



Development of a Self-Efficacy Scale of Technology Usage in Education

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Received 24 March 2014; • Revised 10 September 2014• Accepted 17 September 2014

ABSTRACT

The purpose of this study was to develop a scale instrument to allow us to establish the self-efficacies of elementary education teachers regarding their use of information technologies when educating their students. The study group comprised a total of 924 teachers from different branches working in central Ankara elementary schools. Based on the data acquired from the scales, exploratory and confirmatory factor analyses were conducted during the process of testing the construct validity of the scale. In the wake of the exploratory and confirmatory factor analysis, the model comprising 48 clauses and two factors was found to be statistically and theoretically coherent. When the obtained results are considered with regards to its reliability, the scale can be said to be sufficiently reliable. The scale instrument is thought to put forth perceptions of self-efficacy regarding the use of technology from the context of basic skills and anxiety state.

Keywords: Information technologies, elementary education, self-efficacy, use of technology

INTRODUCTION

Understanding the value of education in the life of the individual and of society, along with the effect of developing technology on education, has led to a universal act regarding the new education systems to be developed in all nations (Senteni, 2006). As such, the Ministry of Education in Turkey determined their education goal as “reaching the information society” in the national development agenda. The national goal and policy of the Ministry of Education in the information technologies field was established as “catching up with the information era, raising universal and national individuals in order to be an information and technology society, imbuing every level of our education system with technology to increase the competitive power of our people and society” (MNE, 2009). In the context of this goal, new education environments began to be designed that were open to

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State of the literature

- The study aims to develop a scale instrument to allow us to determine the self-efficacy perceptions of elementary education teachers regarding their use of technology when educating students.
- The scale instrument was developed based on data gathered from elementary education teachers.
- According to the conducted analyses of the developed scale instrument, it was determined to have validity and reliability.

Contribution of this paper to the literature

- The developed scale instrument is going to contribute to the literature by making information technologies coherent with education, thus creating a model for teachers who develop and design learning environments.
- The developed scale instrument on information technologies includes numerous expressions about different aspects which is vital in terms of it being used for all education instruments.
- It is thought that the scale instrument puts forth the self-efficacy perceptions regarding the use of information technologies from the point of view of basic skills and the anxiety state.

development and renovation, that harbored a disciplinary approach ready to meet the new conditions of the day, and that were supported by rich learning environments alongside the developments in information technology.

Significantly connecting the developing information and communication technologies with each other and adding them to the education process has brought along a new perspective to today's learning environments. When the proper methods are used, there can be no doubt that information technologies develop education (Hennessy, Ruhtven & Brindley, 2005). Needless to say, students should not only have computer knowledge. Alongside this, different disciplines (science, social knowledge, mathematics, etc.) should be taught using sources of information technology. Thus, students will acquire new knowledge about computers and other technology sources as well when studying a discipline (Pelgrum, 2001; Kozma & Anderson, 2002; Fančovičová & Prokop, 2008).

No matter how important and functional the new information technologies of the day are in the education process, the teacher is still the basic factor that gives meaning and life to education, and renders it functional, effective and fruitful. Various evaluations indicate that mature manpower is required in putting the possibilities presented by technology into action effectively during the education process. Here, the teacher carries a vital function, which is managing the information technologies and connecting them with their students (Lin, 2008; Paraskeva, Bouta & Papagianni, 2008).

For teachers to have knowledge of information technology and to know how to use computers during their classes has gained more importance day by day in the 21st century (Hennessy, Ruthven & Brindley, 2005; Bingimlas, 2009). The International Society for

Technology Education (ISTE) defines the abilities teachers should have as being technologically literate, using technology during class, directing the students to use technology, organizing the learning environments where students can use technology, allowing them to reach the information and use it properly, cooperating with their colleagues online for their professional development and sharing their experience (ISTE, 2000). No matter the content, method or technology, reformation in the education system can only be as effective as the teacher who has a positive attitude to accept this innovation (Pelgrum, 2001; Arnold, Padilla & Tunhikorn, 2009).

The effect of technology is increasing gradually in the education process. Educators with high self-efficacy perceptions strive greatly to accomplish things, they do not give up if and when they come up against challenges; they are patient and persistent. Thus, it is known that the self-efficacy perception is one of the characteristics we should focus on in the education process. Therefore, the question of what kind of self-efficacy perceptions teachers have on the use of technology is vital (Torkzadeh & Van Dyke, 2001).

Conducted research has shown that students who took computer lessons during their high school and university education had enhanced self-efficacy perceptions (Aşkar & Umay, 2001; Torkzadeh & Van Dyke, 2001; Torkzadeh & Van Dyke, 2002). Cassidy and Eachus (2002) found with the research they conducted that a large portion of the variability in the self-efficacy—as high as 63.51%—was explainable by experience when we looked at it in terms of experience, acquaintance with software, having taken computer education, age and gender. In another research study, it was found that when computers are used in class, teacher candidates observing proper and sufficient examples in the schools they work at positively affect self-efficacy perceptions.

All these research studies stress the importance of the experience (course, lesson, activity) individuals gather before starting their teaching professions. It is thought that ones with such experience, especially teachers, would have high self-efficacy perceptions about the use of computer in schools, and that this would make the use of computers widespread in schools. On the other hand, Compeau and Higgins (1995) specify that the computer self-efficacy perception is an essential variable in the use of computers. According to the social cognitive theory, one's self-efficacy perception stems from four sources. These are; 1) the information of the experience one acquires from the work conducted for one's own personal experience or done to gain a certain talent, 2) experiences of others; i.e. by taking others' behaviors as a model, sharing their experiences, 3) verbal persuasion; suggestions one takes about a certain matter to cope with it, and 4) emotional situation; the case of an individual being in control of their fear, anxiety and stress levels in evaluating their own self-efficacy (Bandura, 1977).

A person's "own verdict regarding his capacity to organize the necessary activities and concluding it successfully to show a certain level of performance" is called self-efficacy (Bandura, 1986), and "his own verdict about himself regarding the use of computers" is called computer self-efficacy. Based on this, one's own verdict about oneself regarding the

use of instruments for the creation, gathering, processing, re-obtainment, distribution, conversion and evaluation processes of the information in an educational environment or his realization efficacy of making them coherent to these environments can be defined as the self-efficacy of the use of information technologies (Algan, 2006).

When studies regarding the use of technology and learning technology in education are examined, Raines and Clark (2011) came to the conclusion that with the use of technology in class, students perceive their teachers relatively better, both creatively and originally. Williams and Kingham (2003) saw within their research that experienced teachers are not so willing to use technology in class. Aşkar and Umay (2001) put forth with their research that a strong relationship exists between developing a positive attitude towards technology and self-efficacy. Akkoyunlu and Orhan (2003) found in their study that while there is no difference in the self-efficacy beliefs regarding beginner level computer skills between male and female individuals, there is a difference favoring males in skills when it comes to the more complex use of computers. Many research studies are of the same view; the successful use of technology is connected to the attitude teachers develop towards computers (Albion, 2001; Kozma & Anderson, 2002; Hennessy, Ruthven & Brindley, 2005; Yushau, 2006; Šorgo, Verčkovnik & Kocijančič, 2010).

Within this fundamental framework, the necessity of taking the teacher profile, which enables the integration of information technology into our educational institutions, and accordingly designing and developing learning environments as the model is a reality. In this context, determining the efficacies of teachers regarding the use of information technology in education will provide vital data for future studies. Also, in the literature there exists a limited amount of research concerning the use of information technologies in elementary education. This and similar research will be the guides for the teacher profiles, which will enable the assessment of the situation and the integration of information technologies into education, and accordingly designing and developing model learning environments.

Purpose of the Study

With regards to teachers' self-efficacy perceptions concerning information technology, due to its contribution to the do ability of relative behaviours, determining this competence perception is possible with various scale instruments to measure this perception. The existence of such self-efficacy scales within the field is already known (Murphy, Coover & Owen, 1989; Torkzadeh & Koufterous, 1994; Aşkar & Umay, 2001; Cassidy & Eachus, 2002; Barbeite & Weiss, 2004; Algan, 2006; Şahin 2009; Guinea & Webster, 2011). These self-efficacy scales generally try to rate the self-efficacies of computer or information technology with their general dimensions. Alongside this, the aim of this study is to develop an instrument that includes the determination of the self-efficacies of teachers regarding the use of all the information technologies, especially in an educational environment. Based on this justification, the purpose of this study is to develop a scale instrument that will determine

the self-efficacies of elementary education teachers regarding the use of information technology in education, by conducting validity and reliability studies.

METHOD

Study Group

The data in the research was gathered from two independent study groups. The study group consisted of a total of 924 teachers from different branches (Science, Mathematics, Technology Design, Turkish Language, Social Sciences etc.) who were working in central Ankara elementary education schools during the 2012-2013 academic years. The first study group (N=514) was used to determine the factor construct of the scale and the second (N=410) was used to test this determined construct with the model-data fit.

Gathering of the Data

Firstly, the relevant sources needed to be checked when developing the instrument for scaling the self-efficacy perception of teachers regarding the use of technology in education. Afterwards, an item pool was formed, which could express the self-efficacy of technology usage in education. Thereby, 59 clauses were written from four sub-dimensions, which express the self-efficacy perceptions of elementary education teachers regarding the use of technology in education as 'basic skills' (factor 1), 'integrating it into education' (factor 2), 'being aware of the performance' (factor 3), and 'technology anxiety' (factor 4). A 5-point Likert-type scale was prepared by the researcher that consisted of six clauses on the collection of the teachers' personal data, and 59 clauses on self-efficacy. The prepared clauses were applied to the first study group after expert opinion had been sought. Teachers responded with answers based on the extent of their agreement with the emotions, ideas and behaviours stated in each scale clause. Clauses for self-efficacy in the scale were graded from 1 to 5, starting from (1) "I absolutely disagree", ending with (5) "I absolutely agree".

Analysis of the Data

From the data acquired from the scale, exploratory and confirmatory factor analyses were conducted to test the construct validity of the scale. Aside from this, varimax rotation was conducted during the construct validity. The model fit of the clause-factor construct acquired from the exploratory factor analyses was tested by confirmatory factor analysis. The reliability of the scale was examined with the Cronbach Alpha coefficient calculated by test-retest and through clauses depending on internal consistency. In determining the exploratory factor analysis and the internal consistency coefficients, SPSS 16 software was used, and for the confirmatory factor analysis, LISREL 8.71 software was used. The scale sub dimensions were named after the content of the clause.

FINDINGS

The statistical processes were gathered under the titles of validity and reliability in the research.

Construct Validity of the Self-efficacy Scale of Technology Usage in Education

Explanatory Factor Analysis

For the construct validity of the self-efficacy scale of technology usage in education, exploratory factor analysis was conducted first of all. To conduct this analysis, primarily the KMO test, which tests the efficiency of the sample, was applied. The KMO value was found to be 0.97. According to Büyüköztürk (2007), because this value is higher than 0.70, it was concluded that the factor analysis could be conducted through these data. Secondly, since the data obtained from the applied Bartlett Sphericity test ($\chi^2 = 29302.731$, $p=.000$) showed a significant difference, it was determined to be suitable for conducting the factor analysis (Büyüköztürk, 2007). After concluding that the data were suitable for factor analysis, the basic components factor analysis was conducted with 59 clauses without describing the dimension and the unrotated factor analysis was examined. It was observed that four factors existed, whose eigenvalues were over one. Criteria of the factor loads of the clauses of at least 0.40 (Stevens, 1996), and a difference between the clause factor loads entering the two factors of at least 0.10 were acceptable (Hinkin, 1998; Tabachnick & Fidell, 2001; Büyüköztürk, 2007). After completing the varimax rotation method, it was determined that the clauses in the second and third factors could be included in the first factor by taking the "scree plot" graphic into account and by obtaining cognitive significance by examining the properties of the clauses under the factors. Thus, the clauses were gathered under two factors. After deciding the factors in the construct, the clauses in the factors whose rotated factor loads were lower than 0.40, and 11 overlapping clauses whose given load values were high in two or more factors, were removed from the scale and the scale form of only 48 clauses was reached. The scree plot graphic according to the conducted analyses is shown in [Figure-1](#).

When the scale consisting of 48 clauses is taken into account as a whole, the scale shows a two-factored construct. The first factor constitutes the 'basic skills' dimension regarding the use of technology in education, and 38 clauses form this dimension. The second factor constitutes the 'anxiety' dimension regarding the use of technology in education and is composed of 10 clauses. The load values of the 48 clauses in the scale vary between 0.35-0.91 in the factors. The two factors which form the scale explain 57.76% of the total variance. Based on this, the construct validity of the self-efficacy scale of technology usage in education can be said to be high. Confirmatory factor analysis was applied to the model-fit test of the obtained values and the construct.

Table 1. Values regarding the fit of goodness tests for the self-efficacy scale of technology usage in education

| χ^2 | χ^2/df | P-Value | NFI | RFI | CFI | GFI | AGFI | IFI | RMSEA | 90% CI RMSEA |
|----------|-------------|---------|------|------|------|------|------|------|-------|--------------|
| 1114.22 | 3.21 | .000 | 0.97 | 0.97 | 0.98 | 0.75 | 0.71 | 0.98 | 0.073 | 0.070-0.076 |

* p<0.01

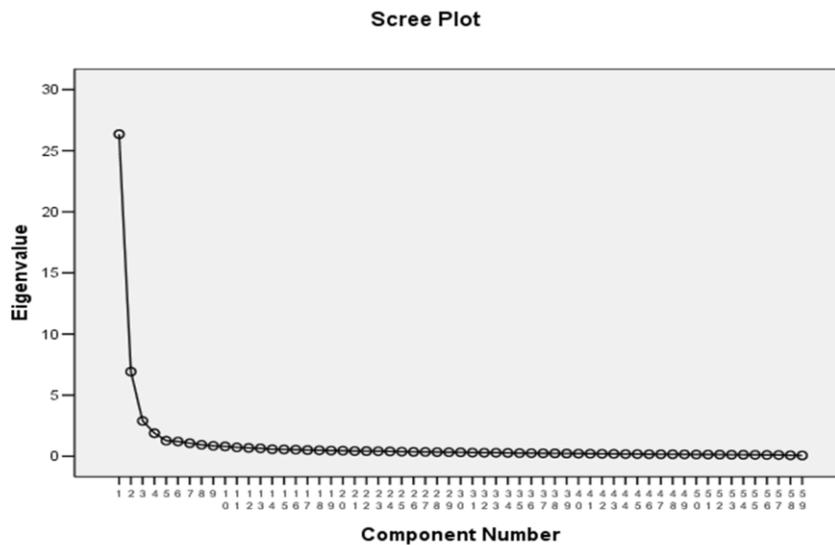


Figure 1. Scree plot of the eigenvalues of the factors

Confirmatory Factor Analysis

The scale, composed of 48 clauses and two sub factors, was tested separately for the basic skills and technology anxiety dimensions with confirmatory factor analysis. In the confirmatory factor analysis of the research, the chi-square goodness (χ^2) Table 1, normed fit index (NFI), relative fit index (RFI), comparative fit index (CFI), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), parsimony normed fit index (PNFI) and the incremental fit index (IFI) were used (Kline, 2005; Schumacker & Lomax, 2010; Şimşek, 2007). The factor analysis statistical results are given in Table 2.

The ratio of the calculated Chi-square value to the degree of freedom is vital. This proportion being lower than (X^2/df) 2 is desired (Eminoğlu & Nartgün, 2009). When Table 2 is examined, it can be seen that the chi-square value ($X^2=1114.22$, $sd=347$, $X^2/df=3.21$, $p=.000$) is significant. In the fit indexes, the values of GFI and AGFI being higher than 0.90 indicate the existence of a good fit (Marsh & Hocevar, 1988). Along with this, the GFI value being between 0.85-0.90 and the AGFI value being higher than 0.80 indicates the existence of an acceptable fit (Cole, 1987; Marsh, Balla & McDonald, 1988). Also in the fit indexes, the CFI and NFI values being >0.90, the RMSEA value being <0.08 (Anderson & Gerbing, 1984; Hu & Bentler, 1999) and the RFI and IFI values being >0.90 (Ayyıldız & Cengiz, 2006), indicate the

Table 2. Clause Factor Loads and the Explanation Variances obtained with CFA

| Clause No | λ | SE | t | R ² |
|-----------|-----------|------|-------|----------------|
| 1 | 0.68 | 0.54 | 15.38 | 0.46 |
| 2 | 0.63 | 0.61 | 13.91 | 0.40 |
| 3 | 0.48 | 0.77 | 10.07 | 0.23 |
| 4 | 0.54 | 0.71 | 11.56 | 0.29 |
| 5 | 0.64 | 0.59 | 14.23 | 0.41 |
| 6 | 0.67 | 0.56 | 15.03 | 0.45 |
| 7 | 0.65 | 0.57 | 14.70 | 0.42 |
| 8 | 0.77 | 0.41 | 18.19 | 0.59 |
| 9 | 0.72 | 0.48 | 16.71 | 0.52 |
| 10 | 0.72 | 0.48 | 16.77 | 0.52 |
| 11 | 0.60 | 0.64 | 13.15 | 0.36 |
| 12 | 0.75 | 0.43 | 17.76 | 0.56 |
| 13 | 0.75 | 0.44 | 17.53 | 0.56 |
| 14 | 0.59 | 0.65 | 12.96 | 0.35 |
| 15 | 0.77 | 0.41 | 18.18 | 0.59 |
| 16 | 0.80 | 0.36 | 19.51 | 0.64 |
| 17 | 0.79 | 0.38 | 19.01 | 0.62 |
| 18 | 0.79 | 0.38 | 18.95 | 0.62 |
| 19 | 0.77 | 0.40 | 18.40 | 0.59 |
| 20 | 0.73 | 0.47 | 16.97 | 0.53 |
| 21 | 0.77 | 0.41 | 18.27 | 0.59 |
| 22 | 0.81 | 0.35 | 19.69 | 0.66 |
| 23 | 0.63 | 0.61 | 13.88 | 0.40 |
| 24 | 0.80 | 0.37 | 19.26 | 0.64 |
| 25 | 0.56 | 0.69 | 12.02 | 0.31 |
| 26 | 0.73 | 0.47 | 16.94 | 0.53 |
| 27 | 0.62 | 0.61 | 13.84 | 0.38 |
| 28 | 0.81 | 0.34 | 19.76 | 0.66 |
| 29 | 0.79 | 0.37 | 19.17 | 0.62 |
| 30 | 0.66 | 0.56 | 14.89 | 0.44 |
| 31 | 0.73 | 0.47 | 17.01 | 0.53 |
| 32 | 0.65 | 0.58 | 14.61 | 0.42 |
| 33 | 0.72 | 0.48 | 16.65 | 0.52 |
| 34 | 0.74 | 0.45 | 17.31 | 0.55 |
| 35 | 0.76 | 0.42 | 18.03 | 0.58 |
| 36 | 0.61 | 0.63 | 13.51 | 0.37 |
| 37 | 0.73 | 0.47 | 17.05 | 0.53 |
| 38 | 0.73 | 0.46 | 17.14 | 0.53 |
| 39 | 0.53 | 0.72 | 11.29 | 0.28 |
| 40 | 0.79 | 0.38 | 18.91 | 0.62 |
| 41 | 0.81 | 0.34 | 19.58 | 0.66 |
| 42 | 0.87 | 0.25 | 21.74 | 0.76 |
| 43 | 0.87 | 0.24 | 21.93 | 0.76 |
| 44 | 0.89 | 0.21 | 22.73 | 0.79 |
| 45 | 0.84 | 0.30 | 20.56 | 0.71 |
| 46 | 0.87 | 0.25 | 21.86 | 0.76 |
| 47 | 0.84 | 0.30 | 20.53 | 0.71 |
| 48 | 0.82 | 0.33 | 19.85 | 0.67 |

existence of an acceptable fit. Although it is not known which ones from the given fit indexes should be checked for the model fit (Şimşek, 2007), it can be seen that in the conducted studies, the RMSEA, AGFI, CFI, RMR and the GFI indexes have been used (Kayri & Günüş, 2009).

From the fit indexes calculated in the study, the values were found to be GFI=0.75, AGFI=0.71, CFI=0.98, NFI=0.97, RMSEA=0.073 and IFI=0.98. When taking these into consideration, it can be agreed that a two-factored construct is a good model in the wake of the confirmatory factor analysis.

The clause factor loads (λ) and the explained variances (R²) were also examined, along with the fit indexes of the 48-clause scale in the wake of the conducted confirmatory factor analysis. The obtained data are shown in [table 2](#).

In [table 2](#), it can be observed that, according to the confirmatory factor analysis, the factor loads alter between (λ) 0.54-0.89. The absolute value of these is what is taken into account and it is expected to be higher than 0.10. If the value is lower than 0.10, it is called "small effect", if it is around 0.30 it is called "medium effect" and if it is higher than 0.50, it is called "strong effect" (Kline, 2005). Based on this, it can be said that the factor loads had a strong effect. Also, when the t values of the obtained factor loads are investigated, t values belonging to all the clauses seem to be significant. As seen in Table 2, the R² (explained variance) values of the clauses are relatively high. With the conducted confirmatory factor analysis, the last form of the scale comprising 48 clauses and two sub dimensions was reached. When the obtained results are investigated as a whole, all the clauses in the model show consistency. Based on these findings, it can be stated that each factor represents the statements that constitute the factor itself in the right manner and that the construct validity of the scale was obtained.

Reliability

The reliability of the scale was examined with the Cronbach Alpha coefficient calculated by the test-retest and clauses based on the internal consistency. In calculating the reliability with the test retest method, the test was applied twice in a three-week gap to 45 teachers working in an official Ankara city center elementary school. The correlation between the points teachers got from the scale was found to be 0.83. This result shows that applying the scale at different times gave decisive results. The Cronbach Alpha value based on the internal consistency was calculated according to the factor total points and the general total points of the scale. The obtained coefficients varied between 0.95 and 0.97. The Cronbach Alpha internal consistency reliability coefficient was 0.972 for the first factor and 0.948 for the second, which makes a total of 0.948. It was determined as 0.935 for the whole scale.

A Cronbach Alpha coefficient, which is used as a sub-estimator of the reliability of the test grades of 0.70 or higher, is generally accepted as sufficient for the reliability of test

grades (Büyüköztürk, 2007). The obtained value in the study showed that the reliability of the scale was high.

CONCLUSIONS AND DISCUSSION

The purpose of this study was to develop the “Self-efficacy Scale of Technology Usage in Education”, which puts forth the self-efficacies of elementary education teachers regarding their use of information technologies in education, by conducting validity and reliability studies. To this end, the construct validity of the scale was investigated with exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

According to the results of the exploratory factor analysis conducted to examine the psychometric properties of the scale, a structure with two factors ‘basic skills’ and ‘anxiety’ was obtained. It was determined that the two stated factors explained 57.76% of the total explained variance. After conducting the varimax method, the clauses whose factor load was lower than 0.40, and 11 overlapping clauses whose given factor loads in two or more factors were high, were removed from the scale and a scale form with only 48 clauses was reached.

The model fit of the construct obtained with the exploratory factor analysis was tested with confirmatory factor analysis. The obtained fit index values related to the model were found to be $\chi^2=1114.22$, NFI=0.97, RFI=0.97, CFI=0.98, GFI=0.75, AGFI=0.71, IFI=0.98 and RMSEA=0.073 following the confirmatory factor analysis. These findings indicate that the model fit was very good. Following the exploratory and confirmatory factor analyses, it was found that the model consisting of 48 clauses and two factors had a fit both hypothetically and statistically. Also, these results provide proof of the scale having construct validity (Ayas & Horzum, 2010).

The reliability of the scale was calculated in two different ways known as test-retest and internal consistency. The result of the scale regarding the test retest applications was found to be 0.88 for the total grade of the scale and showed that the scale gave decisive scaling results (Kaplan & Saccuzzo, 2005). Internal consistency coefficients calculated for each factor and for the scale as a whole were high, showing that the scale measures a similar construct (Kabakçı & Owen, 2010). By taking these obtained results concerning the reliability into account, the scale can be said to have sufficient reliability.

The developed scale is an instrument with validity and reliability according to the conducted analyses. The scale can be used to measure the self-efficacy perceptions of elementary education teachers regarding their use of technology in education. The scale is thought to be effective in measuring self-efficacy perceptions regarding the use of technology in education in terms of basic skills and anxiety states.

When the self-efficacy perception scale developed in relation to the use of the information technologies is examined, the developed sub-dimensions of the scale generally seem to possess sub-dimensions named as formal lives, modeling after others’ experiences (Barbeite & Weiss, 2004); verbal persuasion, affective/ emotional arousal (Barbeite & Weiss,

2004; Guinea & Webster, 2011); browsing, encryption/ decryption, system manipulation (Torkzadeh & Van Dyke, 2001); fundamental computer skills (Torkzadeh & Koufterous, 1994; Algan, 2006); educational activities based on technology, class management based on spreadsheets and system information (Algan, 2006).

The Self-efficacy Scale of Technology Usage in Education including sub-dimensions has originality for several reasons. Firstly, it possesses the ability to measure similar self-efficacy perceptions that exist in the literature. Secondly, many expressions in the dimensions are there for the usage of all the instruments, including within information technology in education. Finally, the scale is there for elementary education teachers.

There is a continuing need for further research in this area. Researchers might focus on improving the items in order to make them more representative of the ever-changing technology domain. In addition, the current study demonstrated the factor stability and reliability of this scale across genders. The instrument should also be validated across other variables such as age, education level and profession in order to assess the generalizability of the scale to a more heterogeneous population.

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