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## The SAMR Model and Bloom's Taxonomy as a Framework for Evaluating Technology Integration at University Level

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**Abstract:** *The purpose of this study was to find out the difference in opinions of the tertiary level teachers regarding technology integration in teaching. The study used a survey method. Participants for data collection were 14% faculty of Social Sciences, Engineering, and Computer Science which were sampled through the proportional stratified sampling technique. The study used a self-developed questionnaire in support of the SAMR (Substitution, Augmentation, Modification, and Redefinition) Model while coupling it with Bloom's revised taxonomy. Findings revealed that the opinions of both public and private sector teachers were better aligned with the study framework. A significant difference was found among teachers' perceptions based on sector (public and private). The study recommended integrating practical components or approaches to ICT usage in training programs and workshops introducing new teaching models and techniques.*

**Key Words:** SAMR Model, Blooms' Revised Taxonomy, Technology Integration, ICT (Information and Communication Technology)

### Introduction

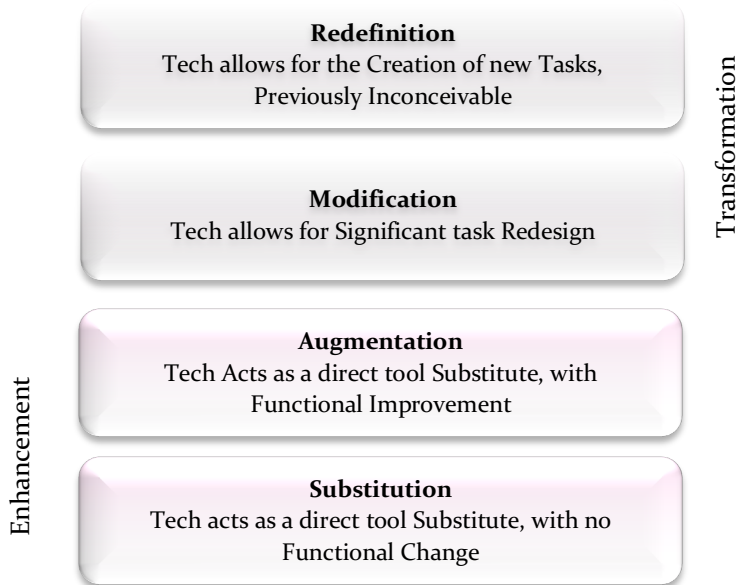
The pedagogy of integration in ICT is commonly mentioned as a method that can make good use of technologies related to information and communications in the teaching-learning process. There are many ways to use these technologies through various tools, e.g. smartphones, T.V. radio, conferences on video, technologies for Web 2.0, CDs/DVDs and internet, etc. The technology integration process is performed in the process of learning through numerous ways; this process is based on the availability of the tools of ICT and teachers' understanding of integration. According to SAMR Model (Puetendura, 2010), these technologies lead to pedagogy as the technology

adoption such as having a direct substitute tool have no change which is Substitute Level, direct substitute tool having useful enhancements (Augmentation), re-designing the instructional tool that is Modification Level and a tool to create new tasks that are unimaginable earlier (Redefinition). The understanding of integration and accessible tools are the base of all these stages. For example, if the model is to be practised, using substitution measurement, to produce documents, the replacement of typewriters were computers, yet there was no prominent change in their function.

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**Figure 1:** SAMR Model (Puetendura, 2010)

In the previous era, the higher education institutes integrated these technologies as improvement tools (substitution and augmentation) for the educational procedures. Though the faculty that used these techniques for the teaching-learning process, the improvements were not even equal to satisfaction level (Tusubira et al. 2006). For these kinds of situations, the causes could not be easily defined as there is no significant sign or it is not obvious if there is any because it was not revealed and never contains involvement which could help to change the situation. Apparently, for maintainable social and economic progress, these technologies are complex drivers. According to the World Bank report, it was suggested that the status of higher education needs innovative methods in support of attaining the millennium goals. At any level, the learners and teachers must be allowed by the pedagogical system to get an advantage by using these techniques for educational objectives (Postman, 1993; Seels & Richey, 1994).

In today's institutes, The Common Core State Standards demands to produce digital literacy and the skills of 21<sup>st</sup> century for students. More importantly, students must have an awareness of using these techniques to attain knowledge, study and evaluate data, discover and draw outcomes, and test theories. More precisely, they must know

about applying their learning in real-life situations. They must have a critical and creative observation to move towards a progressively digital world securely and to conduct significant research to get understanding by discovery. (Ely, 1999; Anastasiades, & Zaranis, 2016).

### Literature Review

The purpose of the review literature is to initiate the requirement of descriptive study to examine faculty perceptions of ICT usage, together with best practices, professional growth, and the level of engaging teachers in activities related to ICT that are planned at modification or redefinition stages which improve the skills of 21<sup>st</sup> century. Many sources like ERIC, ProQuest, Google Scholar, professional journals, dissertations, reference books, scholarly periodicals, and Internet searches are included in the literature review.

Educational patterns are changing by including ICTs in classroom activities and allowing students to keep connected with the internet. The portability of these technologies is making them highly helpful in production and learning. These technologies offer teachers to get continuous chances to increase their knowledge and work on their interests (Johnson et al., 2013).

The increasing number of using ICT(s) together with the extraordinary development of these technologies for education has formed countless chances ([Johnson et al., 2013](#)).

At the substitution level of the SAMR model, it is mentioned that there is no such effective charge as internet browsing or word-processing. The level of technology is signified as a substitute by augmentation, yet by having some purposeful developments like the association with students through utilization of a Google Doc or by offering a project with the usage of Prezi. Modification indicates the level of technology that offers to reform substantial tasks, e.g. for the comments of students, to create a podcast, and then post it on YouTube. The level of technology which is implied by redefinition is the permission of creating new tasks that are impossible in the absence of technology; it can be defined with the following examples; use of GarageBand in producing an iMovie for a documentary. As per [Romrell, Kidder, & Wood \(2014\)](#), if teachers use mobile devices for classroom learning, then the exceptional kind of learning activities would be identified that can be modified, located, and let students involved in such activities.

### **ICT Learning has become too useful to Ignore**

ICT can be explained by the learning that can be personalized, located, and connected by using ICT(s). In most of the researches, the centre of attention is on the advantages of selecting proper technology and its use. Therefore, educators and instructional inventors must have an awareness of using ICT(s) in the improvement of learning. Nowadays, Information and Communications Technologies fulfil the same tasks as they did earlier. The implementation of this stage signifies the lowest stage of the SAMR Model ([Puentedura, 2013](#)). Its framework can guide to decide while evaluation of potential instructional designs which use ICT. On the contrary to the SAMR framework, activities related to these techs were measured to regulate as if their design was done at modification/redefinition stages to improve the skills of the students of the 21<sup>st</sup> century ([Traxler, 2009](#)).

Transformational learning is offered by the instructional activities, which are among the highest level of the SAMR framework. In addition, [Durham, Morrison, & Ross \(1995\)](#) found that

teachers are needed to be qualified in the SAMR model and should be well trained in utilizing mobile devices for useful instructions in the classroom. According to the outcomes of professional growth, the integration of proper classroom technology helps teachers to use technology for the enhancement of the learning of students. Eventually, [Pilgrim et al. \(2010\)](#) mentioned that integration of technology relies on the SAMR model, which demands preliminary and constant professional development for the sake of instructional events which should be applied usefully in the classroom. The strategy of the literature review involved a list of main terms to bound its scope. The well-known keywords comprised of learnings associated with ICT, such as integration of ICT, digital learning, transformational learning activities, student-centred learning, problem-based learning, modified learning, situated learning, constructivism, traditional versus progressive education, student engagement, student autonomy, individualized instruction, 21<sup>st</sup>-century skills, common core, globalization, entrepreneurship, TPACK, and SAMR ([Durham, Morrison, & Ross, 1995](#); [Morrison, Lowther, & DeMeulle, 1999](#)).

[Tondeur, Van Braak, Ertmer, & Ottenbreit-Leftwich, \(2017\)](#) mentioned that there are many reasons for teachers' thinking about not feeling comfortable with the technology integration in their classrooms, as in the level of technology, the key issue is to provide professional growth to teachers. In the classroom, teachers are required to know that they are fully prepared for the implementation of technology precisely.

The main focus of previous researches was on examining skills needed in the 21<sup>st</sup> century, common principles, critically implementing the technology, the analysis of globalization, and the autonomy of students and entrepreneurship afterwards. The background of the study discovered the activities in association with ICT that are developed by teachers of higher institutions nowadays. Furthermore, compatible with the framework of SAMR, these activities are evaluated and measured to find the integrated technology stages (substitution, augmentation, modification, and redefinition) and also to explore whether ICT based activities help in transforming learning and developing the skills of the 21<sup>st</sup> century ([Laurillard, 2002](#); [Zaho, 2009](#)).

[Christensen et al. \(2017\)](#) suggested that in advance, instructional changes include education paradigm change which creates technology and probably needs an implementing action plan further. In reality, teachers must be aware of incorporating technology usefully in the classroom with the implementation of instruction-based activities that encourage technology usage.

According to [Wagner \(2015\)](#), most people admit the significance of the four C's: critical thinking, communication, collaboration, and creative problem-solving, yet he suggested that every day, the skills of the 21<sup>st</sup> century must be taught and assessed in each class. These skills should not replace the content knowledge. Instead, selecting academic content in the creation of the necessary basis of lifetime learning also keeps in search of content to cover the progress of fundamental competencies ([World Bank, 2002](#)).

### **Instructional Activities Based on the SAMR Model**

According to [Green \(2014\)](#), the SAMR model was presented by Dr. Ruben Puentedura (2006), which was had extreme popularity. There are several levels of technology tools that are defined by the SAMR model, including their utilization methods in the classroom. [Romrell, Kidder, & Wood \(2014\)](#), presented a framework that was provided to the teachers and educational designers in which it is discussed that how to create learning skills by using the devices of technology in the classroom and what would be the level of learning which requires an activity to perform.

[Romrell, Kidder, & Wood \(2014\)](#) found that students need an opportunity for the utilization of advanced levels of critical thinking with the help of designing and creating; it would allow the improved engagement of students, including modernization in the classroom. By taking advantage of the SAMR model, it becomes easy to focus on the effect of technology-motivated and instruction-based activities of teaching, learning, and engaging students in the classroom ([Minshew, Caprino, Anderson, Justice, & Bolick, 2014](#)). [Amer & Ibrahim \(2014\)](#) suggested the measurement of the degree of technology integration is possible by the SAMR model in the classroom, as it can spread by the activities which are enhancing the present material by teaching it

to develop and format the current notions, tasks, and exercises.

[Chell & Dowling \(2013\)](#) stated the SAMR model is capable of helping teachers in classification, as with the help of technology-driven and instruction-based activities, students can think critically at its higher levels. In the SAMR model, it is explained that integration of technology is rapidly happening in the classroom without leaving behind any level of developmental learning process neither any concepts that are needed ([Jude et al., 2014](#)). A study conducted by [Abdullah, Siraj, Asra, and Hussin \(2014\)](#) it is revealed that an instruction-based activity that lays beyond the level of substitution can never be possible in the absence of available aids and technology as it cannot provide the highest rate of students' academic succession.

[Hockly \(2016\)](#) opinioned about the proposal of the SAMR model; it was created to find the difference among technology-driven instruction-based exercises that have a focus on the content consumption (substitution level) and the activities that have a focus on new learning activities formation which help form the content (transformation level).

[Romrell et al. \(2014\)](#) discovered that that transformational learning exercises are linked, located, and modified by the usage of the technology devices and are used more than a replacement tool instead. Teachers can distinguish instruction according to the phases of the SAMR model after designing learning exercises.

According to [Romrell et al. \(2014\)](#), by distinguishing the instructions, numerous teachers could make good use of technology in the classroom as it permits students in understanding material and notions derived from different modified perceptions. For every student, the level of content difficulty can be initiated through teachers by utilizing some technology devices that let every single person work on their own, on which the distinguished instruction relied.

[Jude et al. \(2014\)](#) have identified the utilization of such activities, which lie under augmentation level. From the study of technology-driven instruction-based activities, a few examples are combined that occur in the classroom, such as; to make easy the debated and teamwork in-class use a blog, to share a document using Google docs,

and utilization of videos to support the idea of teaching in the classroom. Skype was found the most influential tool of research that most of the time falls under augmentation level but is used very often due to the unawareness of teachers and students.

Activities used by teachers at the augmentation level were mostly performed by the students, and for students, these activities are helpful in the process of learning through the presentation of topics and ideas diversely. Furthermore, on a deep-sea diving tour, Pfeiffer, [Gezgin, Adnan, & Acar Guvendir \(2018\)](#) has separated the class into two groups. During snorkelling, one group was tasked to use a paper guide of diverse kinds of fish and the other to use a portable DVD player having images, video, and audio of multiple fish kinds, that the students would get to see during snorkelling. In conclusion, for the post-test, the students achieve a higher score for utilizing a DVD player as a display, as for using the DVD player portable guide. It has shown slighter improvement by using the DVD player by which a useful development was observed and added in the process of learning. [Keane, Keane, & Blicblau \(2016\)](#) informed that redefinition is considered the hardest level probably for the description of society which is continually redefining the meaning of advanced technology.

### **The SAMR Model and Bloom's Revised Taxonomy**

SAMR model can be related to Bloom's revised taxonomy ([Anderson, & Krathwohl, 2001](#)), a concept commonly used in cognitive learning. SAMR model has previously been implemented at the higher education level. The major advantage of SAMR is to enhance collaboration, interaction, and motivation. However, integrating the SAMR model with Bloom's revised taxonomy can enhance its concept and enable teachers to understand more about technology integration.

The eminent and widely used concept of Bloom's taxonomy of educational objectives ([Bloom, 1956](#)), in which three phases were presented and named as cognitive, affective, and psychomotor. The cognitive domain was further divided into six categories, each category

indicated by a noun, i.e. knowledge, comprehension, application, analysis, synthesis, and evaluation. Anderson & Krathwohl (2001) presented a revised version that also included affective and psychomotor domains. Researchers explained the new cognitive version, which equally mentioned six categories but placed them in a different order at the two highest levels and indicated them by verbs instead of a noun, which reflected accurate and more active form of thinking, i.e. remember, understand, apply, analyze, evaluate and create.

Considering technology-based learning, [Churches \(2010\)](#) introduced the unique concept of Bloom's Digital Taxonomy and Collaboration. This concept was based on Bloom's revised taxonomy by Anderson & Krathwohl (2001). This concept was adjusted to modern technology and its implementation into educational settings. The author presented a separate column for communication which he considered a vital capability holding the teaching and learning process. Churches provided a wide range of ICT-enhanced activities which suit the learners of several individual learning styles.

### **Research Questions**

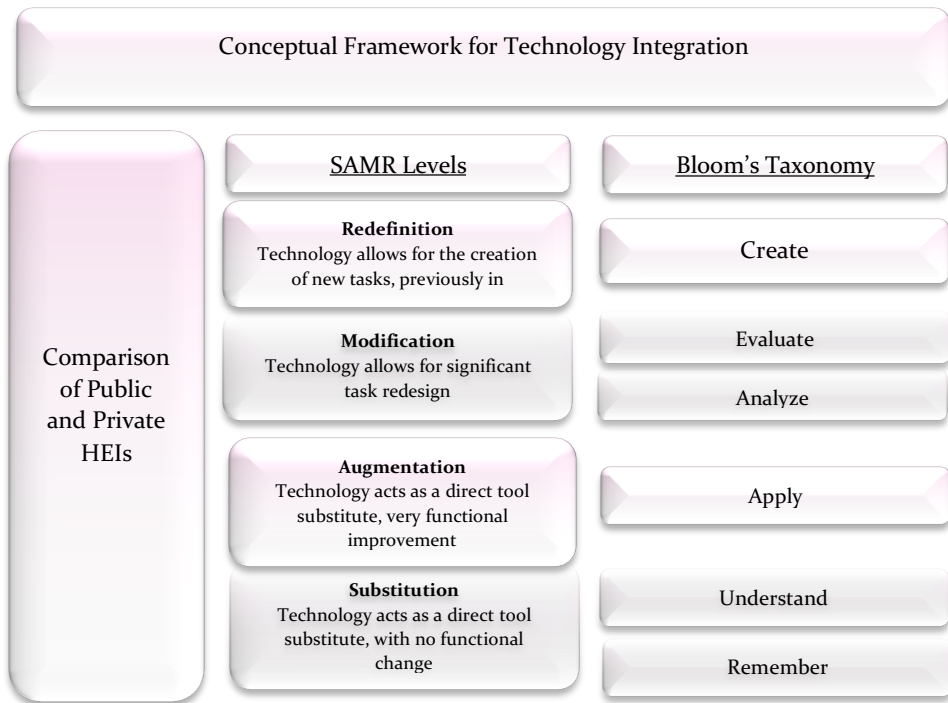
1. What is the status of teachers' technology usage at tertiary level education?
2. Is there any sector base difference in technology usage of teachers at tertiary level education?

### **Objectives of the Study**

1. To determine the teachers' technology usage at tertiary level education.
2. To investigate the difference in technology usage of public and private sector teachers at tertiary level education.

### **Conceptual Framework of the Study**

The conceptual framework of the study is based on the assessment of teachers' technology usage of public and private sector teachers through the SAMR model ([Puentendura, 2010](#)) while coupling it with Bloom's revised taxonomy ([Anderson, & Krathwohl, 2001](#)).



**Figure 2:** Conceptual Framework of the Study

## Methodology

The present study was descriptive, and a quantitative research design was used to conduct the study.

## The Population of the Study

The population of the study comprised 4233 tertiary level teachers teaching in seventy-one public and private sector universities of Punjab, which also include main and sub-campuses of institutions. The population of the study was divided into two major strata, which include 2554 public and 1679 private teachers.

## Sample and Sampling Technique

To acquire an equal proportionate sample from two strata (public and private), the study used a stratified random sampling technique. [Cohen et al. \(2013\)](#) suggested a sample size of 536 for the population count up to 5000 at a 95% confidence interval. Therefore, 14% sample from each stratum was selected. The process ends up taking 593 faculty members from selected universities which

include 358 public sector teachers and 235 private sector teachers, as a sample of the study.

## Research Instrument

A self-developed questionnaire based on the conceptual framework of the study was used. The questionnaire consisted of 48 items which were divided into four major factors of the SAMR model, namely substitution, augmentation, modification, and redefinition.

The validity of the instrument was ensured through educational experts. For the reliability test of the instrument, 100 participants (other than actual participants of the study) of the tertiary level were selected. The questionnaire was found reliable through assessing the value of Cronbach's Alpha, i.e. 0.81. The reliability value of subscales, namely substitution, augmentation, modification, and redefinition, was 0.77, 0.79, 0.81, and 0.76, respectively.

## Data Collection

Data has been collected through personal visits and google forms (while considering the health

SOPs) from the targeted respondents. A total of 593 questionnaires were distributed among respondents. The response rate is depicted in the table given below.

**Table 1.** Response Rate

Sector	Total Sample	Return Rate	Return %	Response Rate
Public Sector	358	340	95%	
Private Sector	235	212	90%	93%
Total	593	552		

Table 1 shows the return rate of the questionnaires; 340 public sector and 212 private sector respondents properly filed and responded to the questionnaire. Therefore, the overall response rate was 93%.

### Data Analysis

The data were tabulated and analyzed by applying appropriate tests such as mean, Standard deviation, and t-test statistics. Data analysis, along with tables and descriptions, is presented in the results section.

## Results

**Table 2.** Technology Usage Practices of Teachers at Tertiary Level

Dimensions	N	Mean	SD
Substitution Phase	552	3.41	0.77
Augmentation Phase	552	3.35	0.78
Modification Phase	552	3.55	0.75
Redefinition Phase	552	3.65	0.74
Total	552	3.51	0.65

Table no. 2 indicates faculty response regarding their technology usage phases at the higher education level. In the first phase of technology usage, i.e. 'substitution phase', the respondents indicate that the faculty focuses on the substitution phase (Mean score = 3.41), whereas on the second phase, i.e. augmentation phase, respondents indicate that the faculty at the higher education level also focuses on the augmentation

phase (Mean score = 3.35) when inquired faculty views about the modification phase, most of the respondent claim that the teachers focus on the modification level (Mean score = 3.55). The last dimension of the study indicates that faculty have greater concerns at the redefinition level (Mean score =3.65). Overall mean score (Mean = 3.51) indicates that in most cases, faculty focus stays on all technology usage phases effectively.

**Table 3.** Technology usage of Teachers (Comparison between Public and Private Sector)

Variable	Sector	N	Mean	t	df	Sig (2-tailed)	Cohen's d
Technology Usage	Public	340	3.41	3.95	550	.00	0.34
	Private	212	3.69				

T.I= Technology Integration

Table no. 3 shows t value (3.95) was statistically significant at a 5% level of significance. There exists a significant difference between the public and private sector teachers regarding their technology usage practices. The mean score of the private sector faculty (Mean score = 3.69) is higher as compared to the mean score of the public sector

faculty (Mean score = 3.41). The effect size was found at 0.34, which shows the medium effect size between the two means.

A commonly used interpretation is to refer to effect sizes as small (d = 0.2), medium (d = 0.5), and large (d = 0.8) based on benchmarks suggested by Cohen (1988).

**Table 4.** Phases of Technology Usage (Comparison between Public and Private Sector)

Phases of Technology Usage	Sector	N	Mean	t	df	Sig (2-tailed)	Cohen's d
Substitution	Public	340	3.41	2.64	550	.00	0.25
	Private	212	3.55				
Augmentation	Public	340	3.53	3.38	550	.00	0.44
	Private	212	3.70				
Modification	Public	340	3.45	4.77	550	.00	0.71
	Private	212	3.68				
Redefinition	Public	340	3.40	3.41	550	.00	0.53

Table 4 shows that in the first phase of technology usage, the  $t$  value (2.64) is found significant at a 5% level of significance. It shows that there exists a significant difference between public sector respondents and private sector respondents at the 'substitution phase'. Private sector response (Mean score = 3.55) is found better as compared to the public sector faculty respondents (Mean score = 3.41). The effect size was found at 0.25 that shows the small effect size between the two means.

In the second dimension, the  $t$  value (3.38) is statistically significant at a 5% level of significance. It shows that there exists a significant difference between public respondents and private sector respondents at the augmentation phase. The mean score of private-sector faculty teachers (Mean score = 3.70) is found better as compared to the mean score of public sector faculty teachers (Mean score = 3.53). The effect size was found at 0.44 that shows the medium effect size between the two means.

In the third dimension, the  $t$  value (4.77) is statistically significant at a 5% level of significance. It shows that there exists a significant difference between the response of the public sector respondents and the private sector respondents at the 'modification' phase. The mean score of private sector respondents (Mean score = 3.68) is found better as compared to the mean score of public sector respondents (Mean score = 3.45). The effect size was found at 0.71 that shows the large effect size between the two means.

In the final dimension, i.e. redefinition, the  $t$  value (3.41) is statistically significant at a 5% level of significance. It shows that there exists a significant difference between the response of the public sector respondents and the private sector respondents at the 'redefinition' phase. The mean score of private sector respondents (Mean score = 3.61) is found better as compared to the mean score of public sector respondents (Mean score = 3.40). The effect size was found at 0.53 that shows

the medium effect size between the two means.

## Discussion

The study results revealed that faculty members are using technology in the teaching process on all four dimensions of the SAMR model and, most importantly, the level of modification and redefinition. These findings are aligned with the study conducted by [Romrell et al. \(2014\)](#) on applying the SAMR model to recently conducted researches; they presented mobile learning activities that were aligned with the classification of the SAMR model. The study found that designing instructional activities based on the SAMR framework has a greater chance that activities may fall in the highest levels of the model. The instructional activities that have the potential to modify or redefine traditional instruction can also transform the learning process. A study conducted by [Jude et al. \(2014\)](#) determined the technology adoption of university teachers in educational settings and found similar results. They also suggested some key areas that could help teachers to integrate the SAMR model in their learning process, which mainly involve the skills and knowledge in educational technologies. Results are in line with the study conducted by [Patton \(2015\)](#), which showed that during initial technology integration, most of the learning activities would fall on the lower two levels, i.e. substitution and augmentation. Participants of the study were mainly practising technology-driven activities at the lower two levels collectively called enhancement level. But with professional development and collaboration, teachers would be able to integrate more learning activities at the higher levels, i.e. modification and redefinition. [Hilton \(2016\)](#) conducted a case study to assess the SAMR and TPACK models and found that the SAMR model can easily be connected with the student-centred design, and each learning activity can easily be examined for specific learning opportunities. The study also found that SAMR

was the easier model and provided opportunities to modify future learning activities.

Significant differences were found regarding the technology usage of teachers of the public and private sector at tertiary level education. These results are aligned with the survey conducted by [Netolicka & Simonova \(2017\)](#) on tertiary level teachers in which a significant difference was found between teachers teaching at different sectors of education. The study found that both the SAMR model and Bloom's revised taxonomy of educational objectives develop the key competencies of teachers. [Aprinaldi et al. \(2018\)](#) found the same results while applying the SAMR model in vocational education, which indicated that the SAMR model uses hierarchy to describe the cognitive level and coupling or parallel use of this model with Bloom's taxonomy can also be possible since both share the identical levels.

In the present study, with the help of faculty-reported responses, it was further found that private-sector teachers are more competent in integrating technology in educational settings as compared to the public sector teachers. The results of the present study are in line with the study of [Caukin & Trail \(2019\)](#), which found a significant difference in the teachers designing the instruction. The study found that some learning activities are best suited for the lower two levels of the models and do not need improvement to the transformation level. [Nyayu et al. \(2019\)](#) also found that teachers effectively used the SAMR model in integrating technology in learning. The present study reported that private-sector teachers are more efficient in integrating technologies in teaching. It is due to their frequent involvement in the training programs and professional development practices.

## **Conclusion**

Both the SAMR model and Bloom's revised taxonomy support the growth of key competencies related to technology usage, especially the work with information, communication, collaboration, team cooperation,

assessment, and various others. The model is considered a helpful tool and step forward in the implementation of technology usage into the process of teaching and learning. The model aligns the single processes; they support each other to create a strong concept of technology integration in teaching.

The study concluded that usage had been successfully applied both in public and private sector institutions. In most cases, tertiary level teachers focus on the redefinition level, i.e. the highest level of the SAMR model. Comparison related to public and private sector teachers revealed that private sector teachers have a slightly better competency in technology usage while teaching. There exists a significant difference among tertiary teachers by sector regarding their perception of technology usage. Private sector teachers while using technology were found at a higher level as compared to the public sector teachers. A significant difference was found among tertiary teachers by sector on the modification and redefinition of the dimensions.

## **Recommendations**

It is recommended that both public and private universities may propose different types of training in using new devices. Despite the tertiary level teachers being digital natives, the training modules may focus on educational activities which require slightly different skills. Latest developments are frequently emerging in ICT; therefore, it is necessary to expose teachers to the updated learning content. While enforcing different policies, the higher-level institutions must ensure positive change through the pedagogical usage of ICT. It is further recommended to integrate practical components or approaches to ICT usage in training programs and workshops introducing new teaching models and techniques. In the future, researchers may incorporate demographical differences such as gender, socio-economic background, etc., with larger sample size.



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