Do Tablets and Aptus Contribute to Improved Learning Outcome? Results from an applied research project in Swat Region, Pakistan

Project for
Innovative Delivery of Education
Using Mobile Technology
Pakistan

REACH OUT TO ASIA
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COMMONWEALTH of LEARNING

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ACKNOWLEDGEMENT

This report contains an analysis of results of activities under collaborative project of the Commonwealth of Learning and the Reach Out to Asia (ROTA) department of Qatar Foundation. It was prepared under the supervision of Professor Mohamed Ally, senior research advisor, and Mr. Raffat Khaqan, consultant on this project. The authors would like to thank ROTA and COL staff who made this innovative and leading edge project a success. Also, thanks to Care International and IDEA for providing support for the project in Pakistan.

EXECUTIVE SUMMARY

Widespread use of affordable mobile technology is an important development in the present times. Leaders of all nations are committed to achieving "inclusive and equitable quality education and promote lifelong learning opportunities for all", which is Goal 4 of the Sustainable Development Goals (SDGs). In this regard with the increasing use and accessibility of mobile technology, trials were carried out in using mobile learning to increase access to education in Swat, Pakistan. The project was implemented during January to March 2016 in Allama Iqbal Public School and College Kanju Swat, Pakistan. Grades 8, 9, and 10 were involved in this project. The mobile learning project involved the use of mobile technology to deliver learning materials to students to provide flexibility of access of electronic learning materials. Qatar Foundation: Reach Out to Asia in collaboration with the Commonwealth of Learning designed a project to use mobile technology to allow sampled school to provide students with the capability to access electronic learning materials from a local server without having to connect to the internet. The Aptus system is portable and was designed to allow children to connect to digital learning platforms and access course materials without the need for grid electricity or internet access. This ideal situation was found in an area like Swat where there is limited or no access to the internet and unreliable supply of electricity. Moreover, the costs of the Aptus system and the tablet computers are reasonable which makes it a good choice for large scale implementations. The Aptus system has been tested in twenty locations in 15 countries across the Commonwealth since early 2014.

The data collection for this research project was conducted by an independent research assistant with no link to the project stakeholders. The research revealed positive impact on children and learning as a result of their participation in mobile learning project. Using the tablet improved 21st century life skills among children. As most of the children from disadvantage community of swat have no access to computer/laptop/tablet. The results from the research study provide evidence that the children are better able to use with mobile/computer technology. Children and parents also reflected that project increased their knowledge on the use of tablet for learning.

Parents shared that the mobile learning project increased children's interest in study. This was also acknowledged by teachers that children were taking more interest in classroom learning and concentrated on their tablets during study. Tablets also help children to learn better through videos and pictures. Children facing visual issue can ZOOM pictures on tablets to increase their understanding of the learning materials. Children also said that videos are very self-explanatory and clear. As a result the children performed well on the post-test and the post-test scores were significantly higher than the pre-test scores, indicating the use of the tablets for learning improve the children performance. Children from grade 10 had one tablet for each child, while children from grade 9 and 8 shared tablet i.e. two children share one tablet. This also impacted on academic performance. Children using individual tablet performed well

Overall mobile learning project was a great success. The study reflects positive impact on academic performance so it should be scaled up to benefit more students. The mobile learning project was implemented with boys, it should be implemented in girls' schools as well.

BACKGROUND

The Commonwealth of Learning (COL) and Reach Out To Asia, a department of Qatar Foundation have initiated a pilot project to conduct trials on the usefulness of Aptus and tablets in increasing access to educational resources thus contributing to improved learning outcomes. The project started with a capacity building workshop on mobile learning which was meant to help fulfill QF's important mission of fostering a progressive society and addressing immediate social needs.

The mobile learning project, funded by ROTA with in-kind contribution by COL, was implemented in Pakistan's SWAT region. The project provided children and teachers of schools in remote locations access to electronic learning materials on a local server without the need for grid electricity or internet through the use of the Aptus system designed by COL. Without technology such as the Aptus system, teachers and students in remote locations of Pakistan are at a disadvantage situation. They cannot access electronic learning materials that are current and the technology that provides flexibility for learning. The Aptus system consists of a server that allows students and teachers to access learning materials on tablets that can be charged. The project focused on both pedagogical approaches includes drill and practice, tutorial, project based learning, problem based learning used during classroom teaching and gauge 21st century life skills among children. All learning materials were saved on the Aptus device. During classroom teaching children used the tablets to access the learning materials from the Aptus and then they complete learning activities. One school was involved in this innovative project. To orient teachers four days training was conducted for 3 teachers from Allama Iqbal Public School & College Kanju Swat, Pakistan and 3 program staff from partner organizations Care International and IDEA (Initiative for Development and Empowerment Axis).

Project Outcomes

The intended outcomes of this project are to:

1. Improve access to education and enhance the quality of teaching and learning in 3 classrooms in rural Pakistan
2. Recommend an educational model for future interventions that provides scalable and sustainable solutions for educational challenges in Pakistan

To achieve the above outcomes the following key activities was planned during project implementation period:

- Trained project staff and teachers on using the tablets for teaching and learning within their classrooms
- Provided Aptus devices and tablets for 3 classrooms

Overall project was planned on two major components:

1. Use of Aptus devices and tablets for teaching and learning in 3 classrooms in SWAT which contribute to outcome "Improved access to education and enhanced the quality of teaching and learning in 3 classrooms in rural SWAT –Pakistan"
2. Conducted research on the effectiveness of mobile learning to reach educational priorities in rural Pakistan which contribute to the outcome "Recommended model for future interventions that provides scalable and sustainable solutions for education challenges in Pakistan"

METHODOLOGY

The mobile learning project was implemented in targeted school for four weeks. Teachers from Grades 10, 9 and 8 prepared study plan for classroom teaching. All learning materials were loaded on the Aptus. The mobile learning project in Swat aims to provide the relevant statistics for the outcome indicators and will be used to show impact of the project by comparing results from pre and post data from schools. The purpose of the research is also to provide data that will improve and strengthen the program for advocacy purpose and for future implementations. Data was collected in the areas of knowledge, attitude and behavior about the use of tablets for learning from the children who are main target group of the project. Qualitative data was also collected from teachers, parents and children to obtain feedback on their attitude and knowledge on the use of mobile learning.

The pre and post data provided evidence on how use of tablet in classroom teaching improved the education quality and 21st century life skills among children. The implications of the research would thus form basis for policy intervention to adopt technology based education on large scale by the government. The analysis will highlight the academic performance of the children in the program and feedback from students, teachers, and parents. Findings from the study will help to strengthen National Information and Communications Technology Strategy for Education in Pakistan[1] (NICT).

The study was conducted in Allama Iqbal Public School & College Kanju Swat, Pakistan. The data was collected at school level from three grades (8, 9 and 10). Overall 77 children participated in study. Three children dropped out during Post data collection, so 74 children participated in pre and post data collection. During data collection pre and post questionnaire and subject test were conducted with children. Six (3 pre and 3 post) focus group discussions were held with children from each grade. Six (3 pre and 3 post) focus group discussions were held with parents of children from each grade. Six (3 pre and 3 post) interviews were held with 3 trained teachers who were involved in the project. In order to compare results of baseline an end line (follow-up) child tracking mechanism was adopted. The evaluation design and sample stratification is presented in Box-1.

[1] http://ilearnpakistan.org/pdf/National-Information-Communications-Strategy-Pakistan.pdf

BOX 1: Evaluation design, sample size and stratification

Tools:	Intervention	Sample Size
Pre and Post Questionnaire	Grade: 8th, 9th and 10th	77 Male[2]
Pre and Post Test	Grade 8th: Pakistan Study Grade 9th: English Grade 10th: Physics	32 28 17
Pre and Post Interviews with Teachers	Grade 8th: Pakistan Study Grade 9th: English Grade 10th: Physics	1 1 1
Pre and Post FGDs with Children	Grade: 8th, 9th and 10th	6-8 children in each FGD
Pre and Post FGDs with Parents		4-7 parents in each FGD

Tools Development and Data Collection Team

Tools were designed in collaboration with the project researcher.

Pre and Post Questionnaire – These tools were prepared to analyze use and availability of laptop/computer/tablet for children. The tools also help to measure skill of children to use tablet and also their level of interest toward education.
Pre and Post Test – Subject specific tests were prepared by each subject teacher. The tests were designed in a view to measure academic performance as a result of use of tablet in classroom teaching.
Focus Group Discussion Questionnaire for Children and Parents – To create a link between quantitative and qualitative data FGDs were conducted with children and parents. Questions were designed in a way to measure knowledge, awareness and attitude toward use of tablet in classroom teaching.
Interviews with Teachers – Questionnaires were designed to measure knowledge, attitude and practice of mobile learning techniques by teachers in sampled classes.

Data was collected and administered by an external Research Assistant from Pakistan in coordination with IDEA team and a note taker/observer. The Research Assistant coordinated both pre and post data collection exercises.

Data Analysis and Construction of Scales and Indicators

The research study adopted standard methods for measurement of competencies and construction of indicators. The data collected from the children were analyzed on their responses and marks they received during pre and post data collection. The sum of each pre and post questionnaire and test score which essentially tells us the change in students responded. The data is analyzed using the tables feature in SPSS.

[2] There was only boys in school. Based on discussion with teachers there was 4 female students but now they are not in school.

The tabulation presented in this report combines the Nominal Regression of pre and post questionnaire data. Data is cross classified by age, grades and pre vs post (counterfactual) to adequately follow evaluation design. The purpose of this design is to demonstrate the impact of intervention at a disaggregated level. Having a counterfactual is a necessary condition to conduct impact evaluation (the difference between pre and post data).

Qualitative data was also analyzed through transcription and translation of interviews with teachers and FGDs with children and parents. Use of tablet was also an indicator which was considered during analysis, because children from grade 10th have access to one tablet individually. In grades 8 and 9, two children shared one tablet.

FINDINGS AND ANALYSIS

The results are desegregated by the grade, use of mobile i.e. individual vs sharing during pre and post data collection.

Pre and Post Questionnaire:

To measure computer skills survey questionnaire was developed. Pre and Post questionnaire conducted with children from all three grades. Following are the key findings from the questionnaire:

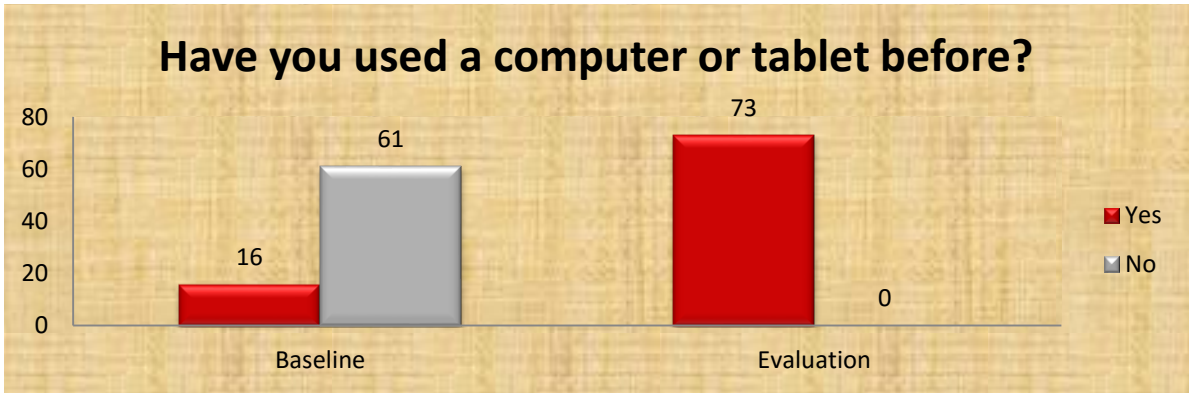
Q 3: Have you used a computer or tablet before?

In response to the above question during baseline (refer to table 1) 79% of children did not use computer or tablet before start of project. During evaluation/post data collection (refer to table 1) 100% of children marked their experience to use tablet. During post data collection 3 children were dropped out and one child did not respond the answer. Chart 1 also shows use of tablet ratio among children who participated in mobile learning project.

Table 1: [b[3] vs e[4]] 3. Have you used a computer or tablet before?

			[b] Grade				[e] Grade			
			10th	9th	8th	Total	10th	9th	8th	Total
3. Have you used a computer or tablet before?	Yes	Count	6	10	0	16	17	28	28	73
		% within Grade	35.3%	35.7%	.0%	20.8%	100.0%	100.0%	100.0%	100.0%
	No	Count	11	18	32	61	0	0	0	0
		% within Grade	64.7%	64.3%	100.0%	79.2%	0%	0%	0%	0%
Total		Count	17	28	32	77	17	28	28	73
		% within Grade	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chart 1:



Q 3 (a): If Yes, what did you use it for?

In response of a follow up question to analyze the use of computer/tablet during baseline most of the children responded that they use computer for Skype chat, play games or for enjoyment to watch movies or listen music. Only three children shared that they use computer for learning purpose. During evaluation all responded that they use tablet for learning purpose.

During Focus Group Discussion children shared that use of tablet help them to understand its use for learning purpose.

Q 4: Do you have a computer in your home?

In response of having computer at home both baseline and evaluation data almost remained same. (Table 2) showed that in grade 10 and 8 two more children get access to computer at home as compare to baseline.

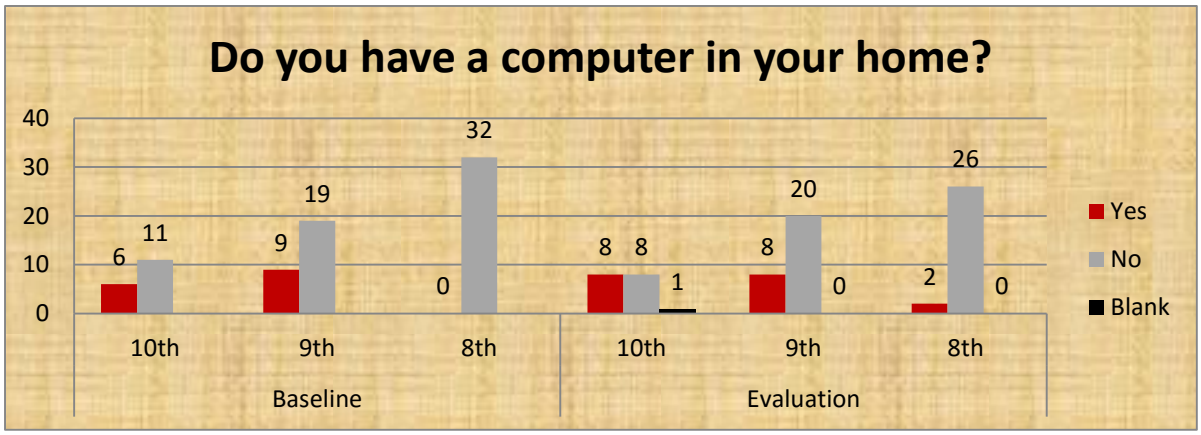
Before Aptus our parents did not allow us to use computer at home. Now we have all chapters in USB devices and our parents allow us to use computer at home to review lessons at home.

[3] b = Pre (Baseline)
[4] e = Post (Evaluation)

Table 2: 4. Do you have a computer in your home?

			[b] Grade				[e] Grade			
			10th	9th	8th	Total	10th	9th	8th	Total
4. Do you have a computer in your home?	Yes	Count	6	9	0	15	8	8	2	18
		% within Grade	35.3%	32.1%	.0%	19.5%	47.1%	28.6%	7.1%	24.7%
	No	Count	11	19	32	62	8	20	26	54
		% within Grade	64.7%	67.9%	100.0%	80.5%	47.1%	71.4%	92.9%	74.0%
	Blank /error	Count					1	0	0	1
		% within Grade					5.9%	.0%	.0%	1.4%
Total		Count	17	28	32	77	15	28	28	73
		% within Grade	100.0%	100.0%	100.0%	100.0%	19.5%	100.0%	100.0%	100.0%

Chart 2:



Q 5: Did you ever use the Internet?

In response of use of internet data reflected that only 12% in baseline and 15% in evaluation children have ever used internet (Table 3). In marginalized communities children and community have less exposure toward use of modern technology.

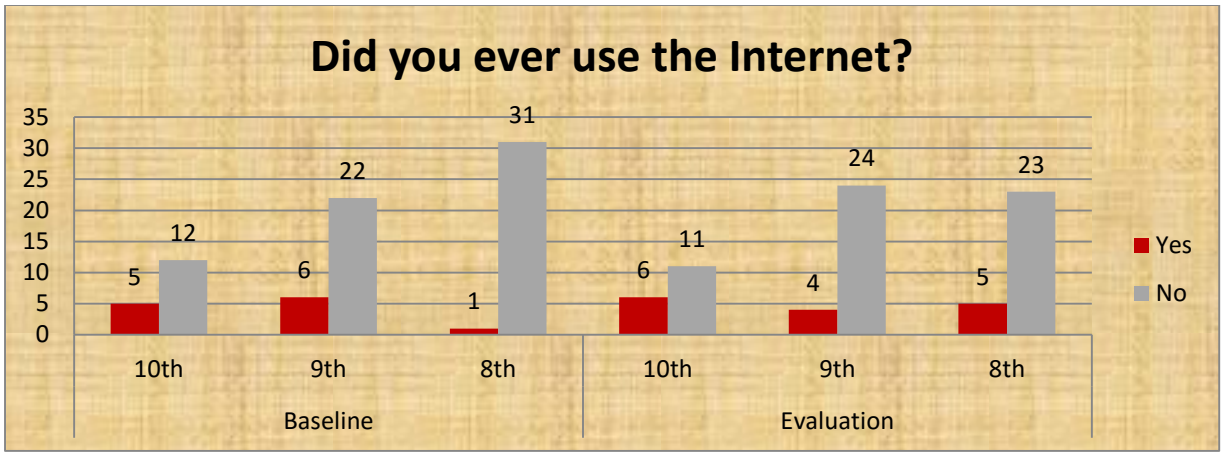
During FGDs children shared that they don't have internet facilities at home, only few children have this facility at home because their fathers' are working outside country. So they have to communicate with them.

One of the participants from parents shared "Yes, children have internet facility at home a couple of months before. But I observed that they are not using it for learning purpose. Mostly they use internet to watch movies and play games, so I disconnected internet facility at my home. So that they concentrate on their study." This reflected that parents also do not encourage their children to access internet at home.

Table 3:. Did you ever use the Internet?

			[b] Grade				[e] Grade			
			10th	9th	8th	Total	10th	9th	8th	Total
5. Did you ever use the Internet?	Yes	Count	5	6	1	12	6	4	5	15
		% within Grade	29.4%	21.4%	3.1%	15.6%	35.3%	14.3%	17.9%	20.5%
	No	Count	12	22	31	65	11	24	23	58
		% within Grade	70.6%	78.6%	96.9%	84.4%	64.7%	85.7%	82.1%	79.5%
Total		Count	17	28	32	77	17	28	28	73
		% within Grade	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chart 3:



Q 5 (a): If Yes, what did you use it for?

There were mix responses from children during baseline and evaluation on use of internet. During evaluation children shared more confidently about use of internet. Commonly children use internet to download games, social media, enjoyment and study purpose. During evaluation additional information shared by children that they use internet to *download information about study.* This reflected their level of increase in awareness for use of internet after having experience to participate in mobile learning project. It appears that the children were motivated to use computers at home for learning based on their experience using the tablets to learn in school.

Questions 6 to 11 are closed ended question focusing on competencies and skill to use computer. For each question children have to rate between "Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), Strongly Disagree (1)".

Q 6: To measure level of enjoyment using tablet for learning purpose

During baseline children were asked to predict whether they will enjoy while using tablet. Below table 4 show baseline results and table 5 show follow-up results. During evaluation it was asked to measure their experience during study period. In response of these question results below (table 4 and 5) show that from grade 10 children's remain same. 89% (table 5) of children from grade 9 responded that they are strongly agree with the statement, during baseline it was 71% (table 4). 93% (table 5) of children from grade 8 responded that they are strongly agree with the statement, during baseline it was 91% (table 4). Chart 4 show graphical presentation of data from baseline and follow-up. The level of enjoyment for using tablets increased for grades 8 and 9 after children use the tablet to learn.

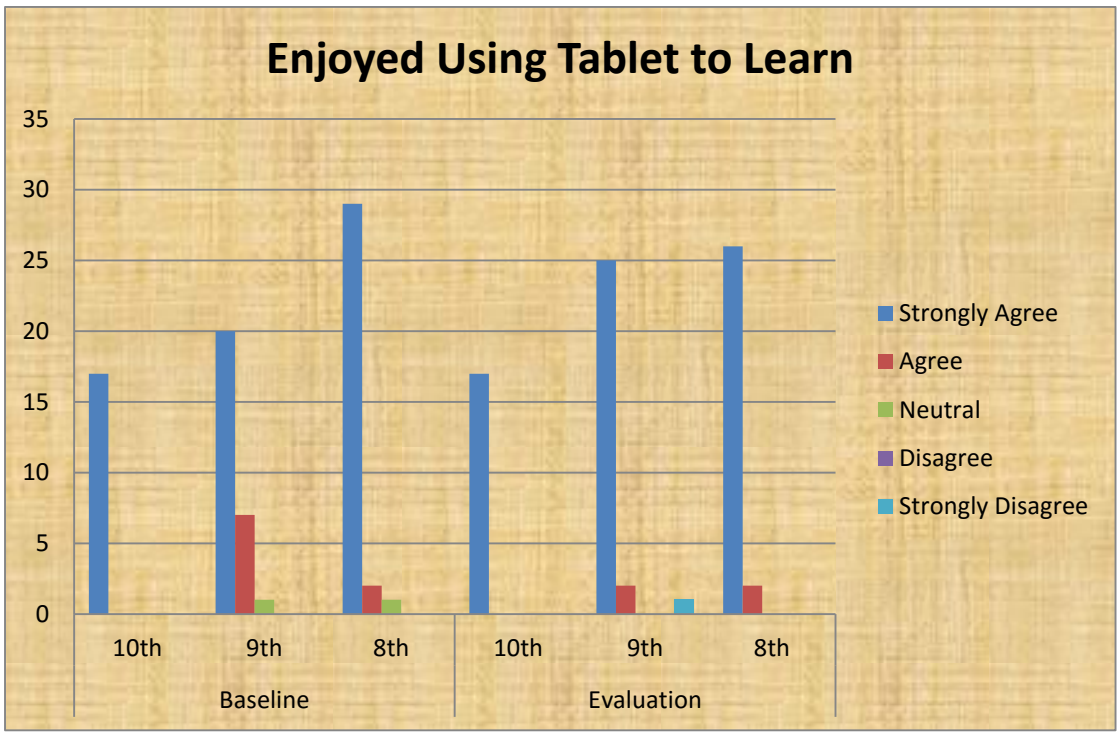
Table 4: [b] 6. I will enjoy using the tablet computer to learn.

			[b] Grade			
			10th	9th	8th	Total
[b] 6. I will enjoy using the tablet computer to learn.	c- Neutral	Count	0	1	1	2
		% within [b] Grade	.0%	3.6%	3.1%	2.6%
	b- Agree	Count	0	7	2	9
		% within [b] Grade	.0%	25.0%	6.3%	11.7%
	a- Strongly Agree	Count	17	20	29	66
		% within [b] Grade	100.0%	71.4%	90.6%	85.7%
Total		Count	17	28	32	77
		% within [b] Grade	100.0%	100.0%	100.0%	100.0%

Table 5 [e] 6. I enjoyed using the tablet computer to learn.

			[e] Grade			
			10th	9th	8th	Total
[e] 6. I enjoyed using the tablet computer to learn.	e- Strongly Disagree	Count	0	1	0	1
		% within [e] Grade	.0%	3.6%	.0%	1.4%
	b- Agree	Count	0	2	2	4
		% within [e] Grade	.0%	7.1%	7.1%	5.5%
	a- Strongly Agree	Count	17	25	26	68
		% within [e] Grade	100.0%	89.3%	92.9%	93.2%
Total		Count	17	28	28	73
		% within [e] Grade	100.0%	100.0%	100.0%	100.0%

Chart 4:



Q 7: To measure improvement in using computer skills:

In response of question related to use of computer skills during baseline and evaluation there was visible change among children. As a result of four weeks participation in mobile learning project 58% of children from grade 10, 70% of children from grade 9 and 61% of children from grade 8 strongly agree with statement that using computer tablet improved their computer skills (see tables 6 and 7). Hence, it seems that one of the benefits of using the tablets to learn is the improvement of the children computer skills which is an important 21st century skill.

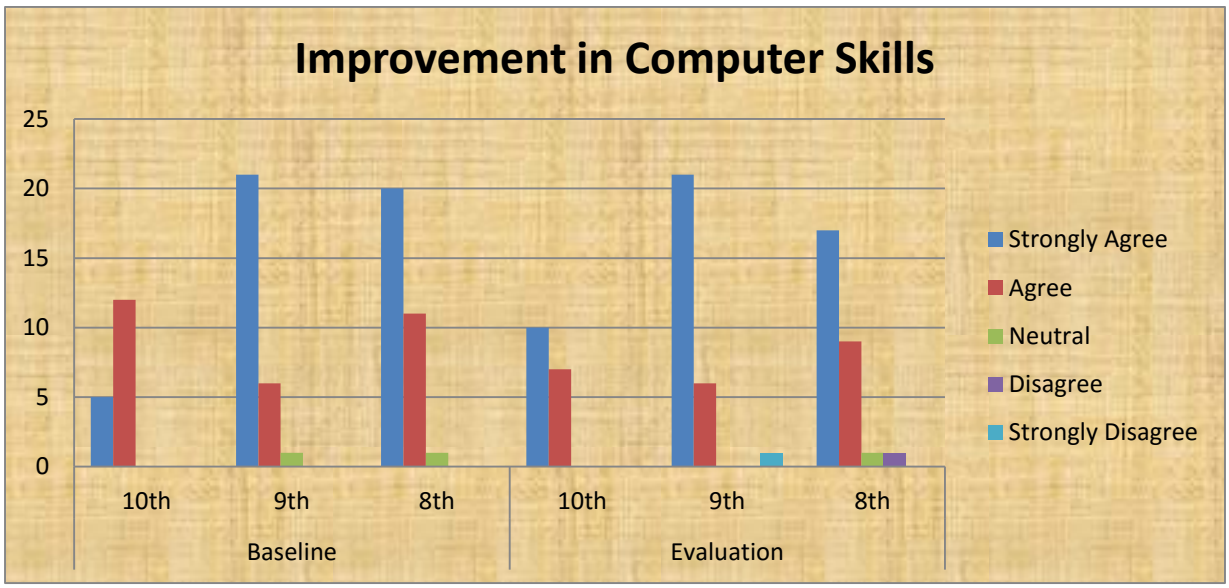
Table 6: [b] 7. Using the tablet computer to learn will improve my computer skills.

			[b] Grade			Total
			10th	9th	8th	
[b] 7. Using the tablet computer to learn will improve my computer skills.	c- Neutral	Count	0	1	1	2
		% within [b] Grade	.0%	3.6%	3.1%	2.6%
	b- Agree	Count	12	6	11	29
		% within [b] Grade	70.6%	21.4%	34.4%	37.7%
	a- Strongly Agree	Count	5	21	20	46
		% within [b] Grade	29.4%	75.0%	62.5%	59.7%
Total		Count	17	28	32	77
		% within [b] Grade	100.0%	100.0%	100.0%	100.0%

Table 7: [e] 7. Using the tablet computer to learn improved my computer skills.

			[e] Grade			Total
			10th	9th	8th	
[e] 7. Using the tablet computer to learn improved my computer skills.	e- Strongly Disagree	Count	0	1	0	1
		% within [e] Grade	.0%	3.6%	.0%	1.4%
	d- Disagree	Count	0	0	1	1
		% within [e] Grade	.0%	.0%	3.6%	1.4%
	c- Neutral	Count	0	0	1	1
		% within [e] Grade	.0%	.0%	3.6%	1.4%
	b- Agree	Count	7	6	9	22
		% within [e] Grade	41.2%	21.4%	32.1%	30.1%
	a- Strongly Agree	Count	10	21	17	48
		% within [e] Grade	58.8%	75.0%	60.7%	65.8%
Total		Count	17	28	28	73
		% within [e] Grade	100.0%	100.0%	100.0%	100.0%

Chart 5:



Q 8: Children were asked to rate their level of comfort to use tablet for learning:
In response of this during baseline and evaluation there is visible change in results shown in (table 8 and table 9). During baseline 14% (table 8) of children from total population were strongly agree that they are comfortable to use tablet to learn, while in evaluation 65% (table 9) of total population of children are strongly agree with the statement. Using the tablets to learn improved their comfort level using tablets.

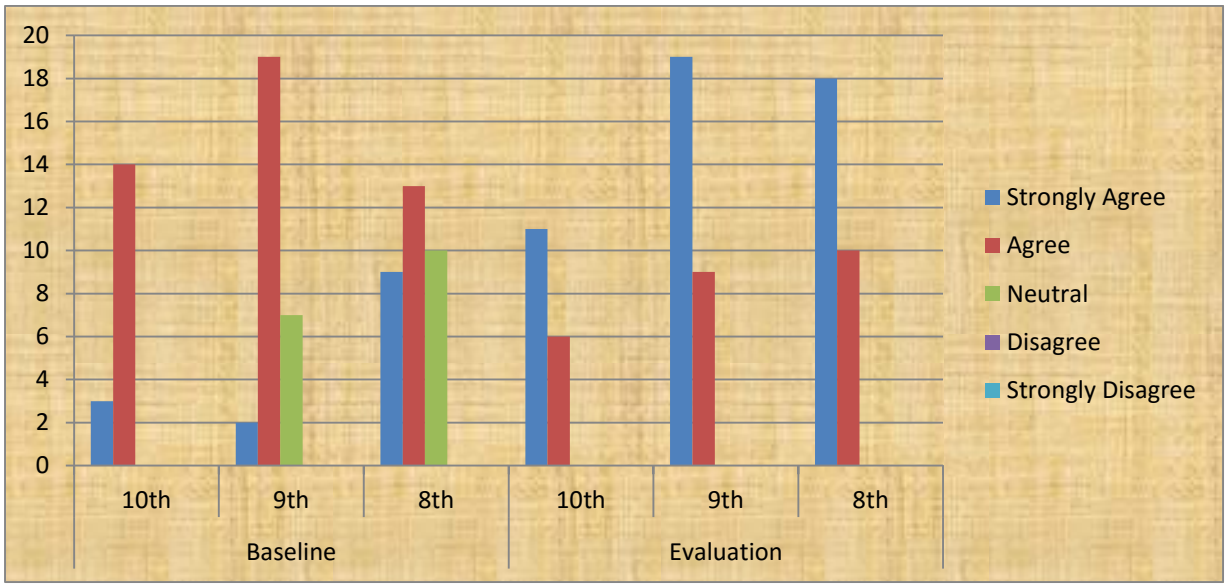
Table 8: [b] 8. I feel comfortable using the computer to learn.

			[b] Grade			Total
			10th	9th	8th	
[b] 8. I feel comfortable using the computer to learn.	c- Neutral	Count	0	7	10	17
		% within [b] Grade	.0%	25.0%	31.3%	22.1%
	b- Agree	Count	14	19	13	46
		% within [b] Grade	82.4%	67.9%	40.6%	59.7%
	a- Strongly Agree	Count	3	2	9	14
		% within [b] Grade	17.6%	7.1%	28.1%	18.2%
Total		Count	17	28	32	77
		% within [b] Grade	100.0%	100.0%	100.0%	100.0%

Table 9: [e] 8. I felt comfortable using the computer to learn.

			[e] Grade			Total
			10th	9th	8th	
[e] 8. I felt comfortable using the computer to learn.	b- Agree	Count	6	9	10	25
		% within [e] Grade	35.3%	32.1%	35.7%	34.2%
	a- Strongly Agree	Count	11	19	18	48
		% within [e] Grade	64.7%	67.9%	64.3%	65.8%
Total		Count	17	28	28	73
		% within [e] Grade	100.0%	100.0%	100.0%	100.0%

Chart 6:



Q 9: Use of computer improve academic performance

In response of children self-analysis toward use of computer for academic learning data reflect remarkable change. As a result of four weeks participation in mobile learning classes 44% (table 10) of children were strongly agree at the time of baseline, while during evaluation 75% (table 11) of children strongly agree with the statement that using computer during classroom improve their academic performance. The children claimed that the tablets helped them to learn. Perhaps, it was the flexibility that the tablets provided resulted in the children improving their academic performance. Chart 6 shows a graphical presentation of improved academic performance among children.

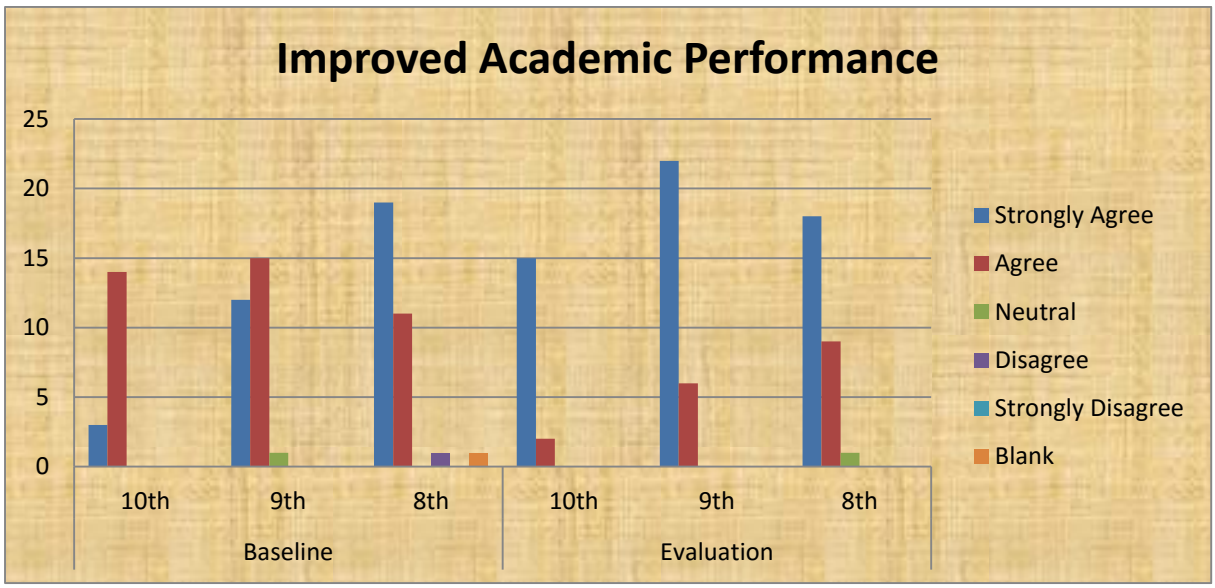
Table 10: [b] 9. Using the tablet computer will improve my academic performance.

			[b] Grade			Total
			10th	9th	8th	
[b] 9. Using the tablet computer will improve my academic performance.	d- Disagree	Count	0	0	1	1
		% within [b] Grade	.0%	.0%	3.1%	1.3%
	c- Neutral	Count	0	1	0	1
		% within [b] Grade	.0%	3.6%	.0%	1.3%
	b- Agree	Count	14	15	11	40
		% within [b] Grade	82.4%	53.6%	34.4%	51.9%
	a- Strongly Agree	Count	3	12	19	34
		% within [b] Grade	17.6%	42.9%	59.4%	44.2%
	Blank/error	Count	0	0	1	1
		% within [b] Grade	.0%	.0%	3.1%	1.3%
Total		Count	17	28	32	77
		% within [b] Grade	100.0%	100.0%	100.0%	100.0%

Table 11: [e] 9. Using the tablet computer improved my academic performance.

			[e] Grade			Total
			10th	9th	8th	
[e] 9. Using the tablet computer improved my academic performance.	c- Neutral	Count	0	0	1	1
		% within [e] Grade	.0%	.0%	3.6%	1.4%
	b- Agree	Count	2	6	9	17
		% within [e] Grade	11.8%	21.4%	32.1%	23.3%
	a- Strongly Agree	Count	15	22	18	55
		% within [e] Grade	88.2%	78.6%	64.3%	75.3%
Total		Count	17	28	28	73
		% within [e] Grade	100.0%	100.0%	100.0%	100.0%

Chart 7:



Q 10: Learning alone

Use of tablet also impacted their attitude toward learning. During baseline 35% (see table 12) of children strongly agree that they enjoy learning alone. When they use tablets and practice learning alone 67% (table 13) of children responded that they enjoy learning alone. Grade 10 children reflected major change in data from baseline 52% (table 12) to evaluation 94% (table 13) because they are not sharing tablet. The Grade 8 and 9 children were sharing tablets which may have reflected their response about learning alone. The majority of Grade 10 children who did not share tablets said they enjoy learning alone.

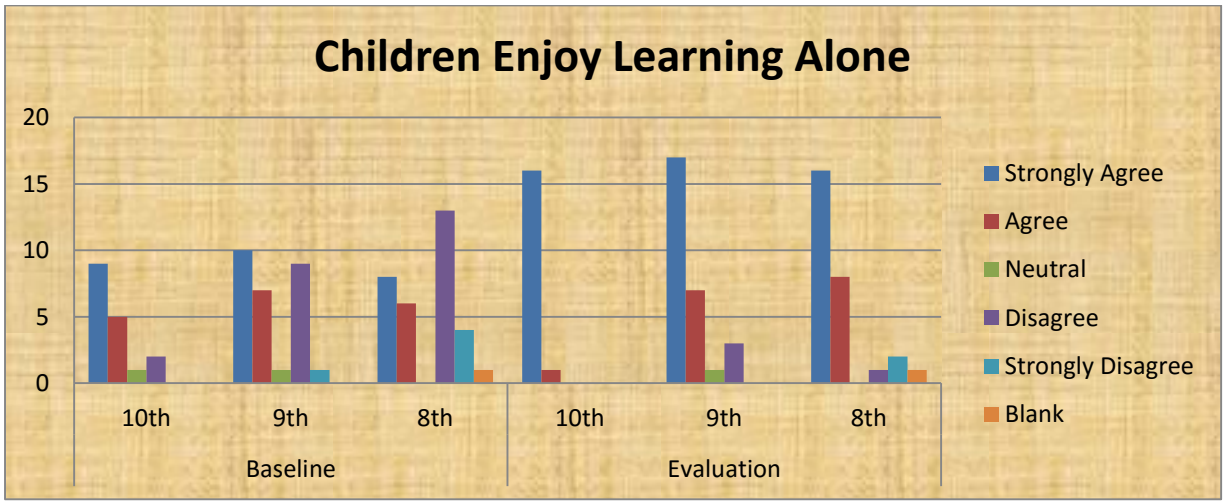
Table 12: [b] 10. I enjoy learning alone.

			[b] Grade			Total
			10th	9th	8th	
[b] 10. I enjoy learning alone.	e- Strongly Disagree	Count	0	1	4	5
		% within [b] Grade	.0%	3.6%	12.5%	6.5%
	d- Disagree	Count	2	9	13	24
		% within [b] Grade	11.8%	32.1%	40.6%	31.2%
	c- Neutral	Count	1	1	0	2
		% within [b] Grade	5.9%	3.6%	.0%	2.6%
	b- Agree	Count	5	7	6	18
		% within [b] Grade	29.4%	25.0%	18.8%	23.4%
	a- Strongly Agree	Count	9	10	8	27
		% within [b] Grade	52.9%	35.7%	25.0%	35.1%
	Blank/error	Count	0	0	1	1
		% within [b] Grade	.0%	.0%	3.1%	1.3%
Total		Count	17	28	32	77
		% within [b] Grade	100.0%	100.0%	100.0%	100.0%

Table 13: [e] 10. I enjoyed learning alone.

			[e] Grade			Total
			10th	9th	8th	
[e] 10. I enjoyed learning alone.	e- Strongly Disagree	Count	0	0	2	2
		% within [e] Grade	.0%	.0%	7.1%	2.7%
	d- Disagree	Count	0	3	1	4
		% within [e] Grade	.0%	10.7%	3.6%	5.5%
	c- Neutral	Count	0	1	0	1
		% within [e] Grade	.0%	3.6%	.0%	1.4%
	b- Agree	Count	1	7	8	16
		% within [e] Grade	5.9%	25.0%	28.6%	21.9%
	a- Strongly Agree	Count	16	17	16	49
		% within [e] Grade	94.1%	60.7%	57.1%	67.1%
	Blank/error	Count	0	0	1	1
		% within [e] Grade	.0%	.0%	3.6%	1.4%
Total		Count	17	28	28	73
		% within [e] Grade	100.0%	100.0%	100.0%	100.0%

Chart 8:



Q 11: Student-teacher relationship

Good student-teacher relationship is one of the key indicators to ensuring quality education quality in schools. Children responses indicated that the student-teacher relationship did not change when they use the tablets (Tables 14 and 15).

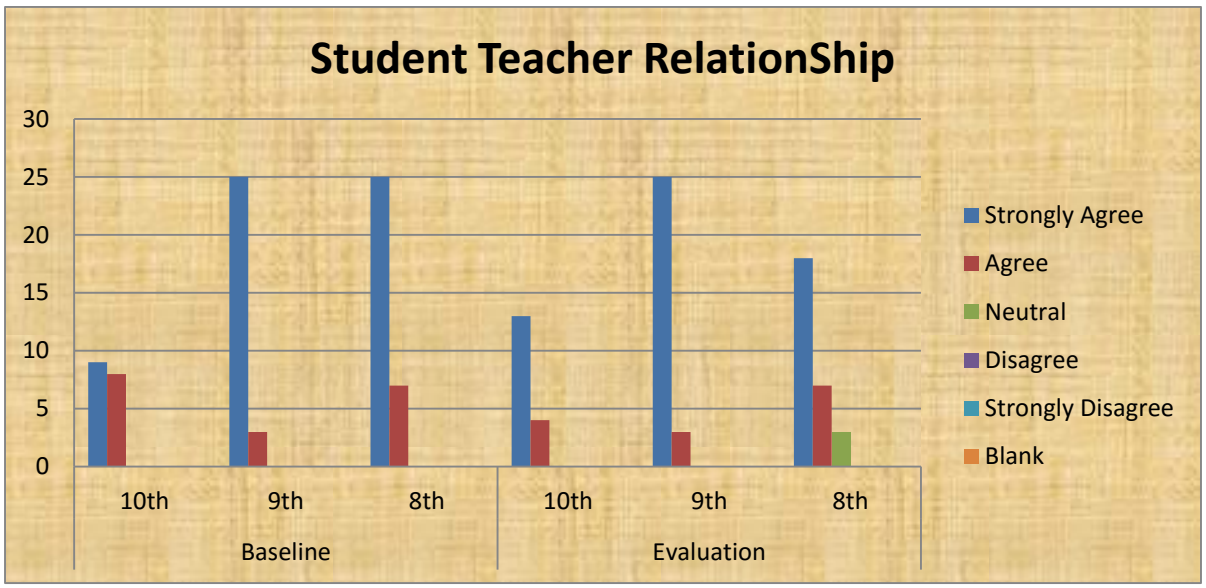
Table 14: [b] 11. Using mobile technology during classroom teaching will improve students-teachers relationship in class.

			[b] Grade			Total
			10th	9th	8th	
[b] 11. Using mobile technology during classroom teaching will improve students-teachers relationship in class.	b- Agree	Count	8	3	7	18
		% within [b] Grade	47.1%	10.7%	21.9%	23.4%
	a- Strongly Agree	Count	9	25	25	59
		% within [b] Grade	52.9%	89.3%	78.1%	76.6%
Total		Count	17	28	32	77
		% within [b] Grade	100.0%	100.0%	100.0%	100.0%

Table 15: [e] 11. Using mobile technology during classroom teaching improved students-teachers relationship in class.

			[e] Grade			Total
			10th	9th	8th	
[e] 11. Using mobile technology during classroom teaching improved students-teachers relationship in class.	c- Neutral	Count	0	0	3	3
		% within [e] Grade	.0%	.0%	10.7%	4.1%
	b- Agree	Count	4	3	7	14
		% within [e] Grade	23.5%	10.7%	25.0%	19.2%
	a- Strongly Agree	Count	13	25	18	56
		% within [e] Grade	76.5%	89.3%	64.3%	76.7%
Total		Count	17	28	28	73
		% within [e] Grade	100.0%	100.0%	100.0%	100.0%

Chart 9:



ANALYSIS OF RESULTS AND DISCUSSION

Pre and Post Test:

Subject based pre and post tests were conducted with children from all three grades.

Key focus of research was linked with academic performance of children through use of tablet in learning. Pre and post tests were conducted to determine the effectiveness of the mobile learning in the targeted school. Standardized tests were conducted on the day the tablets were provided to children and after four weeks at end of project period. The following research elements were focus of project implementation:

1. How effective is mobile learning as a delivery method for learning and student support as measured by students' performance?
2. How effective is mobile learning as a learning and support method as measured by students' feedback?
3. How effective is mobile learning as a teaching and delivery method as measured by teachers' feedback?

Test scores were supported with interviews with teachers and FGDs with children and parents.

As shown in table 16 paired sample statistic test was conducted to analyze the change in test scores as a result of use of tablet during classroom study.

Table 16: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Obtained Marks in Baseline	43.27	73	12.206	1.429
	Obtained Marks at follow-up	62.92	73	15.042	1.761

Results shown in table 17 analyses:
Null hypothesis = Baseline = Follow-up
Alternate hypothesis= baseline ≠ Follow-up
This requires two tailed t-test.

Table 17 show that the significance value that is p = .000 is less than .05 thus the null hypothesis is rejected and we can conclude that there is difference between obtained marks of Follow-up and Baseline. The children test scores significantly from pre-test to post-test.

Table 17: Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Obtained Marks in Baseline - Obtained Marks at follow-up	-19.644	14.767	1.728	-23.089	-16.198	-11.366	72	.000

Table 18.a: Group Statistics

	[b] Use of tablet	N	Mean	Std. Deviation	Std. Error Mean
Obtained Marks in Baseline	Individual	17	48.53	7.938	1.925
	Share	60	41.08	12.651	1.633
Obtained Marks at follow-up	Individual	17	75.88	12.272	2.976
	Share	56	58.98	13.589	1.816

Table 18.b: 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
Obtained Marks in Baseline	Equal variances assumed	6.423	.013	2.296	75	.024	7.446	3.243	.985	13.907
	Equal variances not assumed			2.949	41.487	.005	7.446	2.525	2.349	12.543
Obtained Marks at follow-up	Equal variances assumed	1.123	.293	4.587	71	.000	16.900	3.684	9.554	24.246
	Equal variances not assumed			4.847	28.961	.000	16.900	3.487	9.769	24.032

In above (tables 18.a and 18.b) two hypothesis tests were conducted:

H1= the sharing vs individual user of tablet. In use of tablet does not affect the marks obtained in BL
H2= the sharing vs individual user of tablet. In use of tablet does not affect the marks obtained in FU.

As the p value, (see table 18.b) that is, 0.013 for the H1 is less than 0.05 therefore the H1 was rejected. Whereas, the p value (0.293) for H2 is greater than 0.05 therefore the null hypothesis was accepted.

Thus, we can conclude that in the follow-up the student who has independent or individual access to tables have obtained more marks than the ones who have shared the tablets with peer. We can also conclude that the independent or sole usage of tablet positively impacts on learning.

Grade 10th – children used tablet to learn physics course in classroom sitting. Each child in Grade 10 used the tablets individually. Test scores demonstrate significant improvement in their academic performance table 19). In comparison with two other sampled grades where children shared tablet i.e. two children have one tablet, grade 10th children show much higher score. There

is 21% of increase in test score. Chart 9 will help more to visualize performance of children during baseline and evaluation:

Chart 9:

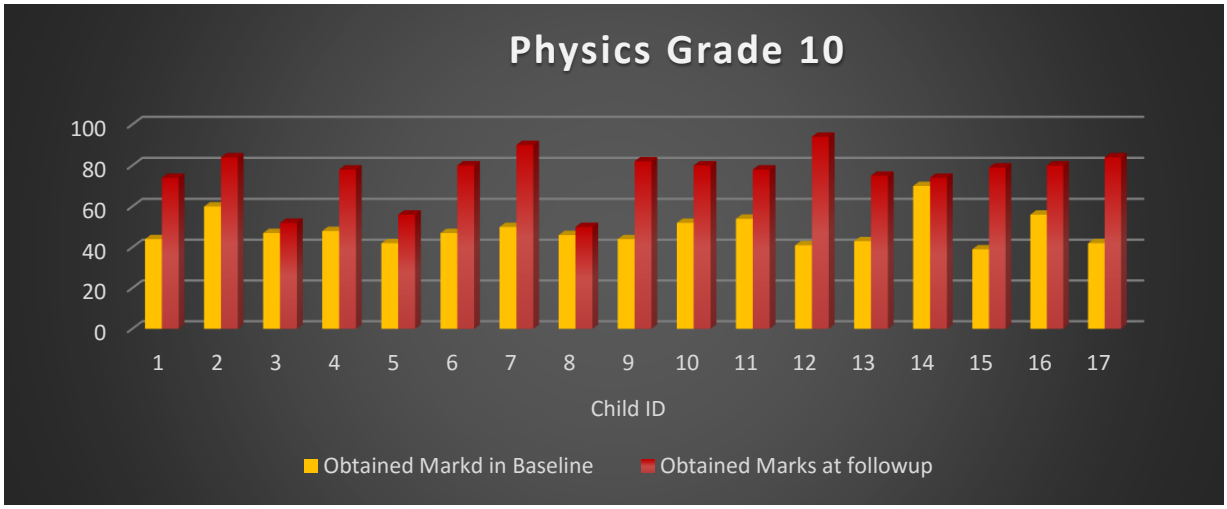


Table 19: Grade 10 Test Score

Child ID	Child Name	Overall mark or standardized test score	Obtained Marks in Baseline	Obtained Marks at follow-up	Difference
1	Student 1	100	44	74	30
2	Student 2	100	60	84	24
3	Student 3	100	47	52	5
4	Student 4	100	48	78	30
5	Student 5	100	42	56	14
6	Student 6	100	47	80	33
7	Student 7	100	50	90	40
8	Student 8	100	46	50	4
9	Student 9	100	44	82	38
10	Student 10	100	52	80	28
11	Student 11	100	54	78	24
12	Student 12	100	41	94	53
13	Student 13	100	43	75	32
14	Student 14	100	70	74	4
15	Student 15	100	39	79	40
16	Student 16	100	56	80	24
17	Student 17	100	42	84	42

Teacher from grade 10 shared that on tablets first we have option to save all our learning materials on tablet. This helped the children to learn well. Secondly there were examples with theories related to each topic. Teacher was of view that there is nothing better than mobile

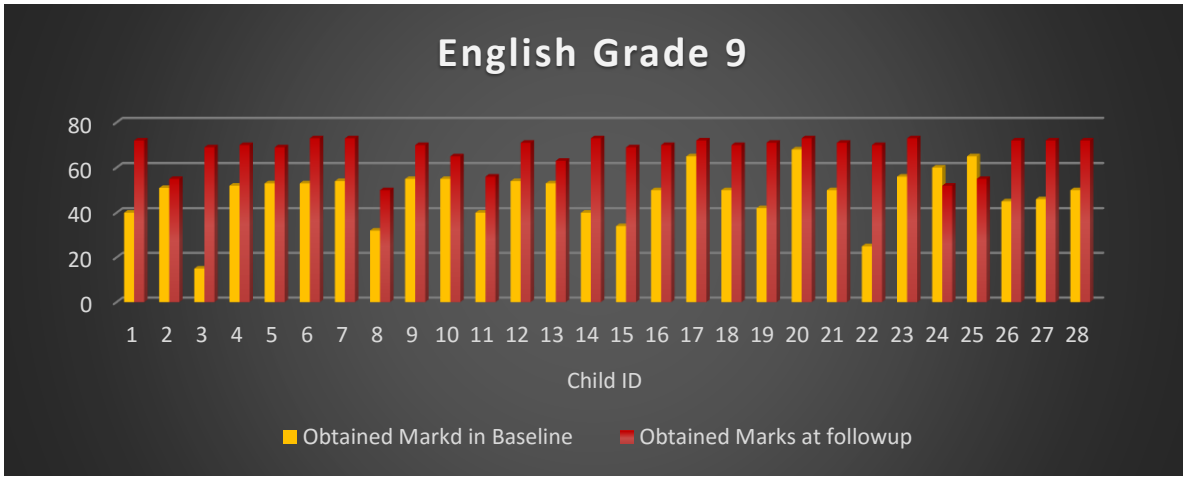
learning method. It was also helpful for teacher. It is better in terms of personal learning and demonstrates lessons to others.

Children take interest in this technology because there is multimedia option using this technology. Children can watch animated videos on each topic. Children were very excited when they receive tablets for learning purpose since they never experienced such thing before. Children were interested in learning through tablets. As a result of children's interest we also added 9th grade practical topics in tablets, which will be accessed by children. Children also showed interest to access other subjects through tablets particularly about biology. This shows the potential of using the tablets in other subjects.

Using tablet also improved classroom teaching methodology. During the research study teacher shared "During this month when I start my topic in class, I wrote topic name on blackboard. Then I write video link on blackboard through Aptus. Help children to download video in the beginning of class. Then I verbally teach them in local language. After that children watch video using headphone and tablet. If they have any confusion or problem they consult me."

Grade 9th - children used tablet to learn English course in classroom sitting. In sampled grade children shared tablet during lesson. Test score from grade 9 also demonstrate positive change among children as part of this program (Table 20). There is 16% of increase in test score of children in grade 9. (Chart 10) will help more to visualize performance of children during baseline and evaluation:

Chart 10:



Teacher shared that we learn more during implementation as compare to training we attended in the beginning of project. On tablet teacher use same technique and than provide them oportunity to respond on their learning and understanding. Teacher support children to get connected with Aptus device.

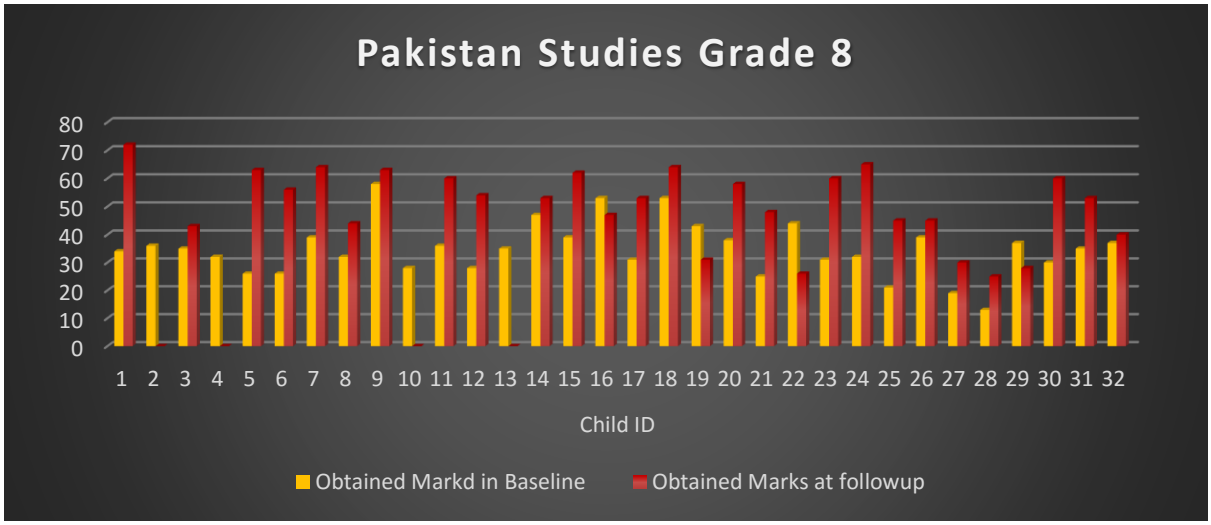
Table 20: Grade 9 Test Score

Child ID	Child Name	Overall mark or standardized test score	Obtained Marks in Baseline	Obtained Marks at follow-up	Difference
1	Student 1	70	40	72	32
2	Student 2	70	51	55	4
3	Student 3	70	15	69	54
4	Student 4	70	52	70	18
5	Student 5	70	53	69	16
6	Student 6	70	53	73	20
7	Student 7	70	54	73	19
8	Student 8	70	32	50	18
9	Student 9	70	55	70	15
10	Student 10	70	55	65	10
11	Student 11	70	40	56	16
12	Student 12	70	54	71	17
13	Student 13	70	53	63	10
14	Student 14	70	40	73	33
15	Student 15	70	34	69	35
16	Student 16	70	50	70	20
17	Student 17	70	65	72	7
18	Student 18	70	50	70	20
19	Student 19	70	42	71	29
20	Student 20	70	68	73	5
21	Student 21	70	50	71	21
22	Student 22	70	25	70	45
23	Student 23	70	56	73	17
24	Student 24	70	60	52	-8
25	Student 25	70	65	55	-10
26	Student 26	70	45	72	27
27	Student 27	70	46	72	26
28	Student 28	70	50	72	22

During interview teacher shared that “using mobile learning is effective teaching methodology, as compare to old teaching technique. This will be good for teachers and children if we use it in future”. This is easy way of teaching as compare to books. Through tablet child can watch learning videos and pictures which help them to review lesson.

Grade 8th - children used tablet to learn Pakistan Study course in classroom sitting. Grade 8th children also shared computer. Pre and Post test score from sampled grade also reflected positive change in academic performance after taking part in mobile learning project (table 21). There is 12% of increase in test score of children in follow up test. (Chart 11) will help more to visualize performance of children during baseline and evaluation:

Chart 11:



During follow up 4 children were absent and did not participate in full program. One child was on medical leave and remaining 3 children dropped out.

Table 21: Grade 8 Test Score

Child ID	Child Name	Overall mark or standardized test score	Obtained Marks in Baseline	Obtained Marks at follow-up	Difference
1	Student 1	75	34	72	38
2	Student 2	75	36	0	-36
3	Student 3	75	35	43	8
4	Student 4	75	32	0	-32
5	Student 5	75	26	63	37
6	Student 6	75	26	56	30
7	Student 7	75	39	64	25
8	Student 8	75	32	44	12
9	Student 9	75	58	63	5
10	Student 10	75	28	0	-28
11	Student 11	75	36	60	24
12	Student 12	75	28	54	26
13	Student 13	75	35	0	-35
14	Student 14	75	47	53	6
15	Student 15	75	39	62	23
16	Student 16	75	53	47	-6

17	Student 17	75	31	53	22
18	Student 18	75	53	64	11
19	Student 19	75	43	31	-12
20	Student 20	75	38	58	20
21	Student 21	75	25	48	23
22	Student 22	75	44	26	-18
23	Student 23	75	31	60	29
24	Student 24	75	32	65	33
25	Student 25	75	21	45	24
26	Student 26	75	39	45	6
27	Student 27	75	19	30	11
28	Student 28	75	13	25	12
29	Student 29	75	37	28	-9
30	Student 30	75	30	60	30
31	Student 31	75	35	53	18
32	Student 32	75	37	40	3

Teacher also reflected positive change among children during classroom learning. During interview grade 8 teacher responded that mobile learning is very supportive. Practically children understand and remember well through mobile learning.

Mobile learning project also improved teaching methodology. Teacher shared that "Before tablet I only read chapter and ask questions to children. On tablet I use same methodology in addition I guide each child to watch video of same chapter. During video I also demonstrate things to children. Children use head phone to hear voice recording".

Overall mobile learning very effective. Teacher shared that during mobile learning children get guidence from me and then they watch video. This helps them to revise their lessons for better understanding.

During pre and post interview teacher were asked to rate their view on using tablet and mobile learning with children in the classroom could make it easier or harder for children to learn. It was analyzed on following levels:

A lot Harder		Somewhat Easier, Somewhat Harder		A lot Easier	I don't know
1	2	3	4	5	N/A

As part of project teachers' attitude toward mobile learning was also improved. During pre interviews two teachers selected level 3 and one selected level 4. Duirng post interview two teachers selected level 5 and one selected level 4. After teachers used the tablets to teach students they become more favourable about using tablets in their classes.

Other Salient Findings from Interviews with Teachers and FGDs with Children and Parents

- Teachers shared that children like to have sport and play activities at school. They also like using tablets for learning.
- Very few children have computer/laptop/tablet at home. There is a computer lab in school but children are not using it.
- It was difficult for children in the beginning but within two days they learn how to use tablet and get connected with aptus device for subject learning. Children also took interest in learning through tablet.
- Children download data on USB/memory card to access it on their mobile/computer at home.
- A child shared that this is very easy approach to teach us. Teacher easily deliver lecture and we can also learn easily.
- A child shared that through tablet we can cover chapter double than book. Through tablet we understand well, we concentrate well so there was no need to review one chapter double time. This increased speed to cover chpater in less time as compare to book reading.
- A child shared that we can ZOOM words, as a result of this it was easy for us to recognize words and understand. Children shared that in class 3-4 children have eye site problem and this technology is very helpful for them.

CHALLENGES

- Teacher also shared that it was difficult for both teachers and children. There was huge gap between training and implementation. As a result of this teachers forget to use it.
- Battery backup of tablets is very low
- Aptus range is very limited. Bandwidth speed be become low when 15 children access to device at same time. Download speed become very low.
- The teachers involved in the project were trained on mobile learning and on the Aptus syatem and tablets. Teachers need support after they start the project so that they can implement the project seamlessly.
- Due to delay in receiving the tablets, this project has been implemented over 4 weeks, and the tablets were used for revision of course materials.
-

CONCLUSION AND RECOMMENDATIONS

Results from this project demonstrate that the use of mobile to access and interact with electronic learning materials benefit students academic performance and improve their ICT skills to prepare them for technological era. The Aptus system along with the provide flexible access to education which can help to reach students in remote locations especially girls who face many restrictions for obtaining a basic education. This landmark project is contributing to the achievement of Goal 4 of the Sustainable Development Goals (SDGs) “inclusive and equitable quality education and promote lifelong learning opportunities for all”. Nations from around the world will benefit from the best practices learned from this project. Use of mobile

learning is a great opportunity to provide education for all and nations must place a sense of urgency to innovate education to educate all citizens to change the world.

The following are recommended based on the outcomes of this project.

- Based on the positive benefits and academic improvement when using the tablets, the project should be scaled up to benefit more students. In the scale up project, addition data should be collected to further evaluate the effectiveness of mobile learning in education in developing countries.
- This project was conducted with boys only. Keeping in view importance of girls education and gender equality the project should be implemented in girls schools.
- Regular mentoring and support should be provided to teacher in future implementations, especially at the start of the project.
- Teachers designed the mobile learning unit during the training. In real-time interventions, teachers will need to allocate time for the planning and design of the mobile learning lessons.