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Technology Implementation Practices in Oromia Education Bureau, Ethiopia: The Implication of the RIPPLES Model

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Abstract: RIPPLES is a technology implementation model in the education sector through its components like Resources, Infrastructure, People, Policies, Learning, Evaluation, and Support. It was originally designed as a way to view technology implementation in higher education and has been further developed to incorporate all educational institutions. The purpose of this study was to test the model whether or not it can be applied at corporate level by investigating the implementation of technologies in Oromia Education Bureau. To underlie the study qualitative study design was deployed and the data were collected through interviews, document review and observation. The data were analyzed qualitatively by considering the seven elements of the model as thematic areas of analysis. It was found that the RIPPLES model can be applicable at corporate level and also found that all the components of the original RIPPLES model are determinant factors for enabling and hindering the implementation of technology at an organizational level. Finally, it was suggested that the model is more effective at corporate level if one essential component '*Strategy*' is added and hence SRIPPLES would be the new model for viewing technology implementation at organizational settings. It was also recommended that careful planning which equally considers all the components of the original RIPPLES model and the upcoming SRIPPLES model is necessary to avoid many of the common problems associated with unsuccessful implementation of technologies at corporate levels.

Keywords: Implementation, RIPPLES, SRIPPLES, Technology

1. Introduction

Organizations do not randomly engaged in adopting particular ICT technologies, but need to choose thoroughly which fit to assist the goal they intended to attain. Various models and theories for technology acceptance, usage and implementations have developed through time with the rapid development of technologies and their importance in our personal lives and organizational goal attainments. Technology acceptance, usage and implementations theories and models were designed to measure the degree of acceptance and satisfaction of the individual users against any technology or information system but from different viewpoints depending on the constructs or determinants which represent their structure [8]. Other models on the other hand have developed only to evaluate technology implementation in a given setting. Among those models, the one which was developed to address the need for the implementation of technology in higher education institutions is the RIPPLES model [13]. It is a model which intended to addresses many of the variables and factors that influence successful technology implementation by outlining areas that educational institutions must address when planning for technology implementation [5].

The RIPPLES model was well popularized by Surry and Ensminger to address the need for the implementation of technology in the University sector in the USA [7]. The model is known as the RIPPLES because the main elements of the model are Resources, Infrastructure, People, Policies, Learning, Evaluation, and Support. It describes these seven major elements that administrators should account for when planning for technology integration in educational institutions. It is a model of implementing technology that advocates the meeting of specific needs within these seven components of the model [13].

Originally, the RIPPLES model was developed to investigate the effective implementation of technology in higher education institutions and through time, it has been

further developed to incorporate KG-12 educational institutions as well. Additionally, while the model was developed specifically for higher education, it was suggested that it tends to be applied to other settings [13]. It was also illustrated through research finding that while the RIPPLES model is not directly applicable to corporate settings, it could be easily adapted to account for the unique circumstances of organizations. Moreover, while the model is focusing on higher education, many of its elements are useful to all organizations, both inside and outside of academia [13]. A study by Benson and Palaskas (2006) also concluded that the RIPPLES model was an effective tool for the post-adoption study of innovation and could be used to guide organizational decision making in regard to implementation [11].

Oromia Education Bureau has been implementing different technologies to enhance work efficiency, attain organizational goals and also ease decision-making processes. However, not all technologies are implemented effectively that expressed by the implementation of some technologies have succeeded while some others have failed to be implemented successfully due to several factors.

2. Statement of the Problem

Oromia Education Bureau is found in Oromia National Regional State, the largest regional state in Ethiopia, which was started to act as regional educational bureau in 1993 with the main objectives of creating equitable educational opportunities for all school-age populations of the region through the mission of offering relevant and quality education for all citizens of the region. The overall goals are to create access to education, ensure equity and improve the quality and internal efficiency of education in the region. As of 2021 regional education bureau statistics, there were 2,097 kindergartens, 15,044 primary and 1,351 secondary schools which are distributed in 318 districts and 19 administrative towns in the region. The number of children which got access to education were 11,046, 785 where 1,264,668 were in preprimary, 8,398,559 were in primary and 1,383,558 were in secondary schools.

To accomplish the anticipated education goals and objectives effectively and efficiently at all levels of the education system in the region, supporting all activities by appropriate technology is advisable. In this technological era, not only educational institutions but also education organizations like Oromia Education Buearu need to use technologies for deferent purposes. Organization can use technologies to shape and accomplish their strategic and operational objectives. However, the way they accept and use technologies depends on the purpose that organization intended to accomplish. In this regard, there were attempts and practices of accepting and implementing technologies at Oromia Education Bureau level that in turn helps to achieve the intended educational goals at all levels of the education system in the region.

Even though the bureau has been accepting, integrating and implementing technologies for more than a decade, the implementation of some technologies have succeeded while some others have failed to be implemented successfully. It was assumed that this has been happened due to any technology acceptance and usage theories and models had not been applied at all education institutions in general and at corporate level in particular. To really implement technologies to support and manage the accomplishment of educational goals, the bureau needs to apply some technology implementation models like REPPLES at regional bureau level.

Indeed, while the RIPPLES model is not directly applicable to corporate settings and has not been tested especially at these levels, it could be easily adapted to unique circumstances of organizations. In this regard, there is a research gap to study technology implementation at corporate level through the elements of the model. It was also found that most of the studies have been conducted at higher education level to study the implementation of technology and is has not been tested whether or not the model can be applicable at corporate levels.

Based on this set-up, this study is intended to assess the status of technology implementation in the Bureau through the RIPPES model. The objectives of this study are, therefore:

1) To assess the practice of technology implementation in Oromia National Regional Education Bureau through the RIPPLES model.
2) To test whether or not the RIPPLES model can be applicable at corporate level in technology implementation process.

To achieve these objectives, the following research questions were proposed:

1) Are the RIPPLES model components affecting the effective implementation of technology in the Bureau?
2) Does the RIPPLES model be applicable in an organizational setting like Oromia Education Bureau?

3. Overview of the Model

Surry, Ensminger, and Haab (2005) drew on the theories of Rogers (2003) and Ely (1990, 1999), among others, to create a model for implementing innovations into higher education settings [15]. Their model, known as RIPPLES has seven components: Resources, infrastructure, people, policies, evaluation, and support which has been used to study technology implementation in higher educations. It is somehow broader than most technology integration models, and hence, begins with the principle that technology is expensive and need an adequate resource to be acquired, utilized, maintained, and upgraded.

According to [13], the RIPPLES model is not linear in that it is not intended to show that resources should come before infrastructure or support should come at the end for example. Hence, while planning to accept and implement technology via this model, equal consideration should be given to all of the elements of the model throughout the implementation process.

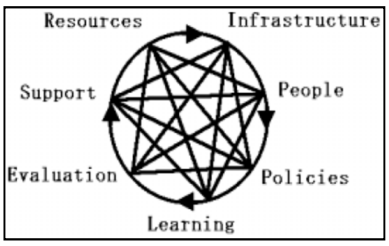

Figure 1. *A diagram of the probable relationship between the seven elements of the RIPPLES Model in practice; source: [13].*

Many researchers have conducted using the model to study technology implementation status in universities. As summarized by Surry, the model has been used to study implementation in higher education by several researchers [15]. Benson and Palaskas (2006) used the model to study the implementation of a learning management system at a university and found that issues related to the components of people, policies, learning, and evaluation were the highest institutional priorities needed to foster the effective implementation of the LMS at their university. Jasinski (2006) used the seven components of the RIPPLES model to study the implementation of web‐based learning among vocational educators in Australia and concluded that all seven components of the model were important to consider during the implementation process. Buchan and Swann (2007) also found the RIPPLES model to be useful in studying the implementation of an innovation in a higher education setting. Romero and Sorden (2008) used the model as a framework to study the implementation of an online learning management system (LMS) at a university in Mexico and concluded that infrastructure and support were the two most critical factors that facilitated the implementation process.

4. Components of the RIPPLES Model

4.1. Resources

This first element of the model refers mainly to fiscal resources required for the technology integration processes. This component incorporates resources and financial planning, including the allocation of resources for ICT implementation [2]. Resources are the financial sources available to cover direct costs of implementing technology, such as the purchase of software and hardware, as well as the indirect or hidden costs associated with maintaining the technology [5]. Indirect costs include items such as upkeep of hardware, purchasing of software or application upgrades, personnel costs associated with maintaining technology, and professional development costs. Hidden costs include expenses that result from using the technology, such as the purchase of storage devices, increase in printing charges, cables, projector bulbs, Wi-Fi access, routers, cloud storage costs, and mobile devices. As technology continues to advance, hidden costs continue to change requiring financial plans to change as well. When financially planning for technology, institutions must consider that indirect costs and hidden costs are long term and extend beyond the initial cost of purchasing the technology.

All cost categories under the resource component of the model are equally important in the process of any technology implementation. When developing a plan for facilitating technology integration, entities have to account for all four cost categories; direct and indirect costs and initial and ongoing costs. Perhaps the most important things institutions can do to facilitate the implementation of any technology are to have a realistic understanding of all the costs involved and to develop a detailed, practical plan for addressing those costs [14].

4.2. Infrastructure

Infrastructure, the second element of the model, refers to the hardware, software, facilities, and network capabilities for technology integration in organizations. According to [13], Rodgers's-curve theory, the Stockdill and Morehouse checklist, and Farquhar and Surry's adoption analysis place particular emphasis on infrastructure for technology integration. It is about infrastructure development, including the planning of robust means of ensuring ICT as a major player [2].

According to Surry, Ensminger, and Haab, 2005 cited in [5], technology infrastructure includes items associated with implementing the technology such as space for storing and securing technology, sufficient internet speed if multiple computers are accessing the internet at one time, sufficient data storage space, building design to allow for the movement of technology if the technology is mobile, sufficient electrical outlets to power devices, and appropriate peripheral technology to support integration. Technology planning requires an examination of the required infrastructure needed to support the implementation of the technology.

4.3. People

The third element of the model, people, refers to the essential role that the people within an organization play in the technology integration processes. The needs, hopes, values, skills, and experiences of the people who will use an innovation play a vital role in deciding if innovation is successfully adopted [13]. People are involved in information systems in just about every way: people imagine information systems, people develop information systems, people support information systems, and, perhaps most importantly, people use information systems. Thus, organizations should further understand the skills of their employees needed before the integration and adoption of technologies in general and ICT in particular within their organization [1].

The first groups of people are those who play a role in designing, developing, and building information systems. These people may include systems analyst who identifies business needs and imagine a new or redesigned computer-based system to fulfill those needs, programmers who write computer code in a programming language in the case of systems development to fulfill the design specifications given

to them by a systems analyst, information-systems operator and administrator who involved in the day-to-day operations and administration of it, a database administrator who manages the databases for an organization and others.

Besides the people who work to create, administer, and manage information systems, there is one more extremely important group of people: the users of information systems. This group represents a very large percentage of the people involved. If the user is not able to successfully learn and use an information system, the system is doomed to failure. So that, while undertaking technology integration processes in an organization, considering people in terms of their need, skill, experience, hope and values is essential.

4.4. Policies

The fourth element of the model is policy. It refers to the need for organizational policies and procedures to adapt to new technologies. Surry, Ensminger, & Haab, (2005) in [7] highlighted that the policies component of the RIPPLES model discusses the need for institutions to put into place policies that compel the use of technology by organizational members. Many organizational policies, especially those relatively stable, were developed before technology became a common tool in the workplace. As a result, many policies prevent, or at least inhibit, the successful integration of technology into the workplace.

Hafkin (2002) noted in [6] that ICT policy can be categorized into vertical, infrastructural, and horizontal policies. Vertical ICT policy addresses the sector needs, such as education, health and tourism. The infrastructural aspect deals with the development of national infrastructure and is closely linked with telecommunication. The horizontal aspect deals with the impact on broader aspects of society such as freedom of information, tariff and pricing, privacy and security.

Policies are usually seen as the strategic statements that provide a broader context for change and articulate a vision that motivates people to change and coordinate otherwise disparate efforts within the system and across sectors Kozma (2005) in [6]. So that it is important to move away from techno-centric planning and implementation approaches to models that focus on establishing sound policy and support strategies leading to the integration of ICT in education. Policymakers themselves need to develop systematic policy formulation and strategic planning for ICT integration.

4.5. Learning

The fifth element of the model, learning, refers to the need for technology to enhance organizational goals. In the current dynamic and international environment, public sectors including education sector, have to align with the fast evolving technology and to keep track with the information and communication technologies in order to satisfy all stakeholders' needs and expectations and to develop, improve and enhance the quality of the provided services [10]. As to Pavel, et al. (2015) in [4], technology increases the capacity to perform tasks, attain more diversified objectives, discover and comprehend the material world, and overcome the challenges, obstacles, and threats of the day.

In the process of technology integration, one should view technology not as an end in itself, but as a means for accomplishing specific organizational goals. In educational institutions, for example, there are three ways that technology can enhance the goals [13]. First, technology can have pedagogical benefits. Technology can allow teachers and students to interact in dynamic new ways, resulting in increased cognitive or motivational outcomes. Second, technology can have access benefits. It can allow education institutions to reach new student populations or to serve current students in new ways. Third, technology can have cost benefits. Technology can allow education institutions to serve students more cost-effectively either by allowing for economies of scale or through reduced operating costs.

4.6. Evaluation

Evaluation is the sixth element of the model which refers to the need for continual assessment of the technology. There are four areas of evaluation that should be considered [13]. First, there should be an evaluation of technology about organizational goals. The main evaluation question in this area would be "Is technology allowing us to do a better job?" Second, there should be an evaluation of the technology itself. This evaluation would include an ongoing assessment of technology alternatives. Third, there should be an evaluation of the overall integration plan. This evaluation would determine the factors that have either facilitated or impeded the integration of technology. And fourth, there should be a benefit/cost evaluation. Benefit/cost analysis would be used to determine the return on investment for any technology expenditures. Evaluation begins with examining the needs associated with the diffusion of the technology, progresses to an evaluation of the planning process, evaluates how implementation plans were carried out, and finally examines organizational and cultural shifts that occur as a result of using technologies [5].

4.7. Support

The seventh element of the model is about the need to have a support system in place. Support is a component common to most models of adoption and diffusion. As stated in Surry (2002), the theories of Stockdill and Morehouse (1992), Surry and Land (2000) & Farquhar and Surry (1994), in particular, described the importance of developing adequate support systems. From these theories, we can determine that there are four components of a support system. These components are training (both formal and informal), technical support, pedagogical support, and administrative leadership [13].

Shonfeld & Goldstein (2014) summarized the components of the model as (1) Resources (budget), (2) Infrastructure (hardware, software and network), (3) Policy (a vision, a declared plan and supportive leadership of the administration), (4) People (motivation of the staff: beliefs, attitudes and values), (5) Learning (perception of change for achieving learning objectives), (6) Evaluation (identifying

the factors that promote or inhibit the process, examining the relationship between investment and output), (7) Support (staff training, provision of technical, pedagogical and administrative support) [12].

5. Methodology

A qualitative research design was deployed to obtain ample data from the deep understanding of participants about technology implementation in the Bureau. It was also used to gain detailed information regarding technology implementation at the Bureau level, from the first-hand experienced participants based on the RIPPLES model components. According to Creswell (2012), the collection of information in qualitative research design is advisable from a small number of individuals or sites [3]. Meanwhile, Oromia Education Bureau is structured with 17 directorates and 32 case teams where there are 17 directors and 32 case team leaders exist which shows the population of the study could be 17 directors and 32 case team leaders. However, only 5 directorates are using some sort of software application technologies and systems in addition to using the common ICT infrastructures like desktop computers, laptop computers and the internet and hence the population of the study was limited to five.

To underlie this empirical study in the selected site which is Oromia National Regional Education Bureau, a non-probability sampling technique, purposive sampling, has been used to include five participants, each from the five directorates. Semi-structured interviews have been taken as one of the data collection mechanisms for the reason that it helps to gather exact data about what participants know about the effective implementation of technology in the Bureau by considering the seven RIPPLES components. A semi-structured interview considers several key questions that help to define the areas to be explored, in this case, the implementation status of technology in the Bureau through the seven RIPPLES components. Accordingly, a semi-structured interview with a total of 24 guiding questions which were sub-categorized under the seven components of the RIPPLES model has been prepared and used for investigating participants' background information about the implementation of technology in the Bureau through the seven components of the RIPPLES model.

The other approach to collect data for this empirical study was data analysis from relevant documents. Documents are one of the valuable sources of information in qualitative research [3]. In this empirical study, the budget plan documents of the last five years which were obtained from the planning and budget preparation and monitoring directorate has been analyzed to gain valuable information about government budget allocation for technology implementation in the Bureau. Observation has also been used as the other source of data for this study. Because observation helps to gather open-ended, firsthand information by observing people and places at a research site and continues to be a well-accepted form of qualitative data collection means [3].

As to [3], five steps should be considered in the process of collecting qualitative data. First, the researcher needs to identify the participants and sites. This step has been accomplished by identifying five participants where they were purposefully selected directors and case team leaders in Oromia National Regional Education Bureau from directorates that are using technologies for different purposes. The second step is to gain access to conduct the study, and hence the participants have been accessed without any difficulties. The third step is to determine the types of data to be collected. Accordingly, it was decided by the researcher that the data that need to be collected are those help the researcher to come up with a piece of evidence to examine the research objectives. The fourth step is to develop data collection forms. Regarding this step, three pages semi-structured interview guiding checklist has been prepared and utilized thoroughly. The final step is to administer the process ethically and the process of collecting and analyzing the data from this study has been conducted in such a way that ethical manners are considered.

In the document analysis process, identifying the types of documents that can provide useful information to address the research objectives was the first step to be considered that helps to collect relevant documents and data. After the documents were identified as budget plan documents for five years, seeking permission to use them from the appropriate directorate in charge of the materials was followed and permission was allowed from the planning and budget preparation and monitoring directorate. Finally, recording information from the documents through taking notes, copping the documents and scanning them to make them ready for analysis has taken place.

In the observation process, some sort of observation procedures like selecting what to be observed, identifying who or what to observe, when to observe, and how long to observe, recording notes during observation and recording notes have been carried out to obtain data about the overall infrastructure availability for technology implementation in the Bureau.

In general, data and information were gathered from the five interviewed participants who were involved purposefully in this study, 2 directors and 3 case team leaders, through interviewing them independently for more than an hour based on the semi-structured interview guiding checklist to access the status of technology implementation in the Bureau in the bases of the components of the RIPPLES model. A secondary data source, document analysis, has been considered specifically to scan government financial resource allocation trends for technology implementation at the Bureau level and data obtained from the observation were used specifically to come up with information about infrastructure, one component of the RIPPLES model, in the process of technology implementation in the Bureau.

In qualitative research, the data collection and analysis (and perhaps the report writing) are simultaneous activities. Qualitative researchers analyze their data by reading it several times and conducting an analysis each time [3]. In the same

phenomenon, the data which were obtained from primary and secondary sources through face-to-face interview and document analysis respectively have been analyzed simultaneously. Though the data gathered were text data, the analysis has made by considering the components of the RIPPLES models as themes or broad categories and then creating 24 sub-categories to ease the interview, data capturing and data analysis process. Excel spreadsheet has been used to collate the text data obtained from the interviewees and categorized through coding the participants' as PD1 (the first participant director), PD2 (the second participant director), PCTL1 (the first participant case team leader), PCTL2 (the second participant case team leader) and PCTL3 (the third participant case team leader). Finally, an interpretation of the meaning of the data was made by reflecting on how the findings relate to the existing RIPPLES model components. The data obtained from document analysis and observations have been also analyzed simultaneously with the analysis of data obtained from the interviews.

6. Findings

The findings of this study revealed that Oromia National Regional Education Bureau has been accepting and implementing different technologies to accomplish its organizational goals through trying to consider human and organizational issues. The findings of this study have been categorized in two to major parts as the overall technology implementation practices and the implementation status of those technologies through the RIPPLES model elements.

6.1. The Overall Technology Implementation Practices in the Bureau

In this regard, it was found that there is a promising condition concerning the availability and usage of hardware equipment like desktop computers, laptop computers, printers, scanners, projectors, network cables, Wi-Fi access routers, security camera, mobile devices and tablets. Almost all of the workers in the Bureau have equipped with desktop computers to ease their daily activities at the Bureau level. However, not all workers have laptop computers that help them to perform some activities out the Bureau including working at weekends and at night. It was also observed that 7 heavy-duty and sophisticated printers are available on every floor of the building which can print thousands of sheets per hour, can photocopy and scan large documents in a short time.

Concerning software applications and systems usage, it was found that there is a gap to introduce and implement software applications and systems at the Bureau level. Regarding the practices of using software applications and systems in the Bureau, PD1, the ICT director stated that:

> 'Unlike the better use of hardware technologies, the usage of software applications and systems is weak at the Bureau level. Some software applications and systems were failed at their introduction phase and some were failed to sustain. Amongst, Book Distribution Management System was failed at its initial phase due to a lack of human resources to use the system at the school level. The Material Management System which was developed by the regional Finance and Economic Development Commission and has been given to the regional organizations including us to be utilized for property management is also not being practical for the reason that the system development has not been completed yet and lack of evaluation and support. Personnel Management Information System (PMIS) is the other system that has been introduced by USAID and UNESCO and failed to be applied due to lack of support and budget'.

Currently, only a few directorates are using software applications and systems to ease their tasks, increase customers' satisfaction and facilitate decision making and planning processes. These software applications and systems with their general-purpose, the directorate in which they are deployed and their current statuses are presented in table 1 below.

Table 1. *Some Technologies Implemented in Oromia National Regional Education Bureau.*

SN	Technology name	Directorate	Purpose	Current Status
1	Document management system (DMS)	Human Resource Management and capacity building	Documentation of All information of Teachers and staff in the region.	Active (Planed to customize to Zonal level)
2	EMIS (Educational Management information system), StatEduc2.	ICT and EMIS	Annual base storage of all detailed information from all schools in the region	Active
3	Optical Mark Reader (OMR) Technology	Assessment and Examination	Scan, score, capture, analyze and save student examination result	Active
4	Book Distribution management system	Curriculum Preparation and implementation	Manage textbook distribution	Not working
5	Material Management System	Logistics Administration	Control and manages all fixed asset and finance follows	Not working,
6	Inspection Automation Application	General Education Inspection	Automate General Education Inspection outputs	Partially working
7	Personnel Management Information System (PMIS)	Human Resource Management and capacity building	Documentation of All information of Regional Bureau staff	Not working

As shown in table 1, there are only four active software applications and systems that exist at the Bureau level that reveals the usage of such technologies at this level is not satisfactory. The functions of these active software applications and systems were illustrated by PD1 and summarized as follows:

Document management system (DMS)

This system is deployed for the Human Resource Management and Capacity Building Directorate through which employees' data are stored in the system for their easy retrieval electronically at issued circumstances. After it is upgraded in near future, it is expected that the system will be utilized for processing employee promotion and evaluation of performance easily quickly and efficiently.

Educational Management information system (EMIS)

EMIS is the system that belongs to the ICT Directorate. The functions of EMIS through the StatEduc2 software include the collection, processing, publication, dissemination and interpretation of information services on important parameters of education such as data related to student numbers, human resources, institutional assets, facilities and student progression. The processed data provide diagnostic information to decision-makers, planners and researchers to facilitate effective planning, decision-making, implementation, monitoring and evaluation of the education system.

Optical Mark Reader (OMR)

This system is deployed in the Bureau since 2005 with almost sufficient and necessary pieces of equipment and connectivity in the Assessment and Examination Directorate. It is used to scan, score, capture, analyze and store grade 8 students' regional examination result information which can be used to perform further analysis to evaluate the success of primary education.

Application for Automating General Education Inspection

Through this application, the General Education Inspection Directorate at the regional level has been able to perform inspection activities effectively and hence inspection results of education institutions stored in the application for further analysis like ranking, grading and dissemination of the inspection results which are free from bias and the results can be generated and used for decision making and planning purposes on time.

6.2. Technology Implementation: The Implication of RIPPLE Model Components

6.2.1. Resource: Continuing and Temporary Financial Resources

According to the RIPPLES model, resource refers mainly to the fiscal resource that an entity needs to secure adequate funding to acquire, utilize, maintain, and upgrade technologies. It is an essential component of the model that helps to the development and ensuring sustainability of applications, procurement of hardware and services related to the implementation, cover cost of operations, such as annual payments of internet network and communications, as well as for training and preparation of human resources to take advantage of related applications [9].

In this regard, the participants of the study were interviewed to forward their view about the allocation of government budget and permanent funding from donors for proper utilization of software applications and systems they are using. The findings from the interview with participants reveal that even though they all believe in the importance of financial resources for technology utilization, maintenances, and upgrading, what has been happening regarding the allocation of government budget in the Bureau for technology implementations is viewed as unsatisfactory. Accordingly, all the participants agreed that government budget allocation, which can be counted on each year, for technology implementation has not been at their expectations. The response obtained from PD1, who is the ICT director, for example, shows that the allocation of budget for ICT directorate for technology implementation issues, in general, is not satisfactory. The ICT director illustrated the problem of government budget allocation for ICT as:

> *'We plan to run some ICT activities like to train works on recent technological advancements, to purchase some favorable applications and software, to update and customize the existing applications and software. Due to the absence of specific budget allocation for these issues, we often fail to accomplish our plans every year.'*

Other interviewees also rose that there is a problem regarding government budget allocation for upgrading and customization of the software applications and systems they are using. Almost all case team leaders explained that there is no specific government budget allocation for training, upgrading, customization and sustainment issues about the applications and software and applications they are using.

The finding from budget planning document analysis also shows that the percentage of government budget allocation for technology implementation issues for the last five years is minimal and insignificant and below 2% each year. The grand government budget allocation trends for the Bureau and the amount of money spent for technology implementations issues in the Bureau for the last five years is illustrated in table 2 below.

Table 2. *Government Budget allocation by Year and Share for ICT/Technology integration.*

Year	Total Allocation		Allocated to ICT/Technology Implementation Issues			
	Recurrent	Capital	Recurrent/training, system development upgrading, and network installation	In %	Capital/ Purchase of computers, maintenance tool kits and more	In %
2009	1,084,714,091.00	1,424,951,712.00	1,153,870	0.11%	2,879,000	0.20%
2010	1,499,521,190.00	936,151,252.00	1,480,000	0.10%	12,030,450	1.29%
2011	1,690,466,088.00	824,799,867.00	6,000,000	0.35%	15,000,000	1.82%
2012	1,882,100,165.00	539,944,419.00	2,600,000	0.14%	8,740,000	1.62%
2013	1,232,995,249.00	4,568,363,721.46	9,000,000	0.73%	61,912,000	1.36%

As shown in the table, both recurrent and capital budgets allocated for the Bureau from the regional government is getting improved and there is a relative increment from year to year. However, what has been allocated for technology integration issues from the Bureau to the school level has shown insignificant. As obtained from the budget plan

document and financial report for ICT integration issues, the recurrent budget includes training, system development, upgrading the existing software and systems, internet service fees and work installation for the Bureau and secondary school. The capital budget on the other hand includes the purchase of computers, purchase of maintenance tool kits and more for the Bureau, zones, woredas and secondary schools too.

The interview findings regarding financial resources mainly obtained from funds or donations for technology implementation at the Bureau level reveal that it is better than the allocation of financial resources by the government. PCTL1, the EMIS case team leader, forwarded his view regarding this financial resource as:

'EMIS team is using a software called StatEduc2 which is developed by UNESCO and used to capture, compile, organize and store educational data which is collected annually from every educational institution in the region. It helps us to capture, compile, organize and disseminate reliable educational data timely for our stakeholders and customers. The software is being to exist and be implemented with the help of the fund allocated by GEQIP-E and UNICEF on annual basis for training, customization and upgrading issues. I doubt the sustainability of the EMIS if GEQIP-E and UNICEF fail to allocate the fund even for a year.'

The response from PCTL2, the general education inspection directorate team member, also resembles the same. She stated that:

'For the application we are using which has been helping us to facilitate all general education inspection activities, the source of budget are utilizing is from GEQIP-E on annual bases to run any inspection activities specifically to train the respective inspectors at Zonal and Woreda level on how to use the application. It was due to the availability of this budget that our directorate is functioning. I think the government needs to emphasize the issue.'

6.2.2. Infrastructure: Hardware Facilities, Appropriate Software and Network Capabilities

Infrastructure is the backbone of any program without which any program cannot be implemented let alone be successful [11]. According to the RIPPLES model framework, the availability of the necessary infrastructures like hardware facilities, appropriate software, and network capabilities need to be considered for the effective implementation of technology. What was obtained from interviewing the participants of this study about the availability of the necessary infrastructures like hardware facilities, appropriate software, and network capabilities in the Bureau shows that better situations exist concerning hardware facilities when compared with the availability of appropriate software and network capabilities.

Concerning equipping the Bureau with hardware facilities, the response from PD1 revealed that almost all necessary hardware facilities like desktop computers, laptop computers, servers, projectors, network cables, security cameras, Wi-Fi access routers, and mobile devices are almost available. Other participants of the interviews have also highlighted that the availability of the necessary hardware facilities to their respective directorates is in a good situation. However, the issue raised by all participants in common is regarding the availability of laptop computers that some workers are not equipped with. The other issue that PD1 seriously illustrated was the unavailability of a data center at the Bureau level. He explained the as:

'In our Bureau, as a big organization at the regional level, we need a data center with necessary infrastructures including servers, racks, network connectivity infrastructure, security measures and appliances, monitoring structures, storage infrastructure, cooling and airflow systems (as well as fire protection) to organize, process, store and disseminate large amounts of data. However, we planned every year to have such a data center at the Bureau level and failed to realize it due to several reasons like resource and leadership commitment'

Concerning network and connectivity facilities, what has been observed revealed that there is a promising network capability that allows workers to upload and download documents, to use e-mail, Face book and telegram to communicate and exchange information. The desktop computers are interconnected and connected to heavy-duty printers so that workers can exchange information using this connectivity and print what they want to print using these connections. On the other hand, it was observed that the Bureau has its website; so that workers, stakeholders and costumes can get updated information of the Bureau via this website.

6.2.3. People: Users and Technical Experts

The people within an organization play an essential role in the technology acceptance and implementation process. Everyone within an organization has an important role to play in the successful implementation of an innovation. Haddad (2007) in [6] noted that appropriate and effective use of technologies involves competent and committed interventions by people.

The participants of this study were interviewed to forward their views concerning the needs, hopes, values, skills, and experiences of workers in the Bureau to acquire and utilize technologies. In addition, they were interviewed to evaluate the availability of technical experts who are capable to inculcate, maintaining, and upgrading technologies in the Bureau.

Accordingly, all the interviewed participants viewed that the needs, hopes, values, skills, and experiences of the works in the Bureau to acquire and utilize technologies seemed to be at a promising status. Moreover, most of the works need to be trained to use advanced technologies like using software applications and systems for their respective activities beyond using Microsoft word and excel.

Regarding the availability of technical experts who are capable to inculcate, maintaining, and upgrading technologies in the Bureau, it was found that leave alone at

the regional level some experts can even be competent at the national level for their skill. PCTL1 expressed this as:

'I remember that one of our team members was assigned by the Ministry of Education to work at ministry level for his greater skill in customization and upgrading of the StatEduc2 software however, he refused to join there for his personal case.'

The response from PD1 also revealed that the availability of such technical experts in the Bureau is somewhat good except for the unavailability of a programmer. He stated the issues as:

'The existing ICT experts in the Bureau are capable to operate basic activities concerning the current situation. However, they need additional advanced training for being competent with the ever-changing technological advancements. Due to unfavorable conditions in the working environment, on the other hand, the Bureau may lose technical ICT experts. For example, it has lost four experienced and talented ICT experts within the last four years, where two were left for Oromia Health Bureau, one for Commercial Bank of Ethiopian and one left for another bank'

6.2.4. Policies: Technology Integration Policy in an Education Context

Policies are usually seen as the strategic statements that provide a broader context for change and articulate a vision that motivates people to change and coordinate otherwise disparate efforts within the system and across sectors (Kozma, 2005) in [6]. Policies involve action plans that provide the instrument in which the vision is to be realized. According to Porter (2012) in [7], the policy itself, however, does not create or implement change; rather, policies serve as guidelines that help direct the behavior of those within the system.

The participants of this study were interviewed to forward their understanding of whether technology integration policies in an education context exist or not. The findings obtained through interviewing them revealed that they have no information about the current status of the technology integration policy availability at the regional and national levels. However, they all assumed that there are no policies in place in respect to technology adoption and implementation at the Bureau level which has to be available to foster the effective implementation of technology in the Bureau. According to the response from PD1, the issue of technology integration policy in an education context is underestimated even at the national level. He expressed the issue as:

'As to my knowledge, leave alone at the regional level, the county itself has no technology intention policy into the education system. Even Oromia National Regional State Information Communication Technology Development Agency has no technology integration policy to the education at the regional level. However, currently, the ICT team in the Bureau is dedicated to the process of writing policies regarding technology adoption and usage in an educational context of the region and will come up with the first draft for discussion in near future.'

6.2.5. Learning: Viewing Technology as a Means for Accomplishing Specific Goals

When planning for the integration of technology, administrators should not view technology integration as an end in itself, but as a means for accomplishing specific learning goals of the institution [13]. Regarding learning, as one component of the RIPPLES model, participants were interviewed to forward their view whether they are viewing technologies as a means for accomplishing specific organizational goals rather than viewing the use of technology itself as an end. Additionally, they were interviewed to share their experience on whether or not using technology can enhance the attainment of organizational goals.

Accordingly, the findings from the interviewees concerning their view about technology implementation revealed that they believe implementing technology for sake of implementation is not an end by itself. Rather, technologies need to be implemented to accomplish specific goals of the Bureau and hence contribute to the enhancement and attainment of the goals. In this regard PCTL2, the EMIS team leader expressed the issues like that:

'The software we are using is helping us to capture, compile, organize reliable educational data from every education institution easily which is difficult to conduct without it and hence enabled us to disseminate the data timely for decision-makers, planners and our stakeholders and customers. Hence timely and reliable educational data acquired for data-driven decision making and planning '.

PD2, the Regional Assessment and Examination Director, also illustrated that:

'Using the OMR technology enabled us to score grade 8 regional examinations within a short time and offer the examination result for students without any error that might be significant if it is scored manually. Besides, it enabled us to store several years of students' examination results of the region in a single system and it is possible to give students examination result certificates at the condition that they apply as if they lost Grade 8 examination result released on time'.

The response obtained from PCTL2 also strength what has been addressed by the other participants. She has reflected that:

'The being automated of the general inspection process helped us in storing, ranking, grading and disseminating the inspection results and hence the burden of workers reduced, time saved, data quality improved, perfection gained and the result used for decision making and planning purpose on timely bases.'

6.2.6. Evaluation: Goal Attainment, System, Plan and Cost-Benefit Evaluations

There are four areas of evaluation that administrators should consider while implementing any technology [12]. These are an evaluation of technology to goals, an evaluation of the technology itself, an evaluation of the overall integration plan and an evaluation of determining factors that have either facilitated or impeded the integration of

technology. In this regard, the participants were interviewed to forward their view regarding the existence of an evaluation system to the attainment of organizational goals, the existence of an overall system evaluation, the existence of an evaluation to technology integration plan and the trend of cost-benefit evaluation/analysis of technology implementation in the Bureau.

Accordingly, the findings from all the interviewed participants revealed that there are no such evaluation trends in the Bureau while some technologies have been implemented for several years. PD1 in his view illustrated the absence of such evaluations in the Bureau in such a way:

'One of the issues which we haven't practiced while implementing technology is the availability of some sort of evaluations. Leave alone these four evaluation approaches; it had been better if one type of evaluation is practical in the Bureau.'

6.2.7. Support: Trainings, Technical and Administrative Support

According to the RIPPLES model, while it was first developed for higher education technology implementation, it incorporates four components as a support system. These components are training (both formal and informal), technical support, pedagogical support, and administrative leadership [13]. For organizational settings, however, trainings (both formal and informal), technical support and administrative leadership can be considered.

In this regard, the participants were interviewed to forward their view and experience regarding the availability of sort of training (both formal and informal), the trend of technical support by experts and administrative leadership support for technology acquiring, utilizing, maintaining, and upgrading, in the Bureau. The findings concerning the availability of sort of training (both formal and informal) revealed that there is sort of training at the beginning and introduction of using software applications and systems but most of the training was for a short time and they lack consistency. PD2, the director of assessment and examination directorate, expressed his view in this regard as:

'At the beginning of the OMR introduction for usage, the provider of the system from England came to Ethiopia and gave us training for only a day.'

On the other hand, PCTL1, the EMIS team leader, illustrated the issue of obtaining training as that he has trained for more than 10 days on the operational and technical areas of the software used by EMIS from UNESCO for more than three times.

Concerning the technical support from respective experts, most of the respondents forwarded their view and experience as that there are gaining technical supports specifically from the ICT team in the Bureau. PCTL3 illustrated the technical support she and her team members gained from ICT team of the Bureau as:

'We are using the DMS for simplifying the tasks concerning documentation issues. In case of any complexity and inconvenience we counter while using the DMS, we call for one of the ICT team members and hence we get relief on time'.

Regarding support from the administrative leadership, the findings revealed that the participants have not been obtaining support from their leaders even for challenges they were suffering from which can be solved if support from leadership exists. PD1 explained the existing lake of administrative leadership support and its importance as:

'Technology implementation is mostly not free from hindrances that need decisions and support from leaders now and then. Leaders on their part view technology implementation obstacles in general as to be solved by ICT experts and see it as the duties and responsibilities ICT experts. However, their support is vital if technologies are about to be implemented successfully hence contribute to organizational goals attainment.'

7. Discussion

To successfully implement technologies, institutions must address both the human needs and organizational issues that affect implementation (Surr & Ensminge, 2006). One of the models that consider the human needs and organizational issues in the process of implementing technology is the RIPPLES model which consist resources, infrastructure, people, policies, learning, evaluation, and support as elements of the model. The resource, financial resources, is one of the essential elements of the RIPPLES model which have a significant role to play to acquire, utilize, maintain, and upgrade technologies. The financial resource allocation trend by non-governmental organizations (funding from donors) was better than the financial budget allocation trend by the government for technology acquiring, utilization, maintenance, and upgrading issues in the Bureau which indicates that government has to give due emphasis to allocate sufficient budget if technology is about to be implemented effectively in the bureau.

Availability of the necessary infrastructures like hardware facilities, appropriate software, and network capabilities for technology acquiring, utilizing, maintaining, and upgrading needs to be considered for the effective implementation of technology. Promisingly, what was obtained from interviewing the participants of this study and from the observation revealed that a better situation exists in infrastructure availability in the Bureau when compared with the other components of the model.

People are the other significant factor for the effective implementation of technology in a given organization. The people within an organization play an essential role in the technology acceptance and implementation process. The needs, hopes, values, skills, and experiences of the people who will use an innovation play a vital role in deciding if innovation is successfully adopted [13]. In technology implementation process in the bureau, it was found that the needs, hopes, skills and experiences of workers to acquire and utilize technologies and the availability of technical experts who are capable to inculcate, maintain, and

upgrading technologies in the Bureau are meant to be at a good state of affairs.

Policy on the other hand is one of the prerequisites for the effective implementation of technology. Availability of clear and favorable institutional policies activates and its absence, on the other hand, hinders the proper adoption and implementation of technology in the educational institutions level and at the corporate level too. However, the findings of this study show that there are no policies in place in respect to technology adoption and implementation at the Bureau level which need to be available.

Regarding learning, as one component of the RIPPLES model, administrators should not view using technology itself as an end, rather as a means for accomplishing specific goals of an organization. The findings in this study also revealed that implementing technology for sake of implementation is not an end by itself; rather, technologies need to be implemented to accomplish specific goals of the Bureau and hence contribute to the enhancement and attainment of the regional education goals.

There must be a series of evaluations by respective bodies if effective technology implementation is about to exist. Accordingly, the findings from all the interviewed participants revealed that there are no sufficient evaluation trends in the Bureau while some technologies have been implemented for several years.

As one element of the RIPPLES model, support is one of the essential elements that affect the implementation of technology. In this regard, the availability of sort of trainings (both formal and informal) was found as moderate when compared with technical support by experts and administrative leadership support. The trend of technical support by experts on the other hand found as better and administrative leadership support has been found as the least activity by leaders in technology implementation processes.

In general, it was found in this study that all the seven elements of the RIPPLES model are equally important factors in enabling and otherwise hindering effective technology implementation. In light of these findings, it is necessary to consider all the components of the model equally if technology implementation in the Bureau is about to be effective.

8. Conclusion

The RIPPLES model was originally developed to study and identify the enabler and hinder elements of the model in technology implementation in higher education institutions. Based on the findings of this study it was concluded that the RIPPLES model can be applicable at the corporate level like Oromia Education Bureau to identify the enabler and hinder factors for effective technology implementation and helps to take appropriate measures to strengthen the enablers and alleviate the hindrances. It was also concluded that all the elements of the model are equally important and equal considerations need to be given by the Bureau if effective technologies implementation is about to exist.

9. Recommendations

For effective technology implementation at organizational settings level like Oromia Education Bureau, careful planning that equally considers all the components of the RIPPLES model and which can help to avoid many of the common problems associated with technology implementation is vital. In addition to the seven elements of the model, it was suggested that if an additional component 'Strategy' is indeed considered in advance and hence SRIPPLES would be the model that is assumed to be applicable for organizational settings and hence, technology implementation could be effective. The additional component, 'Strategy', shall incorporate some sort of steps: identifying the problem why the implementation of technology is needed by the organization, choosing the right technology which can be appropriate to overcome the already identified problem (s) in the organization, building a foundation for the proper implementation of the technology, determining the key performance indicators to measure performance of technology implementation and lastly testing for making it safe to use in real-life scenarios. In general, it was recommended that organizations like Oromia Education Bureau better to use the SRIPPLES model while planning to implement technology effectively to attain organizational goals.

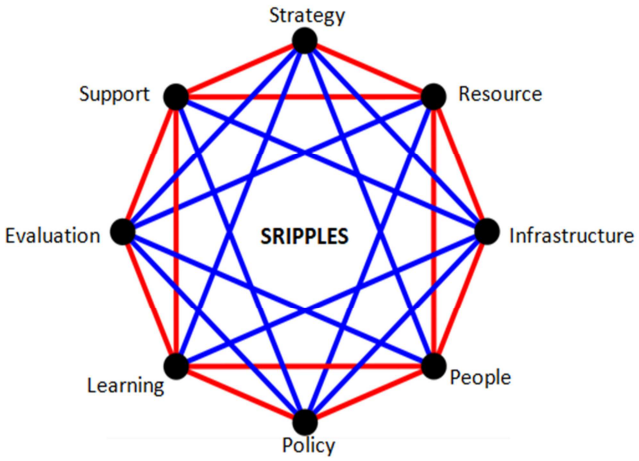

Figure 2. *The proposed SRIPPLES Model for effective Implementation of technology in Organizations (proposed by the author).*

References

[1] Avila, E. C., & Cabrera, H. I. (2021). ICT Competence, Organizational Culture, Motivation, and Task Performance among the Employees of One Polytechnic University Branch. *Journal of Physics: Conference Series*, *1933* (1). https://doi.org/10.1088/1742-6596/1933/1/012121

[2] Baruch, A., F & Ungar, O., A. (2019). ICT implementation in colleges of education: A framework for teacher educators. Journal of Information Technology Education: Research, 18, 207-229 https://doi.org/10.28945/4312.

[3] Creswell, J. (2012). Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative Research (4th ed.). (P. A. Smith, C. Robb, B. Matthew, & K. Mason, Eds.) Boston: Pearson Education, Inc.

[4] Nigussei Daba & Anteneh Tilahun (2015). An Assessment of Information and Communication Technology (ICT) Utilization Status in Sustaining Public Sector Reforms in Oromia Regional State, Ethiopia. Public Policy and Administration Research, 5 (7), 45-67.

[5] Ensminger, D. C. (2016). Technology Planning in Schools. In press, p. DOI: 10.1002/9781118736494.ch24.

[6] Ibara, E. (2014). Information and Communication Technology Integration in the Nigerian Education System: Policy Considerations and Strategies. 21 (3), pp. 5-18.

[7] Jibrin, M., Mustapha, S., & Rabi'u, M. (2019). Parametric Analysis of Inhibitors to ICT-Based Instructional Technology Adoption in Higher Educational Institutions in Bauchi State. Journal of Humanities and Social Science, 19 (6), 50-68.

[8] Momani, A., M., Jamous, M., M. & Hilles, S. M. S. (2017). Technology Acceptance Theories: Review and Classification. International Journal of Cyber Behavior, Psychology and Learning, 7 (2), DOI: 10.4018/IJCBPL.2017040101.

[9] Padmo, D., A. & Belawati, T. (2018). Implementing Sustainable ICT-Supported Innovation Policies: Case of Universitas Terbuka – Indonesia. In L. Hosman, & I. A. Lubin (Ed.), ICT-Supported Innovations in Small Countries and Developing Regions, Educational Communications and Technology: Issues and Innovations (pp. 121-137).

[10] Pavel, A., P., Fruth, A. & Neacsu, M., N. (2015). ICT and E-Learning – Catalysts for Innovation and Quality in Higher Education. Procedia Economics and Finance, (pp. 704 – 711 doi: 10.1016/S2212-5671(15)00409-8).

[11] Shaikh, S. A. (2019). Barriers to web-based education. IMPACT: International Journal of Research in Humanities, Arts and Literature (IMPACT: IJRHAL), 7 (4), 273-284.

[12] Shonfeld, M. & Goldstein, O. (2014). ICT Integration in Teaching and Teachers Training by Faculty Members in Israeli Colleges of Education., (pp. 2648-2653).

[13] Surry, D. (2002). A Model for Integrating Instructional Technology into Higher. Paper presented at the annual meeting of the American Educational Research Association.

[14] Surry, D., W. & Ensminge, D., C. (2006). Facilitating the Use of Web-Based Learning by Higher Education Faculty.

[15] Surry, D. W., Grubb, A. G., Ensminger, D. C., & Ouimette, J. (2010). Implementation of web-based learning in colleges of education: Barriers and enablers. Canadian Journal of Learning and Technology, 35 (3), 1–18. https://doi.org/10.21432/t22g6q