Investigation of Teaching Platforms Used in Grades 11 and 12 Physics Education in Papua New Guinea

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Abstract: ICT in education uses technology to enhance and facilitate teaching and learning processes. It involves the use of various digital tools, platforms, and resources to support teaching and learning activities. The introduction of ICT in education has bridged the gap between traditional teaching methods and modern, technology-driven learning. Through the integration of ICT, students can now access a wealth of information and resources online, collaborate with peers and teachers in real-time, and even engage with interactive learning materials. In our study, we selected physics education because physics is the most difficult science subject. Status of ICT and the types of teaching platforms used in teaching and learning physics at grades 11 and 12 were determined by conducting a survey on first year university physics. ICT status was found to be good for the schools run by the state. Recommendations have been proposed to narrow the disparities in ICT status and the teaching platforms used in cities, urban towns, district towns and rural disadvantaged locations.

Key words: Transitional Physics Education, Traditional Pedagogy, ICT, Online Teaching and Learning

1. INTRODUCTION

Papua New Guinea is a developing country in the Pacific. With the population of over 10, 000, 000, about 20% of the population lives in urban centers while 80% of it lives as subsistence farmers in the rural parts of the country. The country is rich in natural resources but faces challenges of high and rugged mountains and valleys, thick forests, fast and deadly flowing rivers and deep muddy swamps. Given as one of the most challenging landscapes of the countries in the world, fair and effective distribution of basic government services especially in the education system across the country remains a significant challenge.

The structure of the government system of Papua New Guinea is that we have National Government, Provincial Government and Local Level Government in the order from top to the bottom respectively. The National Government prepares and passes the yearly national budget where Provincial Governments are funded to deliver basic government services in the sectors such as education, health etc. The Provincial Governments then fund their respective Local Level Governments to deliver the basic government services such as education to the people of this country at the village levels.

All the schools at early childhood, primary, high school and secondary school levels receive their funding from the National Government through their respective Provincial Governments and Local Level Governments. The schools use the funds received for infrastructure and curriculum developments and the overall management and administrative purposes.

All the schools in Papua New Guinea come under the two categories as School Authority and School Locations. Under the School Authority we have Agency, Private and State. Agency covers the schools run by the churches while the local private citizens and international organizations run the Private schools. The government runs state schools. Under the School Locations we have City, Urban Town, District Town and Rural Disadvantaged schools. City schools have steady access of water, electricity, internet, e-library and mobile networks. Urban Towns are provincial centers and have both water and electricity but lack one of the other three basic learning infrastructures. District Towns are small compared to Urban Towns and have steady access of water and electricity. However, they lack two out of the other three learning facilities. Rural Disadvantaged schools only have water and electricity but suffer from lack of the other three vital learning enhancement infrastructures.

All the Papua New Guinean students entering different technical colleges and universities in this country as first year students after completing Grade 12 level of education come under one of the streams of these two school categories – School Authority and School Location. Transitional physics education from Grade 12 education to the first-year university studies in physics in Papua New Guinea requires attention. This is because physics is known as the most difficult, unifying and multidisciplinary subject of science. The first-year university students taking physics in Papua New Guinea are also deeply rooted in and raised in their local cultural diversities and complexities.

Online teaching and learning particularly at the university level is fast becoming a common trend at the global scale. Papua New Guinea as part of the global community has embraced online teaching and learning in its universities. Teaching platforms are online tools that teachers, academics and instructors use with the aid of digital technology in academia. The online tools facilitate the creation, delivery, and management of educational content. These platforms provide a digital space for instructors to share materials, interact with students, and assess learning. They also feature video conferencing, assignment submission and progress monitoring. Antonio & Castro (2023) sighted in Ramaila (2024) stated that 'The integration of technology in education has revolutionized traditional teaching methodologies, offering innovative tools and resources that enhance the learning experience. In the realm of physics education, technology plays a pivotal role in bridging theoretical concepts with practical applications, making abstract principles more tangible and accessible to students. Physics Education Technology simulations, virtual labs, interactive software, and other digital resources have emerged as transformative pedagogical tools that provide dynamic and engaging learning environments' (p. 1).

The first-year university students taking physics come from different cultural, school authorities and school locations back grounds. The challenges they face and efforts they make to adapt to the conditions of their new home environment far from their family homes is a severe test to every individual student. One of the factors that contribute to successful transition into first-year university physics studies is the relevant and appropriate teaching platforms they have acquired in grades 11 and 12 physics from their previous respective schools. Bhat (2023) sighted in Ramaila (2024) stated that 'Educational technology in physics allows for differentiated instruction, catering to the diverse learning needs and paces of students' (p. 2).

Kebibeck, Piatek-Jimenez & Medina (2024) found that the most prevalent challenges faced by first-year university physics students are difficult course content, pedagogy, competitive environment, lack of community, and lack of mentorship. Teaching platforms aspect of physics education is critical to effective and successful delivery of curriculum content. This enhances physics students' learning resulting in academic success.

Choosing physics to investigate variations in teaching platforms used in different locations of the schools under different authorities is critical for improvements in physics education and successful transitions into university studies. Main driving factors that lead to improving physics education are high failure rates in first-year university physics, declining statistics of students' enrollments in high school and university physics, connection between physics and natural phenomena both from scientific and cultural intelligence perspectives and the invaluable contributions that physics makes in all sectors of development in the world.

Some intervention strategies are required to arrest the global trend of high failure rates in physics at high school and first-year university levels. Ramnarain & Molefe (2012) reported that 'A high failure rate at first year physics is often attributed to the lack of readiness of high school students to pursue such studies' (p. 1). Unqualified physics teachers and not being able to see the relevance of physics with daily life, application in different disciplines and career prospects are also factors that contribute to this trend. Saeed M & Khan A, W (2021) also found that 'secondary school science students' conceptual knowledge about content related to physics is less' (p. 14).

Dodd T (2024) reported a catastrophic decline in the number of students studying physics in senior high schools in Australia between the years 2015 and 2023. The report further highlighted that if the trend continued there would be no female school leavers qualified to study physics at university by 2032 and no males by 2035 with Australia losing the expertise it needs to be competitive as an advanced economy. Physics experts play a critical role in medicine, astronomy, energy transition, nuclear industry and climate science etc.

In this paper we determined which schools under School Authority and School Locations used Conventional, Blended and Fully Online teaching and learning in Papua New Guinea. We also found the ICT status at the respective settings of the schools. Data collection was administered by conducting a survey among the first-year university students taking physics. The data collected was entered into Google Forms as a survey

administration software and used the Google Sheets for effective sorting in spreadsheets. We also proposed measures to improve physics education in secondary schools and first year university studies by embracing ICT and blended teaching and learning platforms.

Table 1: The number of students who took part in the study from the City, Urban Towns, District Towns and Rural Disadvantage schools under the authority of the Agency, Private and State in Papua New Guinea.

		SCHOOL LOCATION				TOTAL	TOTAL
SCHOOL AUTHORITY		CITY	URBAN TOWN	DISTRICT TWON	RURAL DISADVANTAGE		
AGENCY	Male	7	5	9	9	30	
	Female	12	3	7	6	28	58
PRIVATE	Male	2	0	1	0	3	
	Female	2	1	0	0	3	6
STATE	Male	29	39	41	8	117	
	Female	24	14	6	3	47	164
TOTAL	**Male**	38	44	51	17	**150**	
	Female	38	18	13	9	**78**	**228**
	TOTAL	76	62	64	26	**228**	

The number of students who took part in the study is given in Table 1. The survey questionnaire provided a section on ICT and Teaching Platforms. The participants responded according to their physics learning experiences from their previous schools. Participants' responses were categorized under school authority and school locations using legends. The data collected was tabulated and further transformed into respective graphs showing the percentage weightage of the responses.

Below are the legends:

A1: Agency City
A2: Agency Urban Town
A3: Agency District Town
A4: Agency Rural Disadvantaged
P1: Private City
P2: Private Urban Town
P3: Private District Town
P4: Private Rural Disadvantaged
S1: State City
S2: State Urban Town
S3: State District Town
S4: State Rural Disadvantaged

RESULTS

ICT Status

Put a tick (√) in the appropriate boxes below.

49. What was the status of ICT in your last school?

	Good ☐	Poor ☐	Nill ☐
A1:	14	3	2
A2:	4	2	2
A3:	10	4	2
A4:	0	9	5
P1:	4	0	0
P2:	0	1	0
P3:	0	0	1
P4:	0	0	0
S1:	35	12	7
S2:	38	8	7

S3:	14	17	12
S4:	4	4	3

Table 2: Percentage responses on ICT status by School Authority.

SCHOOL AUTHORITY	ICT Status		
	Nill	**Poor**	**Good**
AGENCY	5.8 %	7.1 %	12.5 %
PRIVATE	0.004 %	0.004 %	1.8 %
STATE	13 %	18.3 %	40.6 %

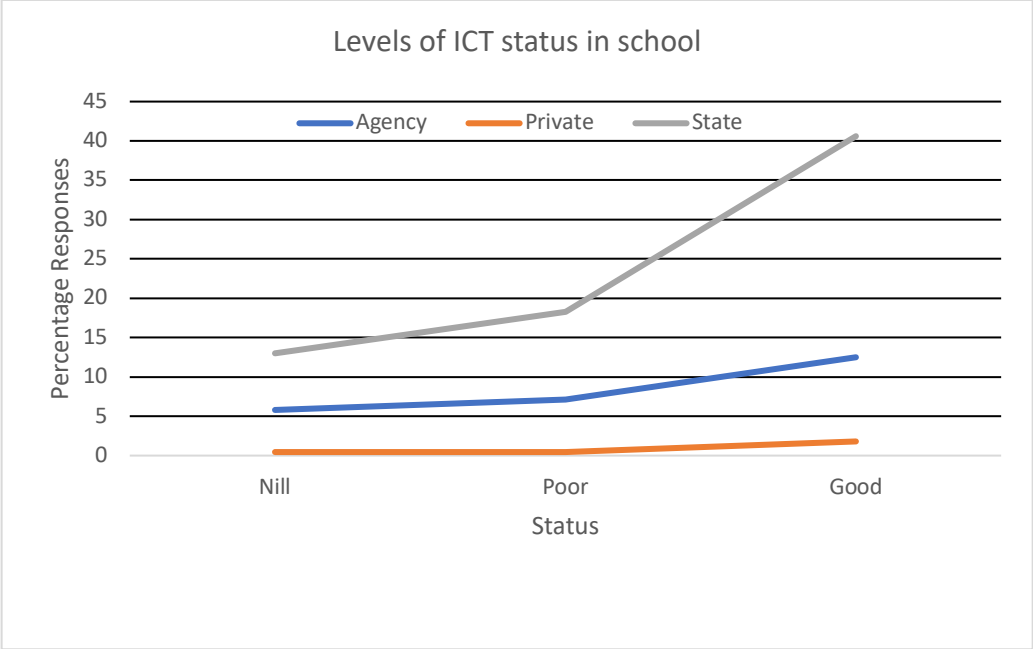

Figure 1: Percentage levels of ICT status.

Table 3: Percentage responses on ICT status by School Locations.

SCHOOL LOCATION	ICT Status		
	Nill	**Poor**	**Good**
City	3.9 %	6.6 %	23 %
Urban Towns	3.9 %	4.8 %	18.4 %
District Towns	6.6 %	9.2 %	10.5 %
Rural Disadvantaged	3.5 %	5.7 %	1.8 %

54. What teaching platforms did your physics teacher use to deliver lessons in your last school?

Fully online ☐ Blended ☐ Fully conventional ☐

A1:	0	5	16
A2:	0	0	8

A3:	1	4	11
A4:	0	2	12
P1:	0	4	0
P2:	0	0	1
P3:	0	0	1
P4:	0	0	0
S1:	0	13	38
S2:	1	22	31
S3:	0	12	35
S4:	0	3	8

Table 4: Responses on Teaching Platforms by School Authority and Locations.

SCHOOL		**TEACHING PLATFORMS**		
AUTHORITY	**LOCATION**	**Fully Conventional**	**Blended**	**Fully Online**
AGENCY	CITY	16	5	0
	URBAN TOWN	8	0	0
	DISTRICT TOWN	11	4	1
	RURAL DISADVANTAGE	12	2	0
PRIVATE	CITY	0	4	0
	URBAN TOWN	1	0	0
	DISTRICT TOWN	1	0	0
	RURAL DISADVANTAGE	0	0	0
STATE	CITY	38	13	0
	URBAN TOWN	31	22	1
	DISTRICT TOWN	35	12	0
	RURAL DISADVANTAGE	8	3	0

DISCUSSION

Table 2 shows that schools under the state authority embrace ICT services more than agency and private schools. Table 2 further shows the lowest percentages of ICT status under private authority. One of the reasons for this observation is due to the lowest number of participants from private schools that took part in the survey. Private schools operate mostly in cities and urban towns and are absent in district towns and rural disadvantage settings given the economic nature of their school management and administration. This study highlights the critical concern that rural disadvantaged schools under all three school authorities suffer from little to no access to ICT services.

Table 4 shows that all schools under the three school authorities and four different locations are dominated by traditional method of teaching and learning. In this study, it refers to chalkboard writing and face-to-face teacher to student teaching and learning. While the study shows a relatively small indication of embracing blended teaching and learning, almost all schools in Papua New Guinea are yet to explore and fully embrace the benefits of fully online teaching and learning.

ICT services are vital part of shifting from traditional pedagogical strategies to student-centred teaching and learning through blended and fully online teaching and learning. The global trend of education in this digital age is to give students opportunities to be responsible and take ownership of their learning. The findings of this study highlight critical need areas to be improved particularly for grades 11, 12 and first-year university transitional physics education. Below are some of the recommendations for transformational physics education. Some of the recommendations to enhance the cultural Intelligence are given below.

- Run upskilling training to physics teachers on blended and fully online teaching and learning.
- Government and private organizations to support schools with ICT and internet facilities.
- First-year physics students to have orientation on fully online teaching and learning platforms.
- Government and private organizations to support universities with digital infrastructure.
- Encourage peer collaborations in fully online teaching and learning.
- Universities and secondary to work collaboratively for transitional physics education.

CONCLUSION

There is a significant disparity in the ICT status between the schools under different authorities and locations. Students attending rural disadvantaged schools under all three school authorities are significantly marginalised from accessing basic and useful ICT services. A critical highlight in this study is the significant gap between the secondary schools and universities in terms of information and resources sharing for transitional physics education. While universities in Papua New Guinea have embraced digital technology to support and promote blended and fully online teaching and learning, high schools and secondary schools continue to hold onto and practice traditional pedagogy. We recommend secondary schools physics teachers upskilling to blended and fully online teaching and learning platforms. Close collaboration between universities and secondary schools is highly recommended for successful transitional physics education into first-year university studies.

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