# DIGITAL TECHNOLOGIES USES IN EDUCATION: A COMPARATIVE STUDY BETWEEN PORTUGUESE SCHOOL PRINCIPALS AND TEACHERS

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**Abstract**

This paper presents the results of a study developed in a doctoral program in education in field of information and communication technologies in education. The study aimed to develop knowledge about the use of digital technologies (DT) in educational contexts, in specific ways, by Portuguese school principals and primary and secondary school teachers. Organized according to a descriptive and exploratory quantitative methodological approach, the study involved data collection from 133 school principals and 1,908 schoolteachers. The results show that school principals present favorable scores of self-efficacy and use of technologies in their professional practices. In same way, high levels of use of technologies in the teachers' practices were identified. The comparative analysis allowed us to distinguish the schools based on levels of technological proficiency evidenced by their principals and the use of the technologies evidenced by their teachers.

*Keywords:* Self-efficacy, school principals, teachers, technology integration, technology uses in education.

## DT in Education: Self-Efficacy, Beliefs, Roles and Use of Technologies by School Principals and Teachers

This study fits into the domain of digital technologies in education with a focus on the use of DT in the professional practices of school principals and teachers. We assumed as relevant the analysis of the beliefs and perceptions of school principals' own practices with technologies of school principals because it has been proved that school principals play an important role as promoters of the integration process of technology in teachers' professional practices in their schools. They should enhance the modernization of practices, teaching and learning, information management and communication between the many educational agents. The process of technology integration in schools requires a favorable combination of all the factors and agents, involving schools, teachers, school principals, students, parents and policy makers.

The DT integration in education is not a simple process; there are a considerable number of inhibiting factors or barriers that need to be analysed and considered. Barriers to the DT integration have been the focus of several studies in the last decades. In many studies and research papers, enhancing factors and obstacles have been analysed. Factors like lack of teacher training, lack of access to technological equipment, teacher motivation, innovative educational projects, stiffness of school curricula and others were pointed out.

Recently studies have pointed to motivational aspects, particularly the sense of self-efficacy, as one of the constraining factors of the educational integration of DT, mainly on their use in the classrooms (Kler, 2015; Petko, Egger, Cantieni, & Wespi, 2015). In the national context, recent studies also pointed to teachers' self-efficacy as a major factor in the DT integration in school practices, as high levels of self-efficacy proved to be directly linked to higher levels of performance with technologies (Piedade, 2010; Piedade & Pedro, 2014; Pedro, 2011; Santos, 2015).

Other studies have identified a strong link between schools' leadership and management practices and the effective process of integration of technology in school daily activities in classroom pedagogical activities and in management and institutional communication practices. The role of school principals in the process is the focus of several international studies (Afshari, Bakar, Luan, Afshari, Say, & Fooi, 2010; Cakir, 2012; Çakir, 2014; Moolenaar, Sleegers, Bryant, & Bryant, 2015; Seyal, 2015; Wong & Khadijah, 2017).

Similarity, Tearle (2003) contended school context and culture, as a whole, play a strong influence on the use of DT in the classrooms. In particular, (a) the support from the school administration and management boards and (b) teachers' constructivist perspectives on teaching and learning play an important role in encouraging the use of technology in teaching practices.

The role played by school administration was also noted by Daly, Pachler and Pelletier (2009) when referring specifically to the challenge of developing in the school principals an appropriate "vision" about the role of ICT in the specific school context. Also, Weng and Tang (2014) in their study with 323 school administrators in Taiwan found that technology leadership strategies had a significantly positive impact on the effectiveness of school administration. The same authors pointed out that technology leadership strategies should be considered as a relevant part of school principals' training programs, in order to improve the effectiveness of such administrative innovation in their school context.

Ibrahim, Razak and Kenayathulla (2013) showed why it is important for principals to acquire the knowledge and skills that will enable them to transform their schools into smart schools. These authors concluded, "A smart school is an educational establishment that adopts instructional processes and educational management practices that foster systemic changes that are intended to enable learners to surmount the challenges posed by the information technology era"(p.828). To that end, school principals need to become proficient users of a variety of software including word processing, spreadsheets, databases and email.

Digital technologies provide a set of potentialities to increase performance of school principals in many dimensions of their professional practices (e.g., communication, assessment, scholar administration, planning, financial, etc.). Zainally (2008) relayed, "ICT provides several facilities for educational administrator to perform their tasks" (p.24). The same confirmation was provided by Maki (2008, quoted by Makewa, Meremo, Role & Role, 2013),

"ICT plays a vital role in supporting powerful, efficient management and administration in education sector"(p.48).

In last years, several quantitative studies have analysed the use of technologies by school principals in their daily activities (Afshari et al., 2010; Arokiasamy, Abdullah, & Ismail, 2015; Çakir, 2014). These studies showed a moderate level of technologies use in principals' practices as well a moderate level of competence. On the other hand, Hoque, Razak and Zohora (2012) pointed out the use of technologies by principals was limited and, in general, the technolgies were not effectively integrated in their practices.

## Research Aims

This paper is based on a wider research (Piedade, 2017) where, among other goals, the author aimed to analyse the practices and proficiency levels in digital technology use presented by Portuguese public school principals as well as technology use by primary and secondary teachers.

The following research questions were assumed:

- What are the levels of proficiency and the levels of DT use in professional practices presented by school principals?
- Is there a correlation between the level of proficiency and the level of DT use presented by school principals?
- What are the levels of DT use in primary and secondary teachers' professional practices?
- It is possible to identify a relationship between the levels of proficiency and DT use presented by a school principal and the level of DT use presented by the school' teachers?

## Methodology

This national study assumes a descriptive and exploratory nature and fits into a post-positivist research paradigm (Creswell, 2007). A quantitative based approach was undertaken for data collection and analysis. Data was collected through three self-report scales, organized in two online questionnaires: the "Computer Self-Efficacy Scale" and "DT Use in Scholar Administration Practices Scale" applied to school principals and the "Measure Teachers Technology Use Scale" applied to school teachers.

Cassidy and Eachus (2002) developed the Computer Self-Efficacy Scale applying the general precepts postulated by Bandura's Social Cognitive Theory. The authors present the instrument as *domain-specific*. It is originally composed of 30 items with a 5-point response options scale in Likert format (ranging from 1 'totally disagree' to 5 'totally agree').

The authors developed the DT Use in Scholar Administration Practices Scale for this research, and it appears as a multidimensional scale, as it considers that technology use by school principals may register different frequency and intensity considering different dimensions of their professional daily practices. In this way, the scale was organized in five dimensions: (1) Communication, (2) Planning, (3) Meetings Promoting, (4) Evaluation, and (5) Administrative

Management. The items are presented in a Likert format scale, and school principals are requested to select an answer according to the shown scale, which varies between ’rarely used’ (1 point) to ‘very often’ used (5 points).

The Measure Teachers Technology Use Scale is proposed by the authors (Bebel, Russel, & O´Dwyer, 2004) as a multidimensional instrument that considers that the use of technology by teachers does not happen in the same way and with equal intensity in different professional tasks. In this way, the scale is organized into seven dimensions: (1) Preparation, (2) Professional email, (3) Delivering Instruction, (4) Accommodation, (5) Student Use, (6) Student Products and (7) Grading. The items are presented in a Likert format scale, and teachers are requested to select the answer choice according to the shown scale between "rarely" to "very often," listed with values ranging between 1 and 5, respectively.

For this article, we will consider the total score of the scales and the score of each dimension. Aside from the process of translation and adaptation of the instruments, it was necessary to analyse their psychometric quality, thus seeking to eliminate any less discriminative items. The internal consistency of the Computer Self-Efficacy scale was previously evaluated by researchers in previous studies, and a Cronbach's alpha coefficient of 0.94 was found, revealing a high internal consistency (Piedade, 2010; Pedro, 2011).

Therefore, in order to validate the DT Use in Scholar Administration Practices Scale, a pilot-study was conducted with 8 public school principals with more than 10 years of experience. High internal consistency was also found. The DT Use in Scholar Administration Practices Scale registered a Cronbach's alpha coefficient of 0.97. The same internal consistency was found in the post analysis with the responses of 133 school principals (α=.904). The analysis of psychometric quality of Measure Teachers Technology Use Scale was evaluated previously by the authors in another similar study, and a high internal consistency was found (α=.93) (Piedade, 2010; Pedro, 2011). The same internal consistency was found in the post analysis with the responses of 1,908 school teachers (α=.92).

In order to obtain answers from the greater number of school principals and teachers of the national public education, it was decided to invite the entire population of 831 schools. The probabilistic and simple random sample was organized with 133 school principals and 1,908 primary and secondary teachers in Portuguese public schools. The school principals were predominantly male (52.63%), who were between 51 and 60 years old (51.13%), had been teaching for more than 20 years (78.95%), and had more than 11 years of experience in school management activities (67.67%). The majority of the school principals have specialized certification in school management and administration (75.19%). The school teachers were mostly female (76.36), were between 41 and 50 years old (42.19%), and had been teaching for more than 21 years (57.66%) however 53.51% of them were teaching in the current school between 1 and 10 years.

According to the comparative analysis we organized a sub-group of the sample with 31 school principals and 572 schoolteachers. For that we considered only the school principals with more than 10 teachers responding from their school. The data were collected through the use of online survey systems, then organized in a spreadsheet and analysed through the use of different statistical procedures developed with IBM SPSS Statistic software (v.23).

## Results

Taking into account the variables under analysis - self-efficacy in the use of technology and use of the DT in the professional practices of school principals and primary and secondary teachers – the results were organized in the following sub-sections: (a) level of proficiency and level of use technology in the each dimension of the school principals professional practices; (b) level of technology use in each dimension of the schoolteacher´s professional practices; and (c) comparative analysis crossing the results of the principals and the teachers.

### Self-Efficacy and Use of DT by School Principals

By analyzing the scores of Table 1, it can be seen, in the level of proficiency variable, that school principals have a score of 3.95, which reveals a favorable sense of self-efficacy in technologies use, taking into consideration that the values of the scale rage between 1, indicating a reduced perception of self-efficacy, and 5, meaning a high perception of self-efficacy. In the same way, for the variable use of technology in professional practices, a score of 4.22 is presented, revealing a high level of use of technologies.

The results for the various dimensions of the DT use scale showed differences in the mean values registered in each dimension, although the data revealed favorable levels of utilization in all dimensions. It appears that the administration dimension has the highest score (M=4.45), revealing a strong use of technology in supporting of school management activities. In the opposite direction, the communication dimension presents the lowest score (M=3.98). The values registered in the standard deviation are near zero showing reduced variance in the participants' responses.

Table 1

*Mean Values and Standard Deviation of Proficiency Level and Level of DT Use by School Principals (n=133)*

| Variables | Mean | Standard Deviation |
|---|---|---|
| Score of Proficiency | 3.95 | .48 |
| Score of DT Use | 4.22 | .64 |
| **Dimensions** | | |
| 1 – Communication | 3.98 | .66 |
| 2 – Planning | 4.25 | .72 |
| 3 – Meetings Promotion | 4.13 | .81 |
| 4 - Evaluation | 4.23 | .80 |
| 5 – Administrative Management | 4.45 | .81 |

Pearson correlation coefficient was calculated in order to explore the relationship between the proficiency level and the level of DT use in professional practices, in various dimensions, presented by school principals.

Table 2

*Pearson Correlation Coefficient Between Variables Under Analyses (n=133)*

| | **DT Use** | 1 Communication | 2 Planning | 3 Meetings Promoting | 4 Evaluation | 5 Administrative Management |
|---|---|---|---|---|---|---|
| Score of Proficiency | .33** | .27** | .39** | .30** | .31** | .19* |
| DT Use | | .87** | .77** | .82** | .90** | .85** |
| 1 Communication | | | .61** | .66** | .72** | .66** |
| 2 Planning | | | | .74** | .59** | .48** |
| 3 Meetings Promoting | | | | | .61** | .52** |
| 4 Evaluation | | | | | | .83** |

**Correlation is significant for α= .01

*Correlation is significant for α= .05

Observing the coefficients shown in Table 2, it appears that the variables are correlated positively and significantly (r=. 33). In the same way, it is also possible to find significant correlations between the scores of the DT use and with all the dimensions of the scale.

**DT Use by Primary and Secondary Teachers**

According the data organized in Table 3, it is possible to identify a high level of DT use by primary and secondary teachers in their teaching practices (M=4.31; SD=. 77). The analysis of the score of each dimension of the scale allows us to visualize different intensity of technologies use by teachers. Thus, the highest scores were in teaching preparation (M=4.53), teaching grading and assessment (M=4.17) and instruction activities (M=3.98). These results reveal a strong use of the technologies in activities related to the teaching planning, classroom instruction and students' grading and assessment. Contrarily, the lowest scores were in student products (M=2.20) and student use (M=2.83). The results in these dimensions express a limited use of technologies by students in their learning activities as well to support their learning products and outcomes.

Table 3

*Mean Values and Standard Deviation of Level of DT Use by School Teachers (n=1908)*

| Variables | Mean | Standard Deviation |
|---|---|---|
| Score of DT Use | 4.31 | .77 |
| Dimensions | | |
| 1 – Preparation | 4.53 | .66 |
| 2 – Professional email | 3.48 | .77 |
| 3 – Delivering Instruction | 3.98 | .95 |
| 4 – Accommodation | 3.83 | .92 |
| 5 – Student Use | 2.83 | 1.08 |
| 6 – Student Products | 2.20 | 1.06 |
| 7 – Grading | 4.17 | .91 |

**Comparative Analysis of the School Principals' and Teachers' Results**
In order to comparatively analyse the levels of self-efficacy and technology use by school principals and the level of technology use by school teachers the results were organized taking into account the data collected from 31 principals and 572 teachers.

The following table shows the technology use evidenced by a group of teachers in each of the 31 schools and the technology use and self-efficacy scores evidenced by each school principal.

Table 4

*Comparative Analyses of Scores of School Principals and Teachers*

| School | n Teachers | Teachers Technology Use Score | School Principal Technology Use Score | School Principal Self-efficacy Score |
|---|---|---|---|---|
| School 1 | 10 | 3.31 | 3.76 | 4.44 |
| School 2 | 19 | 3.17 | 3.52 | 3.59 |
| School 3 | 12 | 3.67 | 4.52 | 4.15 |
| School 4 | 10 | 3.46 | 4.14 | 3.63 |
| School 5 | 27 | 3.58 | 4.67 | 3.52 |
| School 6 | 14 | 3.46 | 2.05 | 4.11 |
| School 7 | 21 | 4.13 | 4.48 | 4.04 |
| School 8 | 12 | 3.54 | 4.52 | 3.67 |
| School 9 | 22 | 3.67 | 3.76 | 3.74 |
| School 10 | 23 | 3.42 | 4.71 | 4.67 |
| School 11 | 13 | 3.71 | 4.33 | 3.93 |
| School 12 | 15 | 3.50 | 4.10 | 3.74 |
| School 13 | 17 | 3.38 | 5.00 | 4.26 |
| School 14 | 15 | 3.67 | 4.76 | 2.56 |
| School 15 | 14 | 3.69 | 4.19 | 4.26 |
| School 16 | 13 | 3.58 | 4.05 | 3.26 |
| School 17 | 22 | 3.04 | 4.33 | 4.63 |
| School 18 | 16 | 3.31 | 4.10 | 3.89 |
| School 19 | 18 | 3.44 | 4.86 | 3.85 |
| School 20 | 20 | 3.21 | 4.71 | 4.85 |
| School 21 | 29 | 3.54 | 3.86 | 3.63 |
| School 22 | 39 | 3.42 | 4.10 | 4.44 |
| School 23 | 24 | 3.98 | 4.71 | 3.67 |
| School 24 | 14 | 3.61 | 4.57 | 3.89 |
| School 25 | 23 | 3.38 | 4.33 | 3.89 |
| School 26 | 41 | 3.46 | 2.33 | 2.33 |
| School 27 | 12 | 3.34 | 4.62 | 4.63 |
| School 28 | 14 | 3.86 | 3.76 | 3.74 |
| School 29 | 11 | 3.75 | 4.67 | 3.44 |
| School 30 | 12 | 3.88 | 4.33 | 4.15 |
| School 31 | 20 | 3.52 | 3.62 | 3.96 |

In order to explore the relationship and the association between the variables under analyses the Pearson correlation coefficient was calculated and organized (see Table 5).

Table 5

*Pearson Correlation Coefficient Between Variables Under Analyses*

| | School Principal Self-efficacy Score | | | | School Principal Technology Use Score | |
|---|---|---|---|---|---|---|
| | School | n Teachers | Pearson Coefficient | *Sig.* | Pearson Coefficient | *Sig.* |
| Teachers Technology Use Score | School 1 | 10 | .19 | .41 | .46 | .18 |
| | School 2 | 19 | .40 | .09 | .16 | .52 |
| | School 3 | 12 | .35 | .27 | .18 | .57 |
| | School 4 | 10 | .00 | .99 | .17 | .40 |
| | School 5 | 27 | .35 | .08 | .18 | .38 |
| | School 6 | 14 | .41 | .14 | .27 | .35 |
| | School 7 | 21 | .34 | .16 | .32 | .15 |
| | School 8 | 12 | .37 | .25 | .37 | .23 |
| | School 9 | 22 | .23 | .31 | .13 | .56 |
| | School 10 | 23 | .18 | .36 | .16 | .39 |
| | School 11 | 13 | .14 | .64 | .01 | .99 |
| | School 12 | 15 | .19 | .47 | .08 | .98 |
| | School 13 | 17 | .17 | .70 | .21 | .43 |
| | School 14 | 15 | .38 | .16 | .04 | .90 |
| | School 15 | 14 | .13 | .66 | .07 | .81 |
| | School 16 | 13 | .10 | .75 | .01 | .98 |
| | School 17 | 22 | .11 | .62 | .06 | .78 |
| | School 18 | 16 | .18 | .65 | .09 | .73 |
| | School 19 | 18 | .19 | .56 | .10 | .70 |
| | School 20 | 20 | .51* | .02 | .11 | .65 |
| | School 21 | 29 | .19 | .34 | .18 | .35 |
| | School 22 | 39 | .24 | .30 | -.07 | .66 |
| | School 23 | 24 | .10 | .65 | .05 | .80 |
| | School 24 | 14 | .51 | .09 | .46 | .09 |
| | School 25 | 23 | .25 | .31 | .23 | .29 |
| | School 26 | 41 | .24 | .14 | .24 | .14 |
| | School 27 | 12 | .49 | .09 | .39 | .21 |
| | School 28 | 14 | .30 | .30 | .25 | .39 |
| | School 29 | 11 | .34 | .30 | .06 | .86 |
| | School 30 | 12 | .38 | .22 | .17 | .60 |
| | School 31 | 20 | .39 | .19 | .15 | .54 |

*Correlation is significant for α= .05

Observing the Pearson coefficients shown in Table 5 it is not possible to identify significant correlations between the variables. Only in school 20 is it possible to identify a moderate correlation between the teachers' technology use and the school principal's self-efficacy.

In order to identify patterns of similarity between the schools, an exploratory cluster analysis was performed taking into account the *nearest neighbor* technique. Before the clusters were defined, ANOVA statistical analysis was performed between the score of technologies use by the teachers and the score of proficiency of the school principal (F = 2.24, sig = .002) and between the score of technologies use by the teachers and the score of technologies use by principals (F = 1.52, sig = .38). According to ANOVA results, it was possible to create clusters of schools considering the proficiency score presented by the school principals because only this variable showed statistical significance. Three clusters of schools, presented in Table 6, were identified based on the self-efficacy score of the principals and schoolteachers' technology use score: (a) a cluster of schools with lower levels of self-efficacy presented by the principal as well lower levels os technology use by school teachers; (b) a cluster of schools with moderate levels of self-efficacy presented by the principal as well moderate levels of technology use by teachers; and (c) a cluster of schools with high levels of self-efficacy presented by the principal as well high levels of technology use by schoolteachers.

Table 6

*Clusters Analysis Based on Self-Efficacy Score of School Principals and Technology Use Score of School Teachers*

| School | n | Subset for alpha = 0.05 | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| School 26 | 41 | -1.18 | | |
| School 14 | 15 | -1.170 | | |
| School 16 | 13 | -.45 | | |
| School 29 | 11 | | -.23 | |
| School 23 | 24 | | -.07 | |
| School 5 | 27 | | -.06 | |
| School 8 | 12 | | -.05 | |
| School 7 | 21 | | -.01 | |
| School 11 | 13 | | .02 | |
| School 21 | 29 | | .13 | |
| School 24 | 14 | | .23 | |
| School 9 | 22 | | .23 | |
| School 12 | 15 | | .25 | |
| School 31 | 20 | | .29 | |
| School 4 | 10 | | .30 | |
| School 2 | 19 | | .33 | |
| School 30 | 12 | | .35 | |
| School 19 | 18 | | .36 | |
| School 18 | 16 | | .44 | |
| School 25 | 23 | | .45 | |
| School 3 | 12 | | | |
| School 27 | 12 | | | |
| School 15 | 14 | | | |

| School | n | Subset for alpha = 0.05 | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| School 28 | 14 | | | |
| School 6 | 14 | | | |
| School 13 | 17 | | | |
| School 22 | 39 | | | |
| School 1 | 10 | | | 1.18 |
| School 10 | 23 | | | 1.29 |
| School 17 | 22 | | | 1.54 |
| School 20 | 20 | | | 1.61 |
| **Sig.** | | **.19** | **.34** | **.87** |

## Discussion and Conclusions

This study aimed to analyse the levels of proficiency and use of DT by principals in their professional practices. It also sought to analyse the level of DT use by primary and secondary teachers in their teaching activities and practices.

The results indicate that school principals have favorable levels of self-efficacy and DT use in several dimensions of their professional activity.

The analysis of the correlation between proficiency level and the DT use revealed that the variables are significantly correlated. The variable association revealed to be positive and significant between proficiency level and all dimensions of DT use scale. Thereby, we can infer that the level of self-efficacy is directly related to the ability to use technology in several dimensions of a principal's daily practices.

Taking into consideration the results of teachers' DT use it was possible to identify a favorable level of use in teachers' professional practices, in particular in planning activities, delivering instruction and students' grading and assessment. In contrast the results showed a lower level of DT to support de students' learning activities and products in the classroom.

The study also intended to analyse comparatively the levels of DT use by school principals and by school teachers to try find a possible relationship between the constructs. The comparative analysis did not find a statistically significant association between the variables. However, it was possible to create three clusters of schools based based on the self-efficacy score of principals' and school teachers' technology use score. In order to examine in more detail the relationship between digital technologies by principals and by teachers and understand how these variables relate to each other, it will be important to observe and analyse each school context in particular.

Through its exploratory nature, this study presented relevant results that need to be consubstantiated by more national and international studies where the role of school principals in innovation processes and DT integration in their schools is continually and deeply addressed.

## Methodological Limitations and Future Work

The option of a quantitative study with a descriptive, exploratory and correlational nature - in which a set of variables is defined and statistical relationships are explored - implies the loss of some capacity for deeper, detailed and contextualized analysis when compared with a qualitative and naturalist approach.

The use of self-report scales presents as a limitation the fact that they do not measure effective use of digital technologies by participants but rather their personal beliefs and perceptions, about their practices.

An awareness of the limitations evidenced in the quantitative studies, was balanced by the premise that they could be overcome by the objectivity and the procedural and scientific accuracy associated with the quantitative and rationalist studies.

Although we can not affirm that the study is representative of the populations under analysis, school directors and teachers of the national public education, namely by the size of one of the samples (16% of the directors and 1.5% of the teachers), the results can be somewhat generalized to populations with the same characteristics based on the randomness of both samples.

Taking to account the main results and some of methodological limitations of the study it's important to define some lines of future research. First, it's important to develop new research about digital technologies use by school principals applying the use scale created in the present study. The results obtained in new studies will allow establishing comparisons with the results and conclusions presented in this study, validating them (or contradicting them), and will contribute to improve the metric quality of the scale. Second, it is also important to analyse what specific actions and programs are promoted by school principals in their schools in order to facilitate and improve the effective use of technologies by teachers and students. Third, it is relevant to try to find a possible relationship between style of school principals' leadership (transformational and transactional) and digital technologies use in schools by teachers and students.

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