Psychodynamics in Information Communication Technology and Perception of Science Teachers and Students: Evidence from Karachi

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Abstract

Pedagogic life in the twenty-first century has embraced many impeding changes and advancement and college teaching has equally endeavored to embrace such advancements. Information and communication technology (ICT) has had a great impact on teaching and learning methodology of Grade XI Physics. Learning the subject contents of Grade XI Physics has been an arduous task for most college students in Karachi. It is also noted that ICT-based Physics education enhances the professional development and performance of the teachers who teach the contents of Sindh Textbook Board. Articles, problem-solving questions, derivations and other concepts in physics seem difficult to comprehend to many science group Grade XI students. The introduction and use of ICT in teaching and learning Physics for teachers and students seems to have made teaching interesting for many teachers. This paper looks into such assumptions and examines the extent to which ICT can make significant contributions in promoting effective teaching of Grade XI Physics. A random sample of n= 149 colleges was drawn from the colleges listed with the Sindh region located in the city of Karachi. The study finds significant impact of ICT on teacher's professional performance and draws the conclusion that ICT-based teaching of Grade XI Physics can enhance the performance of students and teachers.

Keywords: Information Communication Technology, Second Level Support Service

Introduction

The application of ICT in teaching and learning Physics is considered as learning and teaching tool. Not only Grade XI students, but also teachers reckon ICT has impact ted significantly on the learning and teaching behaviors of all stakeholders. ICT helps to acquire conceptual knowledge and pedagogy of Physics. The recent researches have proved that with the help of ICT, the complex and difficult theories and phenomenon can be understood easily. Adeyemo (2010) indicates that ICT has great impact on teaching and learning of Physics. The introduction of ICT makes learning of Physics more interesting and facilitates understanding. Physics is that branch of science which deals with the matter and its interaction with the other matter. Simply, it deals with understanding of the natural world.

Physics and technology are very much integrated with each other because technology aims to apply to develop understanding to man-made world and it is considered as the offspring of Physics. The foundations of modern technologies that are World Wide Web, Superconductor, Semiconductor, the Telecommunication, and Information and Communication technology helps to understand the basis of Physics easily. The defined problem is stated in following words. This research was based on the variables that comprise performance of Grade XI physics students as dependent variable and the instructional framework with ICT inclusion as the

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independent variable. Other variables were age, I.Q, height, BMI, tuition fee, past Physics performance, years of teaching experience and teacher's Socio-economic status.

The research question of the study was whether or not ICT-based teaching of Physics can significantly increase the performance of Grade XI Physics students. The main aim of this study is to determine the extent of successful orientation of the application and analysis of application of ICT in teaching and learning Physics at colleges in Karachi. Physics is a branch of science that deals with matter and its interaction with the other matters. It is observed that students cannot understand its complex and scientific phenomena's easily. The application of ICT in teaching and learning Physics becomes easier to understand. With the help of ICT, it is possible to develop and design teaching material with different animations and slides which can be helpful for the students. The study is beneficial to the Grade XI students and teachers, policy makers of Grade XI curriculum, parents of Grade XI students and the heads of institutions of such colleges. This study is restricted in the context of Karachi only so it must not be generalized beyond the scope. The basic assumptions of the study were that ICT-based Physics education is more effective as compared to traditional way of teaching. ICT generates more content-based interest among the Grade XI students for learning Physics.

Review of Literature

Developing countries can overcome the barriers of potential and capacity in terms of equity and redress' application of ICT (information and communication technology) in their education system.(South African Department of Education, 2003). The use of Information and Communication Technology (ICT) in learning and teaching Physics allows teachers to accelerate the purpose of understanding the contents. By the use of Information and Communication Technology in learning and teaching Physics, teachers are likely to transfer knowledge, build confidence in the students, develop skills easily long before the risk involved in the learning process (Eliot Eisner 1998:105). With the help of ICT, physics teachers can also perform research by means of creative writing. On the other hand, ICT does not atomically add quality in teaching and learning science subjects specifically Physics. According to Tasouris (2009), Physics teaching is based on the theoretical content and laboratory activities so it depends on teachers how they decide how to integrate ICT in their class rooms lectures because some of the Physics teaches consider ICT as a supporting tool for teaching because it is helpful to improve the learning capability of students. Adeyemo (2010) did a study in which questionnaire was used as an instrument to study the impact of Information and Communication technology on teaching and learning questionnaire (ICTITLQ). The findings of the research indicate that ICT have great impact on learning and teaching of Physics.

Vavougios & Karakasidis (2008) investigated the impact of ICT on teaching and learning of Physics. The respondent uses a group of students and teachers randomly. Three null hypotheses with a significant level of 0.05 were postulates. The information and communication technology impact on teaching and learning questionnaire (ICTIT LQ) was used as an instrument for this research. The research finding based on suggestions and recommendations shows that Information and Communication Technology has great impact in learning and teaching Physics because it makes it interesting. Regan (2008) reported about a survey which was held under the 'Second Level Support Service (SLSS).

Kirkwood & Price (2005) presented an article about the experiences and attitude of teaching and learning physics. In this article, the investigators discussed the issues of instructional designers and teachers about the introduction of ICT at higher education especially for those

teachers who use a stretchy and new learning approach for the improvement of students' knowledge and quality. Gustafsson (2004, 2005 & 2002) on the other hand, presented his papers about the inclusive physics education. In this paper, it is clear that the influence of distance learning in Physics teaching at a university is advantageous for both students and teachers because it is noted from the early studies that cooperative work between teachers and students creates a constructive control on teaching and learning Physics. Mji & Makgato (2006) presented a paper focused on the factors with was associated with the poor performance of high school learners' in Mathematics and Physics. Smeetsse, Mooii, Bamps, Bartolomé, Lowyck , Redmond & Steffens (1999) also presented a wonderful case of teaching students the contents of science lesson in an effective manner.

Wheeler (2006) discussed about the available opportunities for Physics teaching in local context. According to the researcher, Physics teachers sets the subject with respect to their local context so that the students can understand it easily and provide the opportunities to enhance their practical skills which is not easily possible in the laboratory and class room, so that the best possible way is the application of ICT in teaching Physics to develop the understanding with respect to the local context. According to experts in Physics, Information and Communication Technology (ICT) has now become the fundamental block of modern society so that many countries now introduce the basic skills and concepts of ICT as an elementary (core) part of their education system. Various new models of teaching are now introduced in response to the new opportunities in terms of integrating ICT for teaching Physics. The most significant object is that the effective integration of such type of application depends upon to large extent on the teacher's familiarity and working ability with the ICT-based learning environments.

Science teachers must be aware about the use of ICT as a teaching tool. Thurmond, Wambach, Connors & Frey (2002) evaluate Physics students' fulfillment by shaping their characteristics in terms of the impact of web-based environment. The finding of this evaluation was based on the virtual learning environment such as e-mail, computer software's and their applications, computer conferences, group chatting, on line discussion, video conferencing and several web-based environments etc. Petrides (2002) conducted a research study on the Web-based technology such as ICT for the distance learning students. The researcher investigated the effect of suing these modern technologies as a supplementary education on the learning behavior of college enrolled students who attend their classes as on online teaching based environments.

Simmons (2005) delivered a lecture on 'Curriculum Integration in the Teaching of Physics to First Year Engineering Students' at 'International Conference on Engineering Education – (ICEE)'. According to researcher educational research (ER) has been pointing out the importance of new approaches such as the application of ICT in learning and teaching physic in Higher Education (HE). Due to the significance of ICT in teaching physics, a number of papers have been published. Scientific literature represents the importance of ICT in teaching and learning physics so that computer becomes a pedagogical aid for teachers because with the help of computer, a teacher shows slides, different animations, photographs, projections, sound etc to make their lesson interesting and more attractive. With the help of ICT teaching, teachers can also observe students' activities during the lecture.

According to experts in teaching of Physics, ICT can be used to enhance the capability of students for learning Physics. It can be utilized to develop and strengthen physics students' learning too. In addition, ICT is also able to enhance Physics students' pedagogy in many ways as it can be used effectively as cognitive tool for teachers' and learners' s. Researchers also agree that the students who use computer for their preparation have greater conceptual gains and more

knowledge for integrating their concepts compared to those students who use their text books and concentrate to solve academic problems of same topic. Jarosievitz (2017) studied the students' attitude in terms of their motivation and ICT based-skills for physics learning with the help of a questionnaire. The study found that learning capability of science students can be increased through effective use of ICT. They tend to perform better in comprehension, structure of knowledge and application of their skills in learning Physics. The application of ICT in teaching and learning science subjects especially Physics is more result-oriented with the help of ICT and multimedia such as presentations, animations etc.

Research Methodology

According to an expert in educational research, quantitative research methods are based on testing of hypotheses and numerical data collection. The research methodologies used for this study was a survey using a questionnaire. The sampling for this method of research was based on an assumption that a survey would respond more accurately than a mere experiment with few science students in specific circumstances. The present study is based on how the data is presented rather than how it is based on the issues of paradigm and not on the realty based assumptions of nature. The questionnaire of this research is used as a guideline for the study.

Target Population

The target population of this study comprised all Physics teachers and students teaching and learning the contents of Grade XI Physics of Board of Intermediate Education Karachi. The basic reasons to select this population are as follows:

- All students study the same subject contents of Physics al over the city at Grade XI in formal classes.
- All participants study the subject at least once every day in their formal classes.

The objective of the researcher was to test the hypothesis pertaining to the target population, the teachers of colleges and higher secondary schools were the focus of this study. As this research was based on quantitative research methodology, therefore the permission granted by the officials of the different colleges and higher secondary schools of Karachi region were ensured. For the fulfillment of the research, the researcher visited different colleges of the city.

Samples and Procedures

The sampling technique of this study was simple random comprising public and private colleges and Higher Secondary Schools. A random sample of n=149 colleges located in the 18 towns of Karachi were selected. The reason to select this population was based on cost implication and availability of Physics teachers. The principals and the head teachers of the Physics departments of the sampled colleges helped the researcher to distribute and collect the questionnaire at their respective colleges. All the selected teachers of Physics voluntarily filled the desired questionnaire. The prior information which was available during this research was that it was observed that most of the students faced difficulties in learning and understanding Physics in normal teaching methodology. The main characteristics of participants were:

- All the student participants were enrolled in regular programme of Grade XI Physics.
- All the teaching participants were regular faculty member of colleges operating in Karachi.

- All the participating students took Physics classes daily.
- Almost all the teachers of Physics had obtained their major degree in Physics.
- Ages of all teachers of Physics were in the range of 34 to 40 years.

Instrument Development

The questionnaire used in a survey research must be appropriate needs to be economical and it must ensure anonymity, especially when it is dealing with a large sample. On the basis of careful consideration of the available questionnaires based on the literature review and hypothesis, the researchers developed the questionnaire for the study. The instrument needs to be closed-ended because it is easy to answer specially when the sample is large and so many items are to be responded to. To determine the scores obtained from the participants, a five-option 'Likert scale' was used. The instrument used in the present study comprised the following sections:

a. Demographic Information:

The first section requested the respondents' demographic information such as age, gender, name of institute, the class taught, qualification, subject specialty, teaching load, length of physics periods, Grade level, teaching experience and their benefits.

b. Teachers Perceptions:

The second section was based on teachers' perception with different items and options such as strongly agree, agree, neutral, disagree, and strongly disagree.

c. Analysis of Questionnaire:

Lastly quantitative analysis was based on the application of statistical tool using independent smaple t-test.

Research Hypothesis

Hypothesis 1

There is no significant difference in the perception of public and private sector Grade XI physics teachers on the basis of effectiveness of ICT in teaching Physics.

Hypothesis 2

There is no significant difference in the perception of Grade XI male and female physics teachers on the basis of project development performance of ICT in teaching physics.

Hypothesis 3

There is no significant difference in the perception of Grade XI public and private Physics teachers on the basis of performance of students' taught who are taught Sindh Textbook Board.

Instrument Reliability

If the primary instrument provided same result of any research questionnaire it's known as 'Instrument reliability'. It was estimated by applying statistical measuring tools. The respondents' physiological sharpness in responses to the items in the instrument must be

consistent. To check the reliability of the instruments, the researchers applied statistical tools using Cronbach Alpha. Table 1 shows the cross product summery for the instrument reliability.

Table 1: Reliability Statistics

Reliability Statistics

Cronbach's Alpha	N of Items
.746	21

Instrument Validity

Instrument validity explains the extent to which a research instrument designed to collect data serves the purpose for which it was created or designed to do so. It must measure what it is supposed to measure. To establish the validity of any question sent for an expert advice for face and content validity. Johnson and Christensen (2004) explained that the content validity is an act of judgment by which the experts and experienced researchers in the pertinent professional field evaluate the instrument. They also represent construct validity for the study. Black (1999) explains about the face validity as the way of checking validity of any instrument.

Data Analysis and Presentation

Hypothesis 1

There is no significant difference in the perception of public and private sector Grade XI Physics teachers on the basis of effectiveness of ICT in teaching Physics.

Table 2: Test of Hypothesis 1

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Effectiveness of ICT	Equal variances assumed	.011	.915	.256	147	.798	.02514	.09808	-.16870	.21897
	Equal variances not assumed			.256	143.931	.798	.02514	.09823	-.16902	.21929

Table 2 shows Levene's test for equality of variances and t-test for equality of means. It reflects that the test is insignificant because the value of 'F' is 0**.**011 with Sig. value of 0**.**915. The value of't' in the t-test equality of means is 0**.**256 with two tailed probability distribution value which reads as 0**.**798. The mean difference value is 0**.**02514 and standard error difference value reads as 0**.**09808 which are negligible values. It also shows that the test is insignificant. The insignificance of test is also evident that the value of zero lies in between the lower and upper value of 95 % confidence level of the difference with a value of 147 degree of freedom.

Hypothesis 2

There is no significant difference in the perception of Grade XI male and female physics teachers on the basis of project development performance of ICT in teaching physics.

Table 3: Test of Hypothesis 2

Table 4.58

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ICT is Help full in Project Development	Equal variances assumed	.374	.542	-1.409	147	.161	-.15888	.11272	-.38165	.06389
	Equal variances not assumed			-1.419	146.556	.158	-.15888	.11194	-.38011	.06235

Table 3 represents the Levene's test for equality of variances and t-test for equality of means. The Levene's test for equality of variances shows that the test is insignificant because the value of 'F' is 0.374 with Sig. value of 0.542. The valve of 't' in the t-test for equality of means is equal to -1.409 with Sig. value of 2-tailed value of 0.16. The mean difference value of t-test for equality of means reads -0.158 and standard error difference is 0.11272 which also reflects that the test is insignificant. The insignificane of the test is also evident that the value of zero lies in between the lower and upper of the 95% confidence interval of the difference with values of -0.38165 and 0.06389 respectively with a degree of freedom of 147.

Hypothesis 3

There is no significant difference in the perception of Grade XI public and private Physics teachers on the basis of performance of who are taught Sindh Textbook Board contents.

Table 4: Test of Hypothesis 3

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
ICT facilitates Sindh Textbook Board Physics Students Performance	Equal variances assumed	2.911	.090	-.977	147	.330	-.13834	.14156	-.41809	.14142
	Equal variances not assumed			-.968	136.722	.335	-.13834	.14289	-.42090	.14423

Table 4 electorate the Levene's test for equality of variances and t- test for equality of means. In Levene's test, it is observed that the value of 'F' reads 2.911 and Sign. value is 0.090 which shows that the test is insignificant. The insignificance of test also reflects from the value of 't' and 2-tailed test in test for equality of means with the values of -0.977 and 0.330 respectively. In 95% confidence interval of the difference, it is observed that the value of zero lies between the lower and upper values of -0.41809 and 0.14142 respectively which also shows that the test is insignificant with the value of 147 of degree of freedom.

Findings

Hypothesis one outcomes reflect that the obtained value of 'F' in Levene's test for the equality of variances is greater than the value of critical region at 0.05 so that the test becomes insignificant. The assumption is upheld. Therefore, according to respondent's frequency of

private and public sector Grade XI Physics teachers' perception about the hypothesis statement, ICT-based Physics teaching for Grade XI is more effective as compared to the non-ICT Physics teaching.

The Levene's test for the equality of variances for hypothesis two shows that the value of 'F' in the test is greater than the critical region value of 0.05 which shows that the test is insignificant. The frequency of the respondents about the statement of Grade XI male and female physics teachers' perception that ICT-based Physics teaching is helpfull in project development performance of the students is upheld.

Hypothesis three out comes reflect that in Levene's test for the equality of variances the value of 'F' is greater than the critical region value of 0.05 which shows that the test is insignificant. The frequency of the respondent about the statement of Grade XI public and private sector Physics teachers' perception that ICT-based Grade XI Physics teaching enhances the performance of students which is upheld.

Recommendations

There must be more ICT-based teaching and learning in the colleges of Karachi to enhance the conceptual skills of Grade XI Physics teachers. Local education authorities in the province of Sindh need to provide active support to the colleges in both public and private sectors. An annual budget is likely to increase the proficiency of Physics teachers and students for developing more ICT-based computerized laboratories with latest soft wares, applications and tailor-made programmes that comprise the contents of Karachi Board Intermediate Physics. This can be done in the form of quiz papers, short-answer questions, long-response questions, MCQs, diagrammatic questions for conceptual enhancement and online paper solving strategy. A mock Physics test of a three-hour will also lead to such mastery of students' and teachers of Physics.

Conclusion

From this research based on the perception of Grade XI private and public sector students and teachers the study concluded that ICT-based Physics teaching is more effective as compared to the non-ICT based Physic teaching for Grade XI. The adequate implementation of ICT in colleges across the city of Karachi can increase the overall performance of Grade XI students in the annual Karachi Board examinations. Students of Physics can present better science projects for effective understanding of the contents of Physics. A supportive and conducive learning of Physics at colleges will result in confidence among the science group students across the colleges of Karachi.

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