

TEACHERS' CONCERNS ON INTEGRATING INFORMATION AND COMMUNICATIONS TECHNOLOGIES INTO PHYSICAL SCIENCE IN LESOTHO

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ABSTRACT

The integration of information and communication technologies (ICTs) into teaching depends on teachers' viewpoints manifested as concerns. This paper investigates teachers' concerns in selected Lesotho schools regarding the new reform namely, the integration of ICTs into physical science instruction. Data were collected from a random cluster sample using the stages of concern questionnaire with an 8-point Likert scale. Statistical analysis software (SAS) was employed to analyse the data to get the descriptive results and the ANOVA of the hypothesis. The percentile score for the informational self-concerns was the highest at 87.5. This demonstrates that the teachers were concerned about gaining knowledge of ICT integration. These teachers therefore require ongoing support providing more information on available ICTs and their potential to improve teaching.

Keywords: ICT integration, concerns-based adoption model, teachers' concerns, physical science

INTRODUCTION AND BACKGROUND OF THE STUDY

The 21st century life is technology-driven resulting in complex learners with different demands from their teachers (Dass, 2014). The link between educational transformation and ICTs has been established in developed countries rather than in developing countries (Shahmir, Hamidi, Bagherzadeh, & Salimi, 2010). Learners need to harness the potential of ICTs in their learning because ICTs can improve the quality of education in a variety of ways (Alkahtani, 2016). However, the use of ICTs for teaching is restricted, even in schools where the ICT resources are available (Gur & Karamete, 2015). The majority of teachers use ICTs in a limited manner even though they have positive feelings towards ICTs' ability to improve instruction (Aslan & Zhu, 2016). The use of complex e-learning software such as Moodle and Sakai, among others, is particularly low in developing countries because these forms of ICTs have quickly evolving digital characteristics that complicate their use (Sife, Lwoga & Sanga, 2007).

ICT infrastructure and training will not necessarily result in the actual usage of ICTs for teaching (Agyei 2013). However, insufficient planning and lack of understanding regarding what the implementation ICT integration involves, among others, may result in limited instructional use of ICTs (Sife et al., 2007). Other barriers to ICT integration into classroom practice include, among others, restricted time, lack of knowledge and confidence among teachers, as well as dearth of technological skills among learners (Alkahtani, 2016). Teachers' lack of control over computer laboratories, particularly where computers are managed by external funders, can also be a challenge. For instance, the Khanya project in the Western Cape in South Africa was perceived to be controlling when and who should use the computer laboratory (Chigona, Chigona & Davids, 2014). It is imperative to investigate teachers' concerns regularly to afford them with appropriate support.

In Lesotho, ICT integration into the general curriculum is a demand of the national ICT policy (Lesotho government, 2005). This policy has led to the localised Lesotho version of the International General Certificate of Secondary Education curriculum. The curriculum demands learners' acquisition of technological and communication skills as they learn the content (Examinations Council of Lesotho, 2012). Although the teachers are expected to use ICTs for instruction, there is no clear guidance regarding how this expectation should be met. Lesotho's infrastructure and accessibility to ICTs are also poor (UNESCO, 2016). As a

result, the rate at which teachers integrate ICTs into teaching is low in Lesotho (Kalanda & De Villiers, 2013). However, cellular phone services have increased the telephone mass in Lesotho from 1% to 96% between the years 2000 and 2015, thus making cellular data services accessible to more people (Morgan-Jarvis, 2015). Teachers need to take advantage of the modern technologies that are brought by smart phones. This paper explores the teachers' concerns related to their response to this call of the curriculum for the integration of ICTs into instructional activities by testing the null hypothesis that: High school teachers in Lesotho do not have significant concerns regarding the integration and use of ICTs for teaching physical science. The paper is outlined into five sections namely the introduction, the theoretical framework, the methodology, the results and discussions, as well as the conclusions and recommendations.

THEORETICAL FRAMEWORK

We need to understand teachers' personal attributes and motivational factors that influence those attributes when introducing ICTs in schools. This is because teachers' perspectives regarding ICTs affect their acceptance and use of technology for teaching (Chigona et al., 2014). Fuller, Parsons and Watkins (1974) refer to these perspectives as concerns by which teachers indicate their requirements. These writers posit that concerns motivate the teachers' choice of what they want to learn. As a result, the present study is based on the concerns-based adoption model (CBAM). This model was developed by Hall, Wallace and Dossett at the University of Texas-Austin in 1973, building on Fuller's concerns theory (Centikaya, 2012).

CBAM was chosen on grounds of its popularity among studies which seek to promote and facilitate innovations from the personal standpoint (Sultana, 2015). It is essential to comprehend the individual aspect of the implementation process to minimise resistance towards innovations (Hall & Hord, 2011). CBAM also helps us to describe and evaluate the phases of improvement of teachers learning about ICT integration into the classroom. This is because CBAM views change as a process rather than a once-off occasion, which transpires gradually through different phases determined by one's abilities and feelings, among other factors. Most importantly, CBAM warns us against the presupposition that use of an innovation is only two-fold (use and non-use) but argues that it is a multifaceted endeavour (Hall, 2010). Table 1 summarises the stages of concern.

Table 1: Stages of concern (Adapted from George, Hall & Stiegelbauer, 2006, p. 40)

Stages of concern	Expression of concern
6. Refocusing impact concerns	Knowing an alternative that has more potential than ICTs.
5. Collaboration impact concerns	Worrying about interaction with colleagues when using ICTs.
4. Consequence impact concerns	Worrying about the effect of ICTs on students.
3. Management task concerns	Worrying about how long it takes to learn about the new ICTs.
2. Personal self-concerns	The need to know of the influence of ICTs on one's daily work.
1. Information self-concerns	The need to know more information about ICT integration.
0. Awareness (Unconcerned)	Complete lack of knowledge about ICT integration.

METHODOLOGY

We applied a quantitative approach, deductive post-positivism and descriptive non-experimental survey design. This approach allowed us to be objective, logical and systematic when testing the hypothesis while concentrating on the purpose of the study (Mulwa, Kyalo, Bowa, & Mboroki, 2012). The design enabled a large population of teachers to be explored through a sample because it is flexible and adaptable (Johnson & Christensen, 2014).

A table of random numbers was used to select a cluster sample of 23 of 138 schools offering physical science (Examinations Council of Lesotho, 2012; StatTrek, 2016). The final sample consisted of 76 teachers. The schools were selected from five of the ten districts of Lesotho, namely Mafeteng, Maseru, Berea and Leribe in the lowlands as well as Mokhotlong in the highlands. This sample was varied for a fair representation of the population at more reasonable costs and time (Creswell, 2013). The respondents filled an 8-point Likert questionnaire consisting of 21 close-ended items covering their demographics and concerns on ICT integration into instruction (Hall, George & Rutherford, 1977). Weightings of the responses ranged from 0=Irrelevant to 7=Very true of me now. The questionnaires were personally delivered to the selected schools and then gathered after completion.

Data were analysed using the statistical analysis software (SAS, 2013). This software has recently become popular in research related to ICT integration into teaching and learning (Alkahtani, 2016). Firstly, the frequencies of the responses to the biographical questions were calculated. Then, the description statistics were calculated for the mean scores. The respondents were categorised for each biographical variable because all the variables were categorical. The mean for the stages of concern of the demographic groups was contrasted through one-way analysis of variance (ANOVA). The sum score in question was the dependent variable whereas the stipulated biographical variable was the single factor in the ANOVA model.

The ethical clearance for this study was obtained from the University of the Free State. Permission to conduct this study was acquired in writing from the Ministry of Education and Training as well as the principals of participating schools. Participation was voluntary and informed. The respondents were not deliberately exposed to harm and their privacy and confidentiality were observed (Johnson & Christensen, 2014). A pilot study was conducted to enable the necessary amendments to the research process to be made for a higher response rate and stronger reliability and validity. Some of the confounding variables of the study, such as teachers' age and gender, were explored in terms of their effect on the teachers' concerns to improve internal validity (Bhattacharjee, 2012).

RESULTS AND DISCUSSIONS

Demographic results

Table 2 shows the demographic details of the sample. The sample was constituted by higher percentages of teachers aged 30 to 39 (53), males (69), teachers with 5 to 14 years of experience (51), teachers from church schools (81) and teachers from schools in the lowlands (89). The numbers of teachers in various categories differ because some of the teachers did not provide some of their demographic details.

Table 2: Teachers' demographic data (n = 76)

Age (n=73)			Gender (n=71)		Experience in years (n=72)			School type (n=73)		School location (n=72)	
20-29	30-39	40+	Male	Female	0-4	5-14	15+	Church	Other	Lowlands	Highlands
15	39	19	49	22	20	37	15	59	14	64	8
21%	53%	26%	69%	31%	28%	51%	21%	81%	19%	89%	11%

Teachers' stages of concern

The percentile scores for the stages of concern for all the teachers in the sample are 12.5, 87.5, 50, 25, 62.5, 75 and 37.5 for stages 0, 1, 2, 3, 4, 5 and 6 respectively. The teachers' concerns are the most intense around stage 1 (informational concerns) and stage 5 (collaboration concerns), as it was the case in other studies (e.g. Centikaya, 2012; Lopez & Wise, 2014). George et al. (2006) posit that teachers with longer experience with an innovation typically have high collaboration concerns (stage 5). In the case of Lesotho, these may be the teachers who started using ICTs before the new curriculum was introduced or when it began in 2012, hence the experience with ICT integration into their instruction.

Teachers who do not use ICTs, or those who are beginning to use them, are expected to have high informational concerns (Hall, Newlove, George, Rutherford, & Hord, 1991). More teachers were at stage 1 showing that they require information about ICTs. The combination of high informational and collaboration concerns is indicative of teachers considering the possibility of learning from each other regarding the integration of ICTs into the curriculum (Shu, 2016).

The percentile score for stage 0 is the lowest at 12.5 indicating that only a few teachers are not aware of the new innovation that demands ICT integration into curricular activities. Hall and Hord (2011) emphasise that many respondents will not be concerned about a reform that is only starting. Therefore, many teachers seem to be aware of the ICT-driven curriculum which commenced in 2012. The sampled teachers also had the second lowest percentile score (25) at stage 3 (management concerns), thus indicating that a relatively low number of teachers is concerned about time and administration issues involved in the learning of the new forms of technology (Hall et al., 1977). The percentile score for stage 6 (refocusing concerns) which is 37.5 is lower than the score for stage 5 (75) showing a downward ending of the results. This means that the teachers are uninformed of any other innovation that works better than ICT integration for instructional improvement (Hall et al., 1991).

Table 3 illustrates teachers' mean and standard deviation scores according to their demographic groups. This table shows the stage 1 mean for teachers working in schools not owned by churches as 6.2 and for teachers working in the highlands as 6.4. These scores are higher than the overall mean score for all teachers which is 5.7 for stage 1. These teachers are relatively more curious about ICTs than the rest of the sample. This concern may be related to the availability of ICT resources for the selected government and community schools (others) as well as schools in the highlands (Hall et al. 1991). Table 3 also shows stage 5 mean scores as 5.0 for female teachers, 5.3 for teachers aged 20 to 29, 5.2 for teachers between 0 and 4 years of experience, 5.3 for teachers from government and community schools (others) and 5.4 for teachers from the highland schools. These groups have higher mean scores for collaboration concerns than the overall mean score for this stage, $M=4.9$. The teachers from schools in the highlands have a more interesting profile indicating the highest mean scores for all stages except for stage 4. This indicates that they have more intense concerns than the rest of the groups in general.

All the standard deviations range from 0.4 to 2.2 (see Table 3). These low standard deviations signal non-significant differences within the groups. However, the group of teachers with 15 or more years of experience has the highest standard deviations for stages 2 (2.0), 3 (1.7), 4 (2.0), 5 (2.1) and 6 (2.0) which demonstrate the largest variations within the group. These teachers seem to have different experiences regarding ICT training. Some of them may have obtained some ICT skills from teacher workshops and self-training initiatives (Khan, 2014).

Table 3: Descriptive statistics of teachers' stages of concern by biographical groups

Variable		Stage 0		Stage 1		Stage 2		Stage 3		Stage 4		Stage 5		Stage 6	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Overall		2.3	1.4	5.7	1.1	4.5	1.3	3.8	1.4	4.6	1.4	4.9	1.5	4.0	1.3
Gender	Female	2.3	1.1	5.7	1.1	4.8	1.2	4.2	1.5	5.1	1.5	5.0	1.5	4.9	0.9
	Male	2.3	1.5	5.6	1.2	4.3	1.4	3.6	1.3	4.5	1.4	4.8	1.5	4.0	1.4
Age	20-29	1.7	1.0	5.8	1.0	4.6	0.9	3.7	1.2	3.9	1.4	5.3	1.1	4.1	1.4
	30-39	2.4	1.4	5.6	1.3	4.6	1.3	3.8	1.5	4.8	1.4	4.9	1.4	4.4	1.2
	40+	2.6	1.8	5.9	0.9	3.4	1.8	3.8	1.6	4.9	1.8	4.4	2.1	4.0	1.7
Experience	0-4	2.4	1.5	5.9	1.0	4.7	1.0	4.0	1.4	4.4	1.1	5.2	1.0	4.3	1.3
	5-14	2.4	1.5	5.6	1.3	4.5	1.4	3.7	1.4	4.6	1.6	4.9	1.6	4.2	1.2
	15+	2.6	1.0	5.7	1.2	4.2	2.0	3.9	1.7	4.8	2.0	4.2	2.1	4.0	2.0
Type	Church	2.3	1.3	5.6	1.2	4.5	1.3	3.7	1.3	4.5	1.3	4.8	1.4	4.2	1.2
	Others	2.3	2.2	6.2	0.9	4.4	1.8	4.1	1.6	4.9	1.7	5.3	1.8	4.3	1.7
Location	Lowlands	2.4	1.4	5.7	1.2	4.4	1.5	3.7	1.5	4.6	1.6	4.8	1.4	4.1	1.4
	Highlands	2.7	2.2	6.4	0.4	5.0	0.6	5.1	0.8	5.0	0.6	5.4	0.8	5.3	0.5

Reliability

The Cronbach alpha coefficients of internal reliability for the stages of concern were 0.63_{S0}, 0.62_{S1}, 0.43_{S2}, 0.34_{S3}, 0.55_{S4}, 0.68_{S5} and 0.27_{S6}. These values are not comparable with the values obtained by Hall et al. (1977) where n=830. Their large sample size may have caused their alpha values' to range from 0.64 to 0.83. However, the coefficients are comparable to George et al.'s (2006) values from their validity study where n=40. This sample size was small and the alpha values ranged from 0.41 to 0.69. Our coefficients indicate that the items used were nonetheless reliable because they were neither above 0.9 nor very close to 0 (Tavakol & Dennick, 2011).

ANOVA for the hypothesis

Most of the p-values (32 of 35) for the stages of concern (Table 4) are above the statistical significance level (α) of 0.05 (Bhattacharjee, 2012). Consequently, we fail to reject our null hypothesis that high school teachers in Lesotho do not have significant concerns regarding the integration and use of ICTs for teaching physical science. The results do not seem to depend on the teachers' age, gender, experience, type or location of school. However, there are three (of 35) p-values below the confidence level, $\alpha = 0.05$. These are the values for gender ($p = 0.0143_{S2}$ and $p = 0.0087_{S6}$) and for type of school (0.0066). These three values demonstrate significant differences between the intensity of concerns between males and females related to how the use of ICTs will affect their daily routine in stages 2 and their knowledge of other innovations that work better than ICTs in stage 6. They also mean that there is a significant difference between teachers working in church schools and other schools regarding how the ICTs impact on their students in stage 4 (Greenland et al., 2016). The sources of the differences between these groups of teachers require further research.

Table 4: The p-values for the stages of concern

Stage of concern	Age	Gender	Experience	Type of school	Location of school
0-Awareness	0.2280	0.8826	0.7397	0.7818	0.2685
1-Informational	0.8526	0.7714	0.7178	0.1757	0.2339
2-Personal	0.1111	0.0143	0.7125	0.6726	0.7935
3-Management	0.4532	0.0937	0.8749	0.3111	0.1610
4-Consequence	0.1284	0.1211	0.5422	0.0066	0.9046
5-Collaboration	0.3766	0.7349	0.2720	0.4173	0.6114
6-Refocusing	0.2122	0.0087	0.5629	0.0948	0.2074

CONCLUSIONS AND RECOMMENDATIONS

In most countries, including Lesotho, it is the government officials', rather than teachers' decision to choose to use various ICT resources in schools (Hall, 2010). Research affords decision makers with the necessary information for planning future reforms and monitoring progress of their implementation (Hall & Hord, 2011). Evidence from studies on teachers' concerns may lead to a tailored support for the teachers.

This article sought to establish the teachers' concerns regarding the integration of ICTs into the teaching of physical science. The sampled physical science teachers experienced the entire spectrum of concerns from stage 0 to stage 6. However, the results demonstrate that most teachers have informational self-concerns (stage 1), which are typical of people either at an early phase of an innovation or who do not use the innovation (George et al., 2006). The physical science teachers are willing to integrate ICTs into their instruction even though they may not be currently doing so for reasons that require further inquiry. A good number of teachers also reported impact concerns in stages 4 and 5. As Hall et al. (1991) have asserted, a profile that peaks around these stages befits teachers with plenty of experience with the innovation. These teachers are interested in learning from their colleagues and they are also curious about how ICT impacts student learning.

These findings should be used with caution because the sample was not large enough to reach the targeted 50% of the 138 schools that offer physical science, which is recommended for the results to be generalised to the rest of the population (Leedy & Ormrod, 2005). However, the results are useful because the sample was representative of most groups of teachers. We recommend that teachers' needs related to ICT integration into the curriculum should be thoroughly interrogated through research in order for them to be incorporated into the future educational plans.

REFERENCES

- Agyei, D.D. (2013). Analysis of technology integration in teacher education in Ghana. *Journal of Global Initiatives: Policy, Pedagogy, Perspective*, 8(1), 69-86.
- Alkahtani, A. A. (2016). The challenges facing participants in integration of ICT skills and equipment into the classrooms in SAUDI secondary schools. *Social Science Learning Education Journal*, 1, 39-47.
- Aslan, A., & Zhu, C. (2016). Influencing factors and integration of ICT into teaching practices of pre-service and starting teachers. *International Journal of Research in Education and Science*, 2(2), 359-370.
- Bhattacharjee, A. (2012). *Social science research: Principles, methods, and practices*. Retrieved from http://scholarcommons.usf.edu/oa_textbooks/3 [Accessed 30 January 2012].
- Centikaya, B. (2012). Understanding teachers in the midst of reform: teachers' concerns about reformed sixth grade mathematics curriculum in Turkey. *Eurasia Journal of Mathematics, Science and Technology Education*, 8(3), 155-166.
- Chigona, A., Chigona, W., & Davids, Z. (2014). Educators' motivation on integration of ICTs into pedagogy: Case of disadvantaged areas. *South African Journal of Education*, 34(3), 1-8.
- Creswell, J.W. 2013. *Steps in conducting a scholarly mixed methods study*. Retrieved from <http://digitalcommons.unl.edu/dberspeakers/48> [Accessed 01 June 2013].
- Dass, R. (2014). Literature and the 21st century learner. *Procedia-Social and Behavioural Sciences*, 123, 289-298. doi:10.1016/j.sbspro.2014.01.1426
- Examinations Council of Lesotho (ECOL). (2012). *LGCSE physical science*. Maseru: Ministry of Education and Training.
- Fuller, F., Parsons, J.S., & Watkins, J.E. (1974). Concerns of teachers: Research and reconceptualisation. *Paper presented at the annual meeting of the American Educational Research Association*, Chicago, Illinois.
- George, A.A., Hall, G.E., & Stiegelbauer, S.M. (2006). *Measuring implementation in schools: the stages of concern questionnaire*. Retrieved from <http://www.sedl.org/pubs/catalog/items/cbam17.html> [Accessed 03 October 2016].
- Greenland, S., Senn, S.J., Rothman, K.J., Carlin, J.B., Poole, C., Goodman, S.N., & Altman, D.G. (2016). Statistical tests, p values, confidence levels, and power: a guide to misinterpretations. *European Journal of Epidemiology*, 31, 337-350. doi:10.1007/s0654-016-0149-3
- Gur, H., & Karamete, A. (2015). A short review of TPACK for teacher education. *Educational Research and Reviews*, 10(7), 777-789. doi:10.5897/ERR2014.1982

- Hall, G.E. (2010). Technology's Achilles heel: achieving high-quality implementation. *Journal of Research on Technology in Education*, 42(3), 231-253.
- Hall, G.E., George, A.A., & Rutherford, W.L. (1977). *Measuring the stages of concern about the innovation: a manual for use of the SoC questionnaire*. Austin: University of Texas.
- Hall, G.E., & Hord, S.M. (2011). Implementation: learning builds the bridge between research and practice. *Journal of Staff Development*, 32(4), 52-57.
- Hall, G.E., Newlove, W.E., George A.A., Rutherford, W.L., & Hord, S.M. (1991). *Measuring change facilitator stages of concern: a manual for use of the change facilitator stage of concerns questionnaire*. Greeley, CO: University of Northern Colorado. Centre for Research on Teaching and Learning.
- Johnson, R.B., & Christensen, L. (2014). *Educational research: quantitative, qualitative, and mixed approaches* (5th ed.). Los Angeles: Sage Publications.
- Kalanda, K., & De Villiers, M.R. (2013). E-learning in the science curriculum: a study in selected high schools in Lesotho. *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications* in Victoria, Canada. Association for the Advancement of Computing in Education (AACE). EdMedia.
- Khan, S.H. (2014). A model for integrating technology into teacher training programs in Bangladesh based on TPCK. *International Journal of Education and Development using Information and Communication Technology*, 10(3), 21-31.
- Leedy, P.D. & Ormrod, J.E. (2005). *Practical research: Planning and design*, 8th ed. Thousand Oaks, NJ: Pearson Education.
- Lesotho government. (2005). *ICT policy for Lesotho final*. Maseru: Government printing.
- Lopez, P., & Wise, D. (2014). Leading change for the implementation of common core state standards in rural school districts. *NCPEA Education Leadership Review of Doctoral Research*, 2(1), 47-56.
- Morgan-Jarvis, L. (Ed.). (2015). *The Lesotho review: an overview of the kingdom of Lesotho's economy 2015 edition*. Durban: Wade Publications.
- Mulwa, A., Kyalo, N., Bowa, O., & Mboroki, G. (2012). Influence of ICT infrastructure on readiness to adopt e-learning in secondary schools in Kitui District, Kenya. *Journal of Continuing, Open and Distance Education*, 2(1), i-229.
- SAS Institute Inc. (2013). *SAS/STAT 13.1 user's guide*. Retrieved from <https://support.sas.com/documentation/cdl/en/statug/66859/HTML/default/viewer.html> [Accessed 10 July 2013].
- Shahmir, S., Hamidi, F., Bagherzadeh, Z., & Salimi, L. (2010). Role of ICT in the curriculum, educational system. *Procedia Computer Science*, 3, 623-626.
- Shu, X.Y. (2016). An action research on TPACK's influence on teachers of national open university exemplified with an English teacher of Zhejiang Radio and Television University. *Open Access Library Journal*, 3, e2336.
- Sife, A.S., Lwoga, E.T., & Sanga, C. (2007). New technologies for teaching and learning: challenges for higher learning institutions in developing countries. *International Journal of Education and Development using Information and Communication Technology*, 3(2), 57-67.
- StatTrek. (2016). *StatTrek random number generator*. Retrieved from <http://stattrek.com/statistics/random-number-generator.aspx> [Accessed 04 February 2016].
- Sultana, N. (2015). Application of concerns-based adoption model (CBAM) for launching the information technology based teacher education program at AIOU. *Asian Journal of Social Sciences and Humanities*, 4(3), 153-166.
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53-55. doi:10.5116/ijme.4dbf.8dfd
- UNESCO. (2016). *Communication and information*. Retrieved from <http://www.unesco.org/new/en/communication-and-information/portals-and-platforms/goap/access-by-region/africa/lesotho/> [Accessed 09 July 2016].