

Exploratory factor analysis of ICT based teaching in secondary schools: A case study of Balasore district, odisha

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Abstract

The present world is known as the "age of information explosion." The pace of technical development has resulted in an unprecedented advancement of information and communication technology (ICT). ICT is employed in a variety of sectors, and it has not left the sector of education unaffected. Schools cannot stay impervious to ICT as it begins to control and reshape our lives. ICT is finding a home in classrooms all over the world. In emerging countries, the introduction of ICT in education has now become a major problem. We cannot imagine education without the use of ICT. In this context, a study was conducted to understand the perception of secondary school teachers towards implementing an ICT-based teaching and learning environment in the Balasore district of Odisha. A total of 256 secondary school teachers were interviewed on various aspects of using ICT in the school system, and the information so collected was analysed by using exploratory factor analysis.

KEYWORDS: Secondary schools, Exploratory factor analysis, ICT

1-Background of the study

In the twenty-first century, the integration of technology has reshaped our society and changed our way of life. Technology has completely changed our way of life; in fact, we can no longer imagine life without it (Grabe, 2007). With liberalization and globalization of India since 1991, the economic process has been changing very fast especially with rise of internet technologies. Technology has pervaded almost all of our daily activities, including our lifestyle and our communication. In this way, technology has come to be a boon for the modern economic environment. So far as teaching pedagogy is concerned, technology has a tremendous benefit in terms of easing the mode of delivery of education and easing understanding by students in the classroom. Educators must build favourable perceptions and also awareness about using advanced technologies in school environments in order to successfully use ICT-based instruction. However, the use of ICT is still limited in the education system (Jonassen, D. H. (1999)). The objective is to provide strong, customized, and learning content packages to students over the World Wide Web. The students can get the materials at a minimal cost. It addresses the skills required to use internet technologies for classroom instruction. It intends to concentrate on adequate teaching methods for e-learning, offering digital research facilities for performance and experimentation.

ICT has become an essential component of today's teaching and learning processes. When we use technological tools, we can encourage students, make our classrooms more dynamic and exciting, and revive teaching methodology with new skills and approaches. The significance of ICT in the education sector is becoming increasingly important and this importance has expanded in the twenty-first century (Finger & Trinidad, 2002). Information and communication technologies (ICT) have become widespread in all spheres of life. Over the last two decades, the use of ICT has significantly modified the traditional practices in the education sector. ICT in education allows for more student-centered learning environments (J. E. Lawrence, 2015). ICTs have been one of the fundamental building elements of modern civilization. In many countries, developing and mastering fundamental ICT skills and ideas is now considered part of the core of education (Daniels 2002).

The use of ICT in the physical classroom helps to build an atmosphere in which students may engage in important learning opportunities. Furthermore, ICT encourages students to think imaginatively and pushes them above their standards (Arnseth & Hatlevik, 2012). The method can help to tie together these new creative energies and skills by creating a student-centered environment for learning that goes beyond the typical classroom.

2-Rationale of the study

Computer-based systems offer enormous platforms for providing education. One of the most exciting aspects of the information age is the fast growth of information and communication technology (ICT). ICT makes information more accessible, allows for new forms of communication, and supports a variety of online services in the domains of commerce, culture, amusement, and schooling. It creates a productive learning atmosphere for students, necessitating a distinct skill set in order to succeed. Critical thinking, investigation, and assessment abilities are becoming increasingly important as students must navigate through substantial amounts of information from a wide range of sources. ICTs for schools refer to the creation of communication and information technology for instruction objectives. There are numerous changes occurring in the instructional process, and in order to address these changes, ICT should be included in educational institutions. However, there is a gap in the process of upgrading instructors' minds in order to embrace it. It is therefore essential to understand how the usage of ICT in schools should be embraced. In this context, a study is being conducted to better understand secondary school teachers' perceptions of implementing an ICT-based teaching and learning environment in Odisha's Balasore district.

3-Review of literatures

Transformation is necessary for progress and is highly prevalent in all areas of life. And so, classroom education must change as well, with the elimination of many old methods for dealing with the current changing scenario. As a result, ICT has been included as part of the school system to help learners receive better education. The incorporation of ICTs into teaching and learning is a pressing requirement in today's life (Albrini, 2006). The use of ICT may have a significant impact on the teaching and learning process. First, the rich representation of information improves learners' perception and knowledge of the context. Second, the widespread dissemination and ease of access to information can alter interactions between instructors and students (Chandra, S. and Patkar, V. (2007)). ICT may also be a strong enabler of educational innovation. The increasing trend of young students accessing ICT-based education has been observed in recent decades (Jamieson-

Procter et al., 2013). ICT allows students to access material at any time and from any location, increasing the flexibility of instructional delivery (Mooij, T. (1999). This, in turn, would start preparing students for continuous improvement and increase learning quality (Moore and Kearsley, 1996). Learners may now explore through e-books and other resources. At the same time, they can easily access resources from all over the world (Flecknoe, 2002). This adaptability has offered learning chances for many more learners who were previously restricted by other responsibilities (Young, 2002). ICT may improve education quality in a variety of ways. The students can be motivated to be engaged in the classroom activities by making the learning procedures more interesting with more visuals in the classroom. If used effectively, ICTs may be revolutionary tools, encouraging the shift to a learner-centered environment (Afshari, 2009). Instead of merely allowing instructors and students to do what they've always done better, ICTs, particularly computers and Internet technologies, offer new forms of teaching and learning (Jorge et al., 2003). Greater availability of best practices and course content in education may be shared through ICT to promote better teaching. ICT also enables academic institutions to enter new worldwide educational marketplaces. In addition to studying at any time, instructors are discovering that the ability to teach at any moment may be utilized to advantage (Nakayima, J. K., 2011). ICT enables access to knowledge by utilizing numerous information sources. ICT may also help people to grasp complicated processes by using simulations, which contribute to genuine learning situations. As a result, ICT may serve as a guide for students to acquire knowledge and improve their judgment (Alexander, 1999; Jonassen, 1999).

4-Objective

The main objective is to identify the factors that explain the way the teachers perceive in implementing ICT based teaching learning method in the secondary municipality schools of Balasore district, Odisha by using the multivariate statistical technique-**Exploratory Factor Analysis (EFA)**.

5- Methodology of the Study

5.1-Population

The study is based on secondary school teachers of Balasore district. And so the population consists of 4210 teachers working in 607 secondary schools spreading over twelve blocks of the district (Source: District Statistical Hand Book). But, it is not possible to conduct the study by including 4210 teachers within limited time period and so 256 teachers were selected at random from each of 12 blocks of Balasore district which constitutes the sample.

5.2-Determination of Sample Size

The sample size decision is tested as follows.

$$n = \text{Total Sample size} = \frac{\frac{z^2 p (1-p)}{e^2}}{1 + \frac{z^2 p (1-p)}{Ne^2}} = 256$$

N = Population size = 4120

e= Error involved = 5%, P = Proportion of schools = 0.50

Z = Critical value at 90% confidence level = 1.645

The sample size is limited to 256 randomly selected teachers from each of 12 blocks of Balasore district.

5.3-Collection of Data

Both primary and secondary data have been used in the study. The information about secondary schools and the number of teachers in each block of Balasore district have been collected from secondary sources like government publications and official websites. The information about various aspects of ICT based teaching; collected from 256 teachers constitute primary data. A well designed questionnaire consisting of eleven items based on implementation of ICT based teaching in school teaching learning process has been used as an instrument tool to collect the primary data from 256 randomly selected teachers on 5-point scale. Where, 5-indicates strongly disagree and 1-indicates strongly agree attitude to that particular item/statement. The selection of the items is made by reviewing various literatures. The reliability of the questionnaire was also tested. Thus the sample size is restricted to 256 teachers of secondary schools of Balasore municipality. The data have been collected within four months period of 2021. The collected data have been analyzed through SPSS-23. The selection of sample size is determined by the following rule.

6-Techniques of Data Analysis

EFA is used to group interrelated variables into more fundamental variables known as factors. It is a statistical approach for condensing data into a smaller number of variables and investigating the phenomena underpinning the conceptual model. A factor is a variable affecting a number of multiple observed variables and accounts for the correlations between them. To put it another way, the observed measurements are linked since they are caused by the same factor. Factor loadings are regression weights that are standardized (Norris, Megan; Lecavalier, Luc, 2009)

7-The Results

The primary data so collected were analyzed by using SPSS-23 as detailed in below tables. The study has considered following eleven statements for Factor Analysis.

X 1	ICT helps teachers to speedy coverage of course.
X2	ICT improves the quality of teaching.
X3	It is easy to understand the course with the help of ICT
X4	ICT enabled learning creates interest among the students to learn
X5	ICT helps to access the information related to the course
X6	ICT keep the students engaged in the class
X7	ICT based schooling makes learning more successful
X8	ICT facilitates to prepare teaching resources
X9	ICT creates interest among students to be involved in lesson with visual descriptions of the facts
X10	ICT helps to learn from anywhere as the student desire.
X 11	There is easy accessibility of information due to ICT

“The reliability and validity of the instrument are tested through Cronobach’s Alpha and KMO value. The value of Alpha needs to be more than 0.60” (Fornell, C., & Larcker, D. F, 1981)

Table-1: Reliability and Validity

Alpha	N
.831	11

The value of Alpha (0.831) is more than 0.60, indicating a strong level of internal consistency for the scale used as measuring instrument. Convergent validity is also tested in factor analysis with high factor loadings of more than 0.760. Construct validity is also explained with alpha reliability value of 0.831 and KMO value of 0.756 (Hair et al., 1995).

Table-2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.756
Bartlett's Test of Sphericity	Chi-Square
	.000

Above table gives the value of “KMO and Bartlett’s” test of the analysis. Bartlett’s test of sphericity indicates that variables are related with each other for measuring and significant. As a rule of thumb, a p value needs be less than 0.05 ($P = 0.000$) in order to proceed with the factor analysis.

Table-3: Communalities

	Extraction
ICT helps teachers to speedy coverage of course.	.829
ICT improves the quality of teaching.	.553
It is easy to understand the course with the help of ICT	.857
ICT enabled learning creates interest among the students to learn	.503
ICT helps to access the information related to the course	.767
ICT keep the students engaged in the class	.579
ICT based schooling makes learning more successful	.816
ICT facilitates to prepare teaching resources	.887
ICT creates interest among students to be involved in lesson with visual descriptions of the facts	.872
ICT helps to learn from anywhere as the student desire.	.906
There is easy accessibility of information due to ICT	.824

Table-3 highlights that the highest communalities value is recorded against “learning from anywhere” (0.906), “facilitates to prepare teaching resources and materials” (0.887), “creates interest among students” (0.872), “easy accessibility of information” (0.824), “makes learning more successful” (0.816), “speedy coverage of course” (0.829), “easy to understand the course” (0.857), these are mostly significant and indicate higher communalities of value greater than 0.8. The communalities are also more than 0.5 in

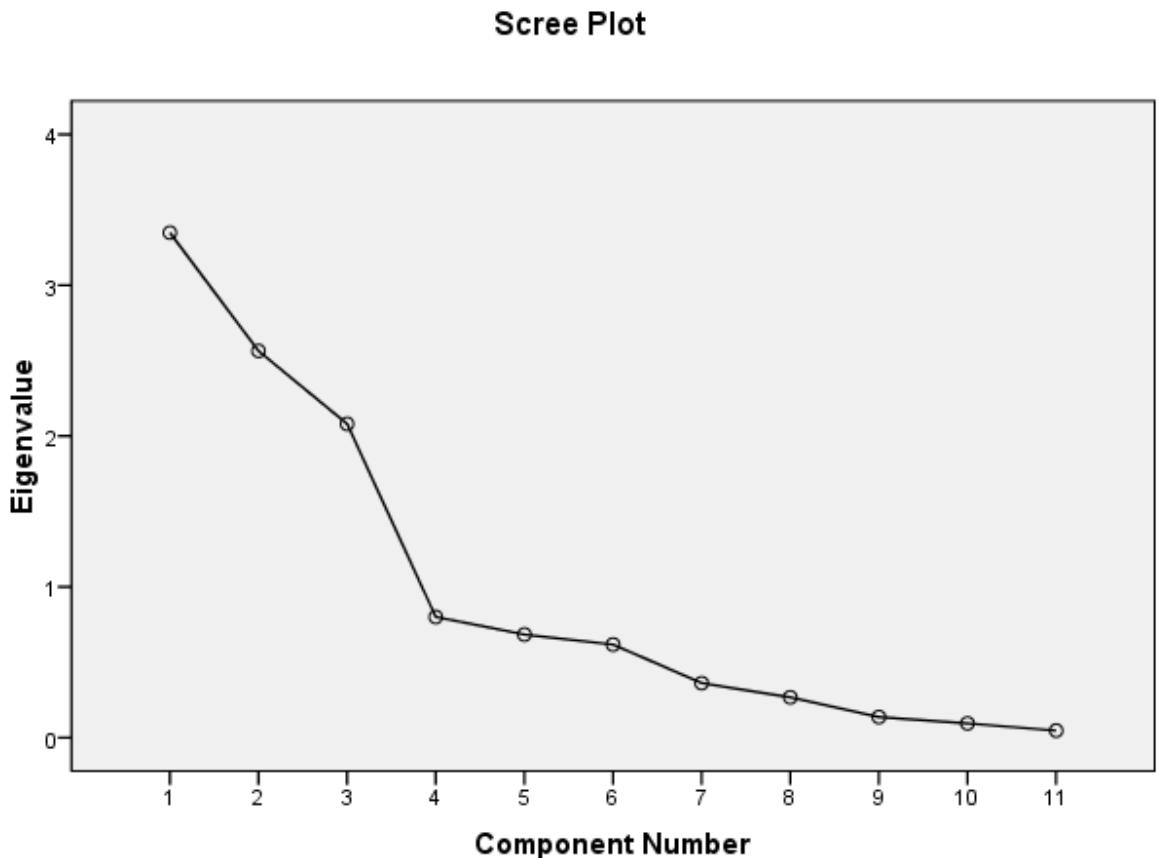
case of other variables, which are mostly acceptable for further analysis and best fit to the loadings.

Table-4: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.349	30.441	30.441	3.349	30.441	30.441	2.890	26.276	26.276
2	2.564	23.309	53.750	2.564	23.309	53.750	2.603	23.660	49.937
3	2.080	18.910	72.661	2.080	18.910	72.661	2.500	22.724	72.661
4	.800	7.273	79.934						
5	.683	6.213	86.147						
6	.617	5.612	91.758						
7	.362	3.287	95.045						
8	.268	2.433	97.478						
9	.137	1.241	98.719						
10	.095	.859	99.578						
11	.046	.422	100.000						

It is recommended to retain all factors with Eigen values of 1.0 or more for further investigation” (Pallant, 2005; Field, 2009). The exploratory factor analysis yielded 3 components with Eigen values >1.0.

Fig-1L: Scree plot



The scree plot demonstrates that all variables load on three factors.

Table-5: Component Matrix

ICT helps teachers to speedy coverage of course.	-.655	.617	.140
ICT improves the quality of teaching.	-.423	.415	.041
It is easy to understand the course with the help of ICT	.641	.355	.565
ICT enabled learning creates interest among the students to learn	.419	.304	.485
ICT helps to access the information related to the course	.438	.539	-.533
ICT keep the students engaged in the class	.453	.166	.382
ICT based schooling makes learning more successful	-.619	.629	.190
ICT facilitates to prepare teaching resources	-.680	.643	.108
ICT creates interest among students to be involved in lesson with visual descriptions of the facts	.648	.339	.580
ICT helps to learn from anywhere as the student desire.	.486	.535	-.619

There is easy accessibility of information due to ICT	.505	.513	-.553
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The correlation of each item with the component is exhibited in above table.

Table-5: Rotated Component Matrix

ICT helps teachers to speedy coverage of course.	.908		
ICT improves the quality of teaching.	.890		
It is easy to understand the course with the help of ICT		.917	
ICT enabled learning creates interest among the students to learn		.708	
ICT helps to access the information related to the course			.871
ICT keep the students engaged in the class			
ICT based schooling makes learning more successful	.902		
ICT facilitates to prepare teaching resources	.937		
ICT creates interest among students to be involved in lesson with visual descriptions of the facts			.926
ICT helps to learn from anywhere as the student desire.			.950
There is easy accessibility of information due to ICT			.901

To produce a more conceptually and relevant factor solution, a rotating technique was used. A factor loading with an absolute value of 0.3 or 0.4 is the minimum permissible value for practical importance. As a result, the current study investigated each variable's rotational loadings in order to identify the variable's function and significance in generating the factor model.

8- Major Findings

The analysis explored four important factors.

Factor-1

The first factor has four significant loadings of more than 0.80. It accounts for 30.441 % of variance and gives importance on “effective teaching”, “course material preparation” and “speedy coverage of course”. That means the teachers will be able to provide quality teaching with the help of ICT enabled teaching learning method. It is therefore named as – “Quality Teaching”

Factor-2

The second factor “Easy understanding” gives importance on “easy to understand, increase in interest amongst student and staying engaged in the class” as a result of ICT enabled teaching. The factor has four significant loadings of value more than 0.70 and accounts for 23.309 % of variance.

Factor-3

The third factor has three significant loadings of the variables –“accessibility of information” with values more than 0.80. And so it is named as “Easy access to information”. The factor accounts for 18.910 % of variance.

9-Educational Implications

The acceptance and use of ICT in education improves teaching, learning, and research. It would create a vibrant environment for the education profession by providing new options for teachers and students. Increased use of ICT also supports better teaching and greater academic accomplishment for students. With the help of technology teacher can be able to present complex concepts in the form of three dimensional pictures. Thus, the standard of education provided to students may be substantially enhanced with the aid of ICT. ICT provides flexibility so that learners may access education regardless of time or location. The interactive aspect of the program encourages students to learn. It has the potential to change the way students are trained and learn in the future. ICT encourages youngsters to think, develop, and solve issues in novel ways, allowing both students and instructors to think "beyond the box". The findings of the study will be helpful to the educational experts and the government to plan strategically to implement ICT based teaching for all levels of school learning system.

10-Conclusion

ICT integration in institutions is seen as a need, and it is increasing at an exponential rate. The widespread use of technological advancements in the fields of life, the information industry, and massive change all put pressure on institutions to embrace strategies that assist students in developing 21st century abilities. The advancement of ICT has resulted in fast development in a variety of sectors. It has also made its way into the education system due to its suitability, application, and adaptability in classroom instruction. For both students and instructors, ICT is the single means to bring forth extra advantages that contribute to more self-regulated learning. ICT has brought about rapid development in the sphere of classroom instruction in society. The use of ICT in the physical classroom helps to build an atmosphere in which students may engage in important learning opportunities. The findings of the study acknowledged that ICT has enormous potential for enhancing the teaching and learning process and identified "**quality teaching**", "**easy understanding**", and "**easy access to information**" as three prominent factors of implementing ICT based teaching and learning methods in secondary schools. ICT promotes personalized learning and the development of problem-solving abilities.

References

1. Afshari, M., Bakar, K. A., Luan, W. S., Samah, B. A., & Fooi, F. S. (2009). Factors Affecting Teachers' Use of Information and Communication Technology. *International Journal of Instruction*, 2(1), 77–104
2. Alexander, J.O. (1999). Collaborative design, constructivist learning, information technology immersion, and electronic communities: a case study. *Interpersonal Computing and Technology: An Electronic Journal for the 21st Century*. 7: 1–2.
3. Albirini, A. (2006) Teachers' Attitudes toward Information and Communication Technologies: The Case of Syrian EFL Teachers. *Computers and Education*, 47(4), 373–398
4. Arnseth, H.C., & Hatlevik, O.E. (2010). Challenges in aligning pedagogical practices and pupils' competencies with the Information Society's demands: The case of Norway. In S. Mukerji & P. Tripathi (Eds.), *Cases on technological adaptability and transnational learning: Issues and challenges*. Hershey: IGI global.

5. Chandra, S. and Patkar, V. (2007). 'ICTS: A catalyst for enriching the learning process and library services in India', The International Information and Library Rev. 39(1): 1-11
6. Daniels J.S. (2002) —"Foreword" in Information and Communication Technology in Education—A Curriculum for Schools and Programme for Teacher Development. Paris:UNESCO.
7. Finger, G., & Trinidad, S. (2002). ICTs for learning: An overview of systemic initiatives in the Australian states and territories. Australian Educational Computing, 17(2), 3-14.
8. Flecknoe, M. (2002).—How can ICT help us to improve education? Innovations in Education and Teaching International, 39(4): 271-280
9. Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. Journal of Marketing Research, 18(3), 382–388. <https://doi.org/10.2307/3150980>
10. Grabe, M., & Grabe, C. (2007). Integrating technology for meaningful learning (5th ed.). Boston, MA: Houghton Mifflin.
11. Hair, J. F., Jr., Anderson, R. E., Tatham, R. L. and Black, W. C. (1995) Multivariate Data Analysis, 3rd ed, Macmillan Publishing Company, New York.
12. Jamieson-Proctor, R., Albion, P., Finger, G., Cavanagh, R., Fitzgerald, R., Bond, T., & Grimbeek, P. (2013). Development of the TTF TPACK Survey Instrument. Australian Educational Computing, 27(3),26-35.
13. Jorge, C. M. H., Gutiérrez, E. R., García, E.G., Jorge M. C. A., & Díaz, M. B. (2003). Use of the ICTs and the perception of e-learning among university students: A differential perspective according to gender and degree year group. Interactive Educational Multimedia, 7, 13-28.
14. Jonassen, D. H. (1999).Computers as mind tools for schools: Engaging critical thinking (second Ed.). Englewood Cliffs, NJ: Prentice Hall.
15. J. E. Lawrence, "Examining the factors that influence ICT adoption in SMEs: a research preliminary findings," International Journal of Technology Diffusion (IJTD), vol. 6, no. 4, pp. 40–57, 2015
16. Mooij, T. (1999).Guidelines to Pedagogical Use of ICT in Education. Paper presented at the 8th Conference of the European Association for Research on Learning and Instruction' (EARLI). Goteborg Sweden, August 1999.
17. Nakayima, J. K. (2011). Perceived usefulness, perceived ease of use, behavioural intention to use and actual system usage in Centenary Bank (Doctoral dissertation, Makerere University).
18. Norris, M., Lecavalier, L. Evaluating the Use of Exploratory Factor Analysis in Developmental Disability Psychological Research. J Autism Dev Disord **40**, 8–20 (2010). <https://doi.org/10.1007/s10803-009-0816>
19. <http://opepa.odisha.gov.in/SchoolReports/SchoolDetails.aspx>