation and writing, research and investigation, communication, teamwork and collaboration. The same path can be followed to enhance the students' higher-order cognitive abilities in problem-solving, analysis and evaluation as well. Our study has revealed the influence of the teacher's perspective and competence of ICT usage. However, it was also revealed that the Principal's attitude and perspective towards ICT usage also plays a major role. Therefore, this research highlights that a strong communication path should link the Principals, Teachers and other stakeholders for successful incorporation of ICT usage in secondary schools in Sri Lanka.

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