

B.2 Digitalization in schools – An empirical study of teachers’ attitude towards the use of ICTs after the introduction of a “One Laptop per Teacher” Initiative

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Abstract: To improve the quality of teaching, many governments around the world have begun implementing extensive programs aimed at supporting teachers in their efforts to employ information and communication technologies (ICTs) to facilitate their introduction in the teaching-learning process. A prominent case study is the “One Laptop per Teacher” (OLPT) initiative, which was introduced in Bolivia in 2011. Due to the lack of evidence regarding the success and effect of this program, this empirical study first deals with teachers’ attitudes towards ICTs by employing a quantitative approach based on three dichotomous distinctions, including: (a) personal experience with ICTs use versus consequences for the society of ICTs use, (b) ICTs use for learning and working versus ICTs use for entertainment and communication, and (c) positive attitudes (i.e., ICTs as beneficial tools) versus negative attitudes (i.e., ICTs as autonomous entities). Study results confirm that most teachers display positive attitudes towards the use of technologies from a personal perspective, but from a social point of view, the use of ICTs to deliver entertainment and communication content is perceived quite negatively, and many teachers still consider ICTs as suppressors of creativity and personal interactions. Significant differences were found in personal attitudes between rural and urban areas, the indicators for ICTs as generators of anxiety were higher in the former. Moreover, teachers with more experience in the use of ICTs and teachers who have participated in virtual courses clearly held more positive attitudes towards the use of ICTs in the workplace.

1 Introduction

In recent years, the educational programs implemented in schools around the world have been adapted and updated to promote learning using information and communication technologies (ICTs¹) in the teaching process. This has turned out to be a very complex endeavor from the perspective of all the educational actors (e.g., governments, teachers, students, parents), since its implementation requires significant changes at all levels (e.g., technological, pedagogical, organizational) (Sutherland et al., 2004). Large investments have been needed to provide adequate

1 For this study ICTs refer to PCs, Laptops, Netbooks and Internet

infrastructure and opportunities for teachers to obtain the skills necessary in the use of ICTs and their integration in the teaching-learning process (Kraemer, Dedrick & Sharma, 2009).

These investments are of great magnitude, particularly for developing countries, as access to computers and the Internet is generally expensive, for both students and teachers. Some countries focused first on the assurance of technology access for students inside and outside the school. Examples include programs like OSOL (One School One Laboratory) in Indonesia (the World Bank, 2005) and OLC (One Laptop per Child) in Nigeria, Rwanda (Miller, 2007), Uruguay (De Melo, Machado & Miranda, 2017), Libya, and India (Coomar & Ryzhov, 2015). Instead, other countries have tried to provide access for teachers through programs like OLPT (One Laptop per Teacher) in Guyana (Moore, 2012) and Bolivia (Ministerio de Educación de Bolivia, 2011). Governments have also been investing in the training of teachers and administrative personnel by developing new policies for the introduction of ICT in schools to bring the expected benefits. However, in spite of large investments in these initiatives, a review of the literature revealed that there are still many encountered barriers in incentivizing teachers to use ICTs as media for their work (Fu, 2013, p. 115). Surprisingly, many European countries have not developed similar approaches yet, and they are lagging behind in the introduction of laptops to school, especially at the primary school level.

The present study takes the example of Bolivia, where an OLPT initiative with training courses for teachers has been in place since 2011. Since a scientific study has not yet been undertaken regarding the acceptance and intention to use ICTs in the teaching practice, this paper primarily focuses on exploring teachers attitudes because the literature indicates that attitudes are strong influencers in the effective implementation of ICTs in the educational practice (Knezek & Christensen, 2008).

The following research questions were developed for the purposes of this study.

- What are the attitudes and beliefs of Bolivian teachers towards the use of ICTs in their personal lives and in the workplace?
- What differentiating attitudes can be identified in the context of Bolivia?

2 Literature review

According to Altmann (2008), the concept of attitude in the literature is very vague. However, most of the definitions emphasize the importance of the experience in the formation of judgments that further determine the actions of the individual regarding an object or a situation. For the scope of this paper, the definition from Crano & Prislin

(2006) will be used as a reference: “Attitudes represent an evaluative integration of cognitions and affects experienced in relation to an object. Attitudes are the evaluative judgments that integrate and summarize these cognitive/affective reactions” (p. 347).

This relationship between attitude and behavior has been the subject of much research generating well-known theories, such as the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980), the Theory of Planned Behavior (TPB) (Ajzen, 1991), the Decomposed Theory of Planned Behavior (DTPB) (Taylor & Todd, 1995). In turn, they have been used as the basis for theoretical extensions regarding the acceptance and adoption of technology, such as the Technology Acceptance Model (TAM) (Davis, 1985) that, with the support of empirical studies, have confirmed the importance of attitudes in the acceptance of new technologies and their real use.

Among these empirical studies, there is research on teachers’ attitudes and acceptance of ICTs in education (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012). Most of them focus on the investigation of the affective and behavioral components of attitudes (Njiku, Maniraho & Mutarutinya, 2019), the abstraction models focus on the feelings and emotions caused by using ICTs through the evaluation of statements based on the subjective experience of the teacher using certain markers (e.g., “I like it”, “I enjoy it”, “it bores me”, “I trust it”, “it provokes anxiety”, “it generates stress”).

However, most studies do not consider the bipolar nature of attitudes since an attitude can be positive or negative, favorable or unfavorable. (Altmann, 2008, p. 146) These studies neither contemplate the normative or social components of attitudes, such as the social acceptance of ICTs or if they fit the moral values and beliefs of the teacher’s society, which are relevant according to theories of changing attitudes and behavior (Wood, 2000). Apparently, the social influence on attitudes and the adoption of media has lost importance in the recent models of adoption of technologies although it is an aspect that cannot be ignored. Fulk, Schmitz & Steinfield (1990) presented some examples of the failure of the introduction of new technologies due to the neglect of the social environment of the user.

3 Research design

3.1 Instrument

The instrument chosen to answer the research questions is based on the Questionnaire for the Content-differentiated Assessment of Attitudes toward the Computer (QCAAC, or FIDEC in German) developed by (Richter, Naumann & Groeben, 2000). This

questionnaire is included in the Computer Literacy Inventory² (INCOBI) (Richter, Naumann & Groeben, 2001) and was updated in 2010 (the revised INCOBI-R version) (Richter, Naumann & Horz, 2010). It was selected because it allows for the investigation of individual and social attitudes along different purposes for its usage. The instrument was translated to Spanish.

The QCAAC is a paper-based instrument composed of eight-attitude scales, each considering three dichotomous distinctions:

1. The “personal experience” (PE) vs. the “social consequences” of using ICTs (CS) (Richter et al., 2010).
2. The use of ICTs “for learning and working” (LW) vs. “for entertainment and communication” (EC) (Richter et al., 2010)
3. Positive attitudes (ICTs as beneficial tools / useful technologies) (+) vs. negative (ICTs as autonomous entities / uncontrollable technologies)(-) (Richter et al., 2010)

The combination of these three dichotomous distinctions results in 8 differentiated scales. Each QCAAC scale contains between 8 and 10 items (77 questions in total) that are evaluative statements about the use of computers and the internet that the teachers can rate using a 5-point Likert scale anchored and operationalized by -2 (strongly disagree), -1 (disagree), 0 (neither agree nor disagree), 1 (agree) and 2 (strongly agree), which are presented in a random order for a better estimation of the validity of this instrument for the present study.

3.2 Sample

Due to the large size of Bolivia, only six of the nine provinces were considered for this study, including La Paz, Oruro, Tarija, Chuquisaca, Santa Cruz and Cochabamba taking schools in both rural and urban areas. The calculation of the sample was based on the total number of teachers in 2017 ($N = 179582$).

Due to the complexity of the instrument, the recommended confidence level is 90% with an error of 5% and a response distribution of 50%, and therefore the ideal sample size is 271. A total of 305 surveys were responded throughout Bolivia and after data screening, 286 complete records were selected for the quantitative data analysis.

2 INCOBI is an instrument for the evaluation of computer literacy and attitudes towards the computer, through assessments of practical knowledge and computer theory, self-confidence in using computer, and attitudes towards it.

4 Results

4.1 Descriptive statistics

The demographic data of the sample is representative of the total number of teachers in Bolivia provided by the ministry of education in 2017.

A total of 72.4% of the respondents have benefited from the OLPT initiative. The majority of teachers were women. Most of the respondents were between 31 and 40 years old. Almost 80% of the teachers possessed a bachelor's degree, and 68.8% of the teachers in the sample are in schools in urban areas.

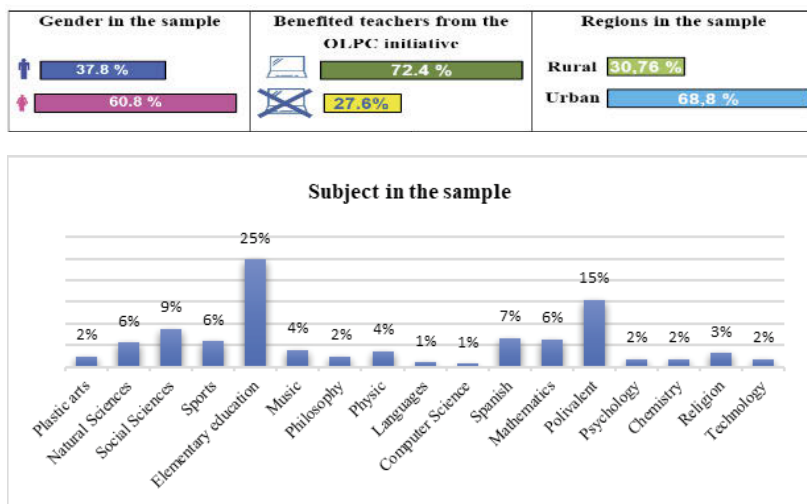


Figure 1: Demographics of Sample

It was not possible to obtain a clear overview on the subjects taught by the teachers, because the two largest groups of respondents are elementary school teachers who teach 4 subjects (Mathematics, Language, Social Studies and Natural Sciences) and polyvalent teachers who teach more than 2 subjects in secondary schools, which could be in different study fields (see Figure 1).

Before conducting the study throughout Bolivia, a pilot study was conducted in the city of Tarija with 20 teachers, helping to correct the 77 statements linguistically in Spanish and avoid misunderstandings. After performing a factor analysis with the whole sample, statement 32 was eliminated, as in the anti-image matrix it had a

value under 0.5. The distribution of the items in the eight scales with their principal descriptive and their estimation of reliability are as follows.

Table 1: QCAAC Scales – Cronbach alpha, means and standard deviations of the sample

Scale	Items	C α	Mean	STD
PE/LW+	Q8, Q16, Q21, Q22, Q23, Q31, Q33, Q47, Q57, Q61	0.806	0.893	0.059
PE/LW/-	Q13, Q14, Q17, Q26, Q27, Q50, Q56, Q58, Q62, Q68	0.710	0.029	0.089
PE/EC/+	Q2, Q11, Q15, Q25, Q37, Q41, Q44, Q49	0.698	0.706	0.080
PE/EC/-	Q10, Q19, Q29, Q34, Q51, Q60, Q63, Q71, Q74	0.718	0.116	0.150
CS/LW/+	Q1, Q6, Q12, Q18, Q20, Q35, Q39, Q43, Q48, Q77	0.728	0.903	0.047
CS/LW/-	Q5, Q7, Q9, Q30, Q42, Q45, Q46, Q59, Q75	0.724	0.141	0.074
CS/EC/+	Q4, Q28, Q38, Q40, Q52, Q55, Q64, Q65, Q66, Q69	0.707	0.746	0.070
CS/EC/-	Q3, Q24, Q36, Q53, Q54, Q67, Q70, Q72, Q73, Q76	0.801	0.631	0.088

SPSS 22 was used for statistical calculations, with all the scales passing the reliability test with a Cronbach's alpha greater than 0.65, which indicated that the internal consistency of the items was acceptable. However, it is recommended that the PE/EC/+ scale be revised, since it has only a minimally-acceptable level of reliability (DeVellis, 2012).

4.2 Distribution of Attitudes

Figure 2 shows that the attitudes of teachers, regarding the personal perspective in considering ICTs as useful tools for learning and working, tends to be positive. However, in evaluating question 21, “Nowadays, I can hardly imagine working without a computer”, most showed a negative or neutral position towards it, meaning they may not consider it essential for work. Based on discussions with some school principals in the pre-study, it was possible to find out that teachers use the laptops provides by OLPT to make their annual teaching plans and the preparation of student reports, which is currently mandatory electronic. However, it seems that teachers do not use the media during the classroom due to different factors (e.g., no applicability by subject or grade, lack of time for production or class planning, poor infrastructure in the school).

Most teachers do not consider ICTs to be uncontrollable, which further reinforces positive attitudes.

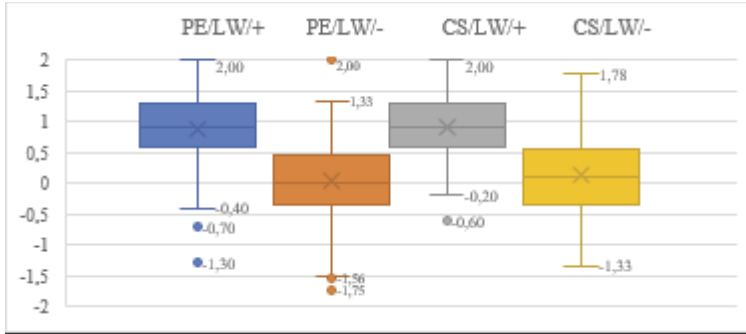


Figure 2: Comparison of teachers attitudes for Learning and Working

Teachers' attitudes towards ICTs as a media for entertainment and communication is, on average, relatively good. However, more than 40% of teachers supported the statement Q34: "I think that communication with electronic media is cold and impersonal", and Q10 regarding the damages on the use of computer games.

Although teachers present positive attitudes from the personal perspective of using ICTs for entertainment and communication, there are some aspects of these social components, which had very negative responses and could impede the introduction of ICTs in pedagogical practice (see Figure 2 CS/LW/- & Figure 3 CS/EC/-). One example is that most teachers strongly agreed with the statement presented as Q42: "It is a problem that computers control so many spheres of society".

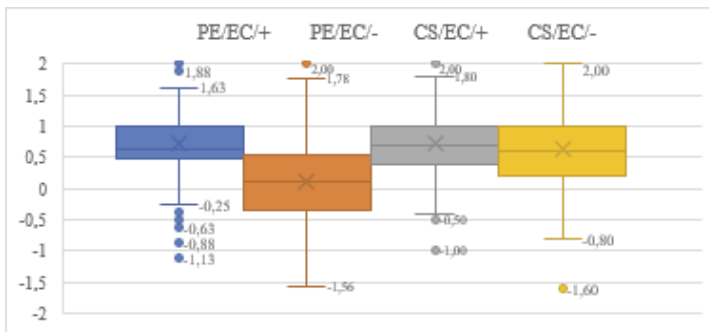


Figure 3: Comparison of teachers attitudes for Entertainment and Communication

From a social perspective, attitudes towards ICTs as useful tools for learning and working are clearly more negative than those from the personal perspective of those who participated in this study. Most teachers agreed or had a neutral attitude towards negative ideas about the use of ICTs in society. For example, teachers widely agreed to the statement presented in Q9: “the negative consequences of computer technology for learning are generally underestimated” (see Figure 2 CS/LW/-). These attitudes could also be a big obstacle for the effective use of ICTs in the classroom.

The most interesting findings of this study are the relatively convincing results related to the social components of attitudes towards ICTs as entertainment and communication media. Most teachers consider new media that is used for fun and games to be harmful to young people in addition to suppressing their creativity and personal contact (see Figure 3 CS/EC/-).

4.3 Differentiating attitudes

With the use of a multivariate analysis of variance (MANOVA) and one-way analysis of variance (ANOVA) to find significant differences between postures to the statements in certain categorical variables, such as age, gender, region, teaching experience, media experience and digital-learning experience, certain significant differences were found between groups.

The following table presents the significant differences ($p < 0,05$) found with help of a Turkey post-hoc test. As seen in Table 2, there are significant differences in attitudes by age, all being found in negative attitudes towards the use of ICTs. There were also clear differences when regarding the use of ICTs for entertainment and communication. The negative attitudes of teachers older than 51 are more pronounced than for other groups, both in personal and social dimensions.

Table 2: Selected significant results – Between-Subject Effects test

Dependent Variable			Mean Difference (I-J)	Std. Error Lower Bound	Sig. Upper Bound	95% Confidence Interval	
PE/LW/-	31-40	51-60	-.90945*	.29264	.018	-1.7130	-.1060
	20-30	51-60	-.96296*	.29844	.012	-1.7824	-.1435
	31-40	61-70	1.03968*	.29977	.005	.2166	1.8628
CS/LW/-	20-30	51-60	-.91085*	.30857	.028	-1.7581	-.0636
CS/EC/-	20-30	51-60	-.87320*	.31288	.044	-1.7322	-.0142
	31-40	51-60	-.94457*	.32151	.029	-1.8273	-.0618
	51-60	61-70	.94457*	.32151	.029	.0618	1.8273

There was also a statistically significant difference in attitudes based on working area (rural, urban), $F(16.550) = 2.135$, $p < 0.05$; Wilks' $\Lambda = 0.886$, and all were found for teachers' attitudes towards ICTs as useful tools, specifically for entertainment and communication. Teachers from urban areas presented better personal attitudes regarding all the reasons for using ICTs. By contrast, statements related to the stress and anxiety caused by ICTs were more prominent among teachers in rural areas. However, the social perspectives of using ICTs for entertainment and communication were evaluated more positively in rural areas than in urban ones.

Table 3: Multivariate Tests – MANOVA – Geographic work area

Multivariate Tests ^a						
Effect		Value	F	Hypothesis df	Error df	Sig.
Area	Pillai's Trace	.117	2.139	16.000	552.000	.006
	Wilks' Lambda	.886	2.135	16.000	550.000	.006
	Hotelling's Trace	.124	2.131	16.000	548.000	.006

The creation of groups according to the “years of teaching experience” shows significant differences in the evaluation of attitudes, from the social perspective, towards the use of ICTs for entertainment and communication. Teachers with more than 20 years of experience are more in agreement with statements regarding the danger of having fun or communicating with ICTs.

There are no significant differences between the attitudes of teachers who have received a laptop from the government and those who have not, even when the date on which the laptop was provided is considered. There are also no significant differences in attitudes between genders. It was not possible to perform the tests with subjects as grouping variable because there were many teachers who taught more than 2 subjects in completely different fields, such as mathematics and religion.

Finally, the digital-learning experience was the grouping variable in which the most difference was seen. There is a statistically significant difference in the attitudes based on experience, $F(8, 276) = 3,352$, $p < 0.005$; Wilks' $\Lambda = 0.763$, and on the experience with online course $F(24, 795) = 1,73$, $p < 0.05$; Wilks' $\Lambda = 0.863$. Teachers who rated their experience with the computer as “very experienced” and teachers who have participated in virtual classes present better personal and social attitudes for the use of ICTs as beneficial tools to learn and work, as well as media for entertainment and communication.

5 Conclusions

Attitudes towards the use of ICTs influence the use of ICTs for a purpose. Thus, they are decisive in the measurement of success or failure of the individual decision of a teacher to introduce ICTs in his/her teaching practice. This paper has attempted to study the attitudes using different perspectives reaching the following conclusions:

- Bolivian teachers generally have positive personal attitudes towards the use of ICTs as a working and learning tools, and as media for communication and entertainment. These attitudes are more positive in urban areas. However, there are still clear negative attitudes, which were possible to identify due to the integrated dichotomy of the instrument. As Altmann (2008) advised, the study of negative attitudes should not be ignored since they illuminate possible obstacles. At this point, a deeper qualitative study is recommended to confirm the data of this investigation and find the causes of the negative attitudes mentioned previously.
- The attitudes towards the use of ICTs from social perspectives were more negative. More specifically, teachers considered their personal use as positive, though they were skeptical about the social use of ICTs, especially as a mean of entertainment and communication. Seven years after the introduction of the OLPT initiative, several teachers still consider ICTs, especially the internet, as a suppressor of creativity and interpersonal communication when used in learning. This may be the result of the internalization of a general idea of the group of teachers as explained (Graf-Vlachy & Buhtz, 2017, p. 2336). Accordingly, a qualitative study to understand the cause of these negative attitudes is much needed in future research.
- Teachers with more experience of ICT in their personal lives who have participated in virtual classes or who are engaged with social media presented more positive attitudes than others. Interestingly, in this group, the age ranges are varied and the dates on which they were provided with a laptop. The social component is what differs most in this group from the others. This is supported by Köhler (2003, pp. 145–147) that explains that the decision about using media has a very strong social influence, which is only rationally motivated in individual cases in which the influence of the experience of media use is denoted.
- Attitudes towards the use of ICTs in urban and rural areas varied significantly. That may be due to the fact that internet access in the countryside is still very limited in Bolivia. Specifically, in some cases, the bandwidth would not be enough to watch a high-quality video or for playing an online game. This was the reason most frequently named by school principals during the pre-study.

- The vast majority of the teachers in the sample acknowledge the radical changes in society brought about by ICTs, though many of them are still afraid of the negative consequences with respect to their use for children and young people. The causes for these negative attitudes also deserve further study. According to Moussaïd, Kämmer, Analytis, & Hansjörg (2013), the attitudes regarding the collective perspective are the most difficult to change and require a significant amount of time to evolve.
- It was also possible to identify aspects that could be improved through the use of training courses, such as the insecurity of teachers in troubleshooting technical issues, which may reduce the stress generated by using ICTs.
- Since there is no research on this subject in Bolivia, a comparative study in the future would be recommendable to know if there is an improvement in attitudes towards the use of ICTs in the classroom over time.

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