# Impact Factors of Information and Communication Technologies (ICTs) in Education

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**Abstract**

*This study reports the impact of Information and Communication Technologies (ICTs) on teaching and learning at a Nigerian University; the survey data were drawn from 593 respondents (students and lecturers) and was analyzed using factor analysis. Five factors are extracted named improved student learning, task enabler, psychosocial aid, collaborative assessment and lastly, improved learning output.*

**Keywords:** *ICTs, impact, Teaching and Learning, Education*

## INTRODUCTION

The research question addressed in this study (*What are the underlying impact factors of ICT in teaching and learning in the perspectives of both students and lecturers?*) revealed 5 underlying impact factors of ICT in teaching and learning at a Nigerian University. Perceived impact scale of the survey instrument used was analyzed to extract the impacts of ICT in teaching and learning from the perspectives of both lecturers and students. The perceived impact scale was singly analyzed because it is the only scale of the questionnaire in which all its 21 items describe how students and lecturers perceive the values of ICT in teaching and learning. Quota sampling method known for its representativeness was used to select the samples for this survey; though, it may lack the generalizability associated with probabilistic random sampling (Trochim, 2006). However, this study could benefit from transferability to other settings and population because of the high reliability of both students' and lecturers' survey instrument and the pilot study conducted in a different setting for validity purpose (Tashakkori & Teddlie, 2009).

TESTS OF ASSUMPTIONS

The data was analyzed by means of a principal components analysis with varimax rotation. The various indicators of factorability were good. The KMO value is .863, exceeding the recommended value of .6 (Kaiser, 1974). It shows that the partial relationship among the variables is significant and for the application of factor analysis (Table 1). The Bartlett Test of Sphericity reached a statistical significance (Bartlett, 1954) confirming the strength of the relationship among the variables and supporting the factorability of the correlation matrix (Table 1).

Table 1

KMO and Bartlett's Test

| Measures | Values |
|---|---|
| KMO Measure of Sampling Adequacy | .863 |
| Bartlett's Test of Sphericity | |
| ▪ Approx. Chi-Square | 2886.122 |
| ▪ DF | 171 |
| ▪ Sig. | .000 |
| | |

In the anti-image correlation matrix, all the individual variables included in the analysis were greater than 0.5, (between .800 and .900) supporting their retention in the analysis (Costello & Osborne, 2005). The correlation matrix also yielded a pattern of relationship among the five factors. The degree of inter-item correlations is moderate as shown in Table 2 (Sahari & Langgulung, 2005).

Table 2

Correlation Matrix

| | Stdlearn | Taskenabler | Psychosoc | Colasses | Learnout |
|---|---|---|---|---|---|
| | | | | | |
| Stdlearn | 1.0000 | | | | |
| Taskenabler | .5236 | 1.0000 | | | |
| Psychosoc | .5437 | .4820 | 1.0000 | | |
| Colasses | .5301 | .5693 | .5489 | 1.0000 | |
| Learnout | .4609 | .5115 | .4097 | .5421 | 1.0000 |

Five components have initial eigenvalues greater than 1.0 and they accounted for a total variance explained

of 57.9%. The first factor has an eigenvalue of 30.3%, three others have values of 7% while the last factor has an eigenvalue of approximately 5.4% (see Table 3).

**Table 3**

Total Variance Explained

| component | Initial eigenvalues | | | Extraction sum of squared loadings | | |
|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| | | | | | | |
| 1 | 5.756 | 30.294 | 30.294 | 5.756 | 30.294 | 30.294 |
| 2 | 1.511 | 7.952 | 38.246 | 1.511 | 7.952 | 38.246 |
| 3 | 1.367 | 7.195 | 45.440 | 1.367 | 7.195 | 45.440 |
| 4 | 1.357 | 7.140 | 52.580 | 1.357 | 7.140 | 52.580 |
| 5 | 1.018 | 5.360 | 57.940 | 1.018 | 5.360 | 57.940 |

The communalities tell how much variance each variable has in common but items 9 and 10 have disturbingly low values of .26 and .39 respectively (see Table 4). Costello and Osborne (2005) state that .5 or better is desirable and indicates a solid factor. This makes those two items unlikely to be useful in defining a factor thus, they were removed and the remaining 19 items were computed again. In the rotated component matrix analysis (Table 4), the computed 19 items of the instrument are loaded into five factors. There is no cross loading among the 5 factors. One of the 5 factors has 5 loaded variables, two have 4 loaded items, and the other two have 3 loaded variables. All the items in each factor have factor loadings greater than .4. This result indicates a moderate data (Costello & Osborne, 2005).

Table 4

Rotated Component Matrix with Communalities

| Item No | Item Label | 1 | 2 | 3 | 4 | 5 | Communalities |
|---|---|---|---|---|---|---|---|
| P1 | Quality of education | .751 | | | | | .675 |
| P2 | Learning is learner-centred | .739 | | | | | .636 |
| P3 | Students' motivation | .709 | | | | | .660 |
| P5 | Increases positive effects | .489 | | | | | .504 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| P11 | Lessens lecturers burden | | .708 | | | | .571 |
| P13 | Students explore more | | .687 | | | | .564 |
| P12 | Reduces students' task | | .671 | | | | .513 |
| P15 | Facilitates learning process | | .554 | | | | .469 |
| P7 | Higher-order thinking | | | .837 | | | .737 |
| P8 | Improves critical thinking | | | .754 | | | .675 |
| P6 | Student/lecturer interaction | | | .612 | | | .463 |
| P17 | Enhances students' assessment | | | | .659 | | .517 |
| P14 | Improves lecturer' performance | | | | .596 | | .602 |
| P4 | Increases collaboration | | | | .580 | | .631 |
| P19 | Lecturer collaboration | | | | .570 | | .512 |
| P18 | Enables resource sharing | | | | .546 | | .574 |
| P20 | Improves research output | | | | | .766 | .640 |
| P21 | Students' independent learning | | | | | .710 | .551 |
| P16 | Access to information | | | | | .462 | .512 |

THE EXTRACTED UNDERLYING IMPACT FACTORS

The first factor extracted is named **improved student learning** because it contains items P1 (improves quality of education), P2 (changes learning environment), P3 (increases motivation), and P5 (increases positive effects) all of which describe benefits pertaining to students' learning. This factor explains 30.3% of the total variance which is

relatively large compared to subsequent factors. The second factor explains close to 8% of the total variance and it describes ICT as a **task enabler** because it eases learning tasks and enhances performance as measured by items P11 (ICT lessens lecturers burden), P12 (reduces students' task), P13 (enables students to explore more), and P15

(facilitates learning process). Items P6 (changes the nature of student/lecturer interaction), P7 (improves higherorder thinking), and P8 (improves critical thinking/learning) describe ICT as a thinking and social relation tool thus leading to the third factor, **psychosocial aid**. 7.2% of the total variance was accounted for by this factor.

The fourth factor **collaborative assessment** stems from four items that revolve round **collaboration, students' assessment and resource sharing** with ICT to achieve academic goals. The items P4 (enhances students' assessment) P14 (increases collaboration among students), P17 (improves lecturer performance), P18 (enables

resource sharing), and P19 (enables lecturer collaboration) accounted for 7.1% of the total variance and they are listed below respectively.

Lastly, the factor **improved learning output** explains 5.4% of the total variance and culminates from items P16 (ICT increases access to resourceful information), P20 (Improves research/project output), and P21 (Aids students' independent learning). Having extracted the factors, a reliability test was subsequently run on the factors loaded. The Cronbach's alpha value of each factor is shown in Table 5.

Table 5

Reliability Statistics for Individual Loaded Factors

| Factors | Cronbach's Alpha |
|---|---|
| Improved Student Learning | .800 |
| Task Enabler | .794 |
| Psychosocial Aid | .804 |
| Collaborative Assessment | .784 |
| Improved Learning Output | .816 |

The first factor named **improved student learning** addressed improved quality education, learning environment, motivation and positive effects. The second factor describes ICT as a **task enabler** because it eases learning tasks and enhances performance. The third factor described ICT as a thinking and social relation tool thus leading to the name **psychosocial aid**. The fourth factor **collaborative assessment** revolves round collaboration, students' assessment and resource sharing with ICT to achieve academic goals. Lastly, the factor **improved learning output** culminates from the fact that ICT increases access to resourceful information, improves research/project output and aids students' independent learning.

Several researchers (Trucano, 2005; Wright et al., 2007; Kozma, 2005) have found that ICT has great potentials that impact on teaching and learning which are consistent with the findings of this study. On the factors "improved student learning" and "improved learning output", Trucano (2005) believes ICT motivates and engages students to learn and helps broaden their skills, helps to simulate the work place experiences thereby preparing students for the challenges of the labour market. This revolutionalizes the school environment, facilitates teaching by providing resourceful teaching aids for teachers and connects the school to the outside world. Trucano (2005) ascertains that technology empowers teachers and learners and promotes the growth of skills necessary for the 21st century workplace.

On collaborative assessment, Wright et al. (2007) describes ICTs as giving opportunities for students to explore, discover, create, communicate effectively and freely with instructors, complete and receive assignments and feedback online, initiate and participate in online discussions. Spector (2008) advocates how student collaboration is achieved through technology-mediated communication such as e-mail and teleconferencing across space and time

in local and wider communities. Kozma in Kozma (2003b) and Kozma and McGhee (2003) illustrated a student learning approach in which students collaborate with their peers in given projects. He named this approach the Student Collaborative Research Cluster. These classroom practices support the development of skills needed by a society focused on sustained economic development and social transformation: information management skills, communication and collaboration skills, interpersonal and self-directional skills, and ability to create and innovatively apply new knowledge to solve complex problems. Similarly, Simonson, Smaldino, Albright and

Zvacek (2003) ascertained that ICTs foster collaborative learning.

Considering teachers' professional development cannot be achieved in isolation, Kozma also exemplified how teachers collaborated with students, colleagues in the school and others outside the school such that ideas on how classroom problems are solved could be shared and disseminated across. Collaboration among lecturers as a benefit of ICT use in teaching is also found in Abolade and Yusuf (2005) that ICT allows for networking with other teachers, thus teachers are more connected with each other to exchange ideas, share resources, and improve teaching practices.

The impact, "task enabler", is supported in Abolade and Yusuf (2005) having described ICT as essential tools in any educational system which has the potentials of being used to meet the learning needs of individual students, promote equality of educational opportunities; offer high quality learning materials, increase self-efficacy and independence of learning among students, and improve teachers' professional development. They also affirmed that ICT provide opportunity for connecting schools to world, as learning is expanded beyond the classroom; that allows students and teachers to access information and resources.

The psychosocial impacts described in both lecturers and students' finding in this study has a backing in the works of Lajbcyier and Spratt (2007) and Garrison, Anderson and Archer (2001). They argue that the social presence develop critical thinking and cognitive skills and promote higher order learning in a community of learners. Some of these impacts of ICT in teaching and learning such as interaction and social negotiation of meaning were also affirmed in Madden, Nunes, McPherson, Ford and Miller (2007).

## CONCLUSION

The five impact factors extracted from this study named improved student learning, task enabler, psychosocial aid, collaborative assessment and improved learning output are consistent with findings of several other authors that ICT motivates and engages students to learn and helps broaden their skills, helps to simulate the work place experiences thereby preparing students for the challenges of the labour market.

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