An attitude scale for smart board use in education: Validity and reliability studies

Süleyman Nihat Şad*
Curriculum and Instruction, Faculty of Education, İnönü University, Malatya TR 44800, Turkey

1. Introduction

First produced in 1991 (Shenton & Pagett, 2008; Smart Technologies Inc. [SMART], 2006), Smart Boards [SBs] began to be used in education in late 1990s (Beeland, 2002). It has been given several names including Interactive White Board, Electronic White Board or Smart Board (Erduran & Tataroğlu, 2009; Smith, Higgins, Wall, & Miller, 2005; Türel & Demirli, 2010). It can be described, in technical terms, as “a touch-sensitive screen that works in conjunction with a computer and a projector” (SMART, 2006, p. 5). SB use in education is getting more and more widespread (Erduran & Tataroğlu, 2009; Lan & Hsiao, 2011; Levy, 2002; Murcia, 2008). Actually, SB use in teaching is “not only a current trend but also a major policy of education” (Lan & Hsiao, 2011, p. 172). The ministries of education in Australia, the USA, and the UK have invested good amount of money to equip the classes with SBs (Hall & Higgins, 2005; Shenton & Pagett, 2008; Wood & Ashfield, 2008).

It is well documented in the relevant literature that teachers and students have strong preference and positive attitudes towards SBs in general (Hall & Higgins, 2005; Levy, 2002; Morgan, 2008; Smith et al., 2005). Some studies also found positive attitudes of teachers and students towards SB use in specific subjects such as Geography (Ateş, 2010), English (Elaziz, 2008), Science and Maths (Erduran & Tataroğlu, 2009), Social Studies (Kaya & Aydin, 2011), and Science, Maths, and English (Moss et al., 2007). Students and teachers think that SB use in education makes lessons more entertaining and interesting (Ateş, 2010; Beeland, 2002; Kaya & Aydin, 2011; Levy, 2002), exciting (Elaziz, 2008), motivating (Erduran & Tataroğlu, 2009), and enjoyable (Hall & Higgins, 2005; Levy, 2002). Both students’ and teachers’ positive attitudes can be attributed to the contribution of SB use to teaching and learning process (Moss et al., 2007). Based on the relevant literature, this contribution can be treated under two interrelated titles: SBs’ contribution to instructional excellence and SBs’ contribution to learning.

1.1. Smart boards’ contribution to instructional excellence

SB technology plays an important role in making the whole-class teaching more effective, productive, and creative (Elaziz, 2008; Lan & Hsiao, 2011; Lewin, Somekh, & Stedman, 2008; SMART, 2006; Wood & Ashfield, 2008). SBs enable the teachers to plan their lessons more effectively (Levy, 2002), conduct lessons in a more organized and planned way (Ateş, 2010), and facilitate reflective practices (Schuck & Kearney, 2007).

* Tel.: +90 422 341 0010x4445, +90 5426424583 (mob).
E-mail address: nihat.sad@inonu.edu.tr.
As a whole-class presentation medium, SB has strong multimedia and multi-sensory presentation capabilities (Smith et al., 2005). SBs can appeal three major senses of students i.e. seeing, hearing, and touching (Beeland, 2002; Hall & Higgins, 2005). Thanks to its rich visual presentation tools, teachers can use photos, flash animations, videos, documentaries, power point presentation (Ates, 2010), graphics, animations, pictures (Türel & Demirli, 2010), produce more legible handwritings (Levy, 2002), and more precise and clear drawings (Kaya & Aydin, 2011), and add color and movement to their presentations (HALL & Higgins, 2005). Thanks to computer and other multimedia, SBs enable teachers to have the student listen to audio or music (Beeland, 2002; Elaziz, 2008), and use voice records and sound effects (Hall & Higgins, 2005). Moreover, touch-sensitive screen of SBs let the students, for example, touch the board, write or draw with fingers (Beeland, 2002), drag sentences to form paragraphs or move geometrical angles through different degrees (Hall & Higgins, 2005). Furthermore, powered with internet connection, SBs offer a large spectrum of sources (Ates, 2010; Elaziz, 2008; Levy, 2002). Thus, teachers can have quick access to online visuals, maps, posters, graphics, videos etc. Thanks to these features, SBs facilitate the contextualization of abstract concepts or ideas in subjects like science and maths via concrete models and examples (Levy, 2002; Murcia, 2008).

Teachers can use various functions of SBs to meet different needs of students in a fast, flexible, and easy manner (Levy, 2002; Schuck & Kearney, 2007). To illustrate, teachers can use special instructional software with SBs (SMART, 2006), modify lesson materials, keep the last-saved versions of their materials for re-use latter (Elaziz, 2008; Levy, 2002; Wood & Ashfield, 2008), highlight one part of text/picture, zoom in or attach an annotation (Türel & Demirli, 2010). With respect to quick, flexible, and easy use of SBs, Erduran and Tataroglu (2009) noted that "the most important function of SB might be the opportunity to notice a mistake or common misconceptions […] and go back to fix it" (p. 15).

1.2. SBs’ contribution to learning

Research findings suggest that SBs’ direct contribution to instructional excellence -specially through multimedia capability and variety of sources- further supports students’ learning indirectly (Beeland, 2002; Elaziz, 2008; Kaya & Aydin, 2011; Levy, 2002). There is a well-documented literature about the SBs’ contribution to learning by enhancing motivation, student engagement and active participation to lessons, hands-on applications, interaction, attention, and taking individual differences into consideration.

One key function of SBs is to motivate students to learn thanks to various properties they have (Smith et al., 2005). For example, Beeland (2002) argues that the effective use of visual, auditory, and tactile characteristics of SBs motivates the learners to learn. Elaziz (2008) reports “IWBs are perceived as good motivators in teaching and learning contexts by the students [from primary to higher education] and this motivational power can affect students’ achievement positively and reinforce learning.” (p. 85). Moss et al. (2007) found, however, that although it was welcomed initially by students because of its newness the increase in their motivation was short-lived and was not represented in their achievement. In a similar vein, Torff and Tirotta (2010) reported one but extremely weak gain of Interactive whiteboards in elementary students’ self-reported motivation in mathematics. Thus, from a pedagogical perspective, it can be asserted that SB is not itself an effective and motivating instructional tool in terms of learning, but can achieve the desired impact only if it is used in accordance with the appropriate teaching strategies, methods, and techniques (Türel & Demirli, 2010).

One strength of SB is its promotion of class interaction, especially between the teacher and the students (Beeland, 2002; Hall & Higgins, 2005; Lan & Hsiao, 2011; Levy, 2002; Schuck & Kearney, 2007). Thanks to its wide and touch-sensitive screen, a teacher and a student can interact with the SB in front of other students allowing them see what is going on, which is not possible otherwise (SMART, 2006), and personal works can be presented and discussed or a class voting can be done on an SB (Schmid, 2008). This way of interaction also triggers student engagement and active participation (Beeland, 2002; Elaziz, 2008). Moreover, as SBs relieve the students from the obligation of note taking, they might have more time to participate into class discussions (as cited in Levy, 2002). Furthermore, the interactive nature of SBs allows students to experience many applications themselves. For instance, Elaziz (2008) reported that students are eager to use SBs and able to do such applications as “highlighting, writing with the special pen, saving the generated materials, searching on the Internet, and playing audio and visual files” (p. 93–94). Considering all these features, coupled with its visual, audio and tactile modalities, and entertainment and motivation elements, students can concentrate onto lesson and learning (Levy, 2002; Morgan, 2008). However, some teachers have concerns that higher levels of attention can be mainly because of novelty-value, and the impact of using the SBs may decrease in time (Levy, 2002). Yet, Lewin et al. (2008, p. 292) note that “when teachers use an IWB [interactive whiteboard] for a considerable period of time (at least 2 years), teachers learn how to mediate the greatly increased number of possible interactions to best aid pupils’ learning.”

Despite of the positive considerations about SB use in education, there is insufficient evidence from systematic researches considering the impact of SB use on student attainment (Levy, 2002; Smith et al., 2005). Moreover, the available research findings seem to be controversial. Ekici (2008), in his experimental study, found the positive contribution of SB use to 6th graders’ math achievement. Levy (2002) reports that many students believe in the contribution of SB use to their learning experiences and learning achievements. Lewin et al. (2008) found positive impact on children’s Math, English and Science test scores only after being taught with an SB for more than 2 years. Moss et al. (2007), however, could not find a statistically significant effect of SB use on Math, Science, and English lesson outcomes. Besides its strengths, SB use also has some limitations, which can cause negative attitudes among students.

1.3. Limitations of SB use in education

The most critical limitation of SB use in education seems to be inadequate or improper use of SBs by teachers. Armstrong et al. (2005) stress that SB use must not be reduced to physical installation of the board itself and the relevant software. They note that “teachers are the critical agents in mediating the software, the integration of the software into the subject aims of the lesson and appropriate use of the [SB] to promote quality interactions and interactivity” (p. 457). But there is a risk of under-use by reducing SBs to a projection or a writing surface (Murcia, 2008). To avoid this, teachers should utilize those functions of SB technology which are superior to previous technologies. As a matter of fact, when SB’s capabilities are under-used students are disappointed and frustrated (Levy, 2002), and this rather expensive investment (Smith et al., 2005) turns out to be unproductive.
These negative outcomes of inadequate or improper SB use can be prevented at best through teacher training, which is another problem as highlighted in the relevant literature (Somyürek, Atasoy, & Özyürek, 2009). In their review Smith et al. (2005) reported the need for teachers for an adequate and comprehensive training. While some teachers report they have had this in-service training (Ateş, 2010), some others state they have not yet had any in-service training and most (63%) need one (Elaziz, 2008).

Some instructional practices, methods or techniques used by teachers with SB can also cause problems. As Cox and Abbott justify, the SB’s impact on students’ success depends on the teacher and the pedagogical approach she uses with SB (2004, as cited in Kennewell & Beauchamp, 2007). Accordingly, SB should be used so as to “place students at the centre of the teaching and learning experience” (Murcia, 2008, p. 20). It should not be employed in a limited way, say, by using traditional lecturing method in which knowledge is transmitted, but in such a way which optimizes opportunities to engage students with the creative learning processes (Wood & Ashfield, 2008). Although SB is a fast and effective presentation tool, Ateş (2010) emphasizes the risk of using SB to overload the students with the content as soon as possible to complete the content of the syllabus. Another counterproductive practice is described as restricting learners’ access to SB (Hall & Higgins, 2005), thus preventing interaction, participation, and experimenting.

Choosing and using SB-compatible pedagogical software appropriate to the learning goals is crucial (Armstrong et al., 2005). It is reported that these pedagogical software, or materials, can be prepared by subject teacher groups (Ateş, 2010), publishing houses (Elaziz, 2008), or the teacher herself (Levy, 2002; Moss et al., 2007). Actually, well designed materials compatible with SBs is limited in the market (Türel & Demirli, 2010). As a matter of fact, since teachers know best the learners’ needs and flexibly plan their lessons using the outputs of formative evaluation, they had better take an active role in the material development process. This certainly will put a time constraint burden on teachers (Levy, 2002), as well as causing difficulty among teachers not familiar with material design principles (Moss et al., 2007).

In addition to the lack of pedagogical knowledge and skills, teachers’ failure to handle the technical problems cause another limitation. To illustrate, one common problem with SB use is wasting time and related classroom management problems as a result of technical troubles with PC, projector or software (Ateş, 2010; Hall & Higgins, 2005; Levy, 2002). In a similar vein, displacing board or projector as a result of hurriedly setting up etc. practices re-setting the calibration (Beeland, 2002; Hall & Higgins, 2005; Smith et al., 2005). Moreover, such problems degrade teacher’s confidence (Levy, 2002).

Finally, some other problems related with SB use in education can be summarized as the sunshine blocking students’ sight (Ateş, 2010; Hall & Higgins, 2005; Levy, 2002), the shadow cast by hand or arm blocking the writings (Beeland, 2002; Hall & Higgins, 2005), problems about planning the allocation of a limited number of SBs in large schools (Elaziz, 2008; Levy, 2002); dust on the projector lenses (Levy, 2002), health and safety problems caused by electric or connection cables (as cited in Smith et al., 2005).

1.4. The purpose of the study

As summarized above, SB use in education contributes to instruction and learning process, and both teachers and students generally have positive attitudes towards SB use in their classes despite of some limitations due to the teacher or the environment. Also it is understood that there is limited research about SB’s impact on student attainment. It is believed that, from a curriculum evaluation perspective, it is necessary to investigate whether this rather new and costly technology generates the desired pedagogical impacts. Researcher’s literature review yielded no Turkish instruments developed to measure elementary students’ attitudes towards SB use in education in general, other than those developed or adapted to evaluate SB use in specific subjects (see Ateş, 2010; Elaziz, 2008; Tataroglou & Erduran, 2010). Therefore, in this study it was intended to develop a standardized instrument [Smart Board Attitude Scale-SBAS] which can be used to evaluate SB use in elementary education in terms of its contributions to instructional excellence and students’ learning, and limitations from the students’ point of view.

2. Method

2.1. Research design

In order to develop SBAS, a sequential exploratory mixed method was used. The main aim of sequential exploratory mixed method design is to explore a phenomenon with the priority given to qualitative methods followed by quantitative analyses and interpretation (Creswell, 2003). Among its other uses, this design is especially advantageous when a researcher is building a new instrument (Creswell, 2003, p. 216). In the present study this model is preferred as the aim is to develop an instrument to investigate students’ views about a phenomenon i.e. SB use in education. To this end, first qualitative methods (literature review, student interviews and expert analyses) were used to build a draft item pool and next quantitative methods were used to test the psychometric properties of SBAS.

2.2. Study groups

In the qualitative part of the study, ten students from Kale İzollu Elementary School (4th–8th classes) were interviewed to help build the item pool. Also, one teacher trainer specialized in SB use, three teachers from different subject fields experienced in SB use, and one Turkish language expert took part in the expert panel to test the content and face validity of SBAS.

In the quantitative part, analyses were done on data obtained from 203 students (refined from 235 students after initial analysis) studying at 4th to 8th classes of two local elementary schools in Malatya, Kale İzollu Elementary School and Argun Cumhuriyet Elementary School, during the second semester of 2010–2011 school year. These schools were included in the study mainly because they are two of the three schools equipped with SB in all classrooms in Malatya (as far as the researcher was informed by the authorities in Provincial Directorate of Education). While the students in the former school had been instructed using SBs for about two years, SBs had been introduced to the latter school rather newly, for about a semester. Table 1 shows some demographics about the participants of quantitative part of the study.
2.3. Procedure

The procedure started with producing a pool of items. This initial qualitative phase of the study comprised literature review (the analysis of previously developed instruments in particular), student comments, and asking the views of an expert panel, through which the content and face validity of the scale was secured. Next, the trial form of the scale was subjected to construct validity studies.

Construct validity of the scale was tested with factor analysis technique. In this study factor analysis was applied using two main approaches: exploratory and confirmatory. In exploratory factor analysis [EFA], researcher tries to define or summarize the data set in hand by gathering together the inter-correlation variables during the early stages of research (Pallant, 2007, p. 179; Tabachnick & Fidell, 2007, p. 609). The aim of confirmatory factor analysis [CFA], however, is to test a hypothesis or theory regarding the structure obtained based on the interrelationships between variables, using sophisticated and higher order analysis (Büyüköztürk, 2010, p. 123; Pallant, 2007, p. 179; Tabachnick & Fidell, 2007, p. 609). Also convergent and discriminant validity of the scale was tested based on the CFA results.

Studies about the reliability of the scale were done at three distinct phases successively. First, following the EFA, preliminary reliability analyses estimating Cronbach Alpha internal consistency and Guttman Split-Half Coefficients, and corrected item-total correlations were done. Next, following the CFI, composite reliability was tested. Finally, the confirmed final version of SBAS was subjected to test-retest temporal reliability analysis.

3. Findings and results

3.1. Content and face validity

In order to write the draft items for SBAS, first the relevant literature was reviewed. Next the instruments previously developed to measure students’ attitudes towards SB use in education in general or for specific subjects (Ates, 2010; Beeland, 2002; Elaziz, 2008; Levy, 2002; Morgan, 2008; Moss et al., 2007; Tataroğlu & Erduran, 2010) were analyzed. Also ten students from different classes of Kale Izzolu elementary school were interviewed about their opinions regarding SB use in their lessons. As a result of the analyses of previous instruments’ items and students’ comments, a 24-item pool was produced. Next, draft form of SBAS was consulted to an expert panel (see 2.2. Study groups) for evaluation in terms of content, clarity, suitability for the target group (Yurdugül, 2005). Based on the feedback from expert panel, modifications were done on the SBAS in terms of content and face validity. Next the draft form of SBAS (see Appendix) was administered on the students in the quantitative study group for construct validity and reliability studies.

3.2. Results of exploratory factor analysis (EFA) and reliability studies

Prior to conducting EFA on SBAS, data set was checked for suitability for factor analysis. Some of the criteria used in the literature to test the suitability of the data set for EFA include inter-correlations between variables, linearity, lack of outliers and missing data, normality of data set, sample size, and sampling adequacy (KMO and Bartlett’s sphericity test) (Çokluk, Şekercioğlu, & Büyüköztürk, 2010; Hair, Black, Babin, Anderson, & Tatham, 2006; Pallant, 2007; Tabachnick & Fidell, 2007). Following these criteria, first correlation matrix for variables were analyzed and it was seen that correlations between variables (items) are above .30 in most cases, which indicates that correlation matrix is suitable for EFA (Tabachnick & Fidell, 2007). Yet, since EFA also assumes the linearity of the correlations between variables, randomly selected pairs of scatterplots were examined as recommended by Tabachnick and Fidell (2007, p. 734) and no distribution violating linearity was observed. Next, the cases with missing data (n = 10) were deleted (Tabachnick & Fidell, 2007, p. 613). Moreover, the remaining data set comprising 225 students was transformed to standardized scores using z scores and 22 rows falling within –3 and +3 range were discarded from data set as they contained outliers. Finally, normality of the data set (previously purified from outliers) were assessed using skewness and kurtosis coefficients, which yielded skewness and kurtosis coefficients between –1 and +1 indicating normal distribution for all but 1st and 20th items. As they showed high negative skewness (1st item = −2.108 and 20th item = −2.120) and kurtosis (1st item = 3.734 and 20th item = 3.514) 1st and 20th items were excluded from analysis. As for the sample size, though 300 is considered ideal (Tabachnick & Fidell, 2007), the sample size of 203 can be said to be adequate taking into consideration the number of variables (n = 22) and results of sampling adequacy test (KMO = .889) (Pallant, 2007, p. 183). In addition to KMO test, the results of Bartlett Sphericity test ($X^2 = 1,402.902; \text{df} = 231; p = .000$) verified sampling adequacy of the data set for factorability.

After the data set was checked for factorability, 22 items were subjected to factor analysis. In order to extract factors, principal component analysis, a common factor extraction technique, was used. In determining the number of factors, following indicators were used: Kaiser criteria (≥ 1 eigenvalue), scree test, component matrix, communalities, total variance accounted for (Büyüköztürk, 2010; Çokluk et al., 2010; Hair et al., 2006; Pallant, 2007; Tabachnick & Fidell, 2007). First analysis produced 5 factors with eigenvalues over 1. While 1st and 2nd factors’ eigenvalues were 6.183 and 2.375 accounting for the 28.015% and 10.793% of total variance respectively, eigenvalues of remaining three factors were almost 1 and their contribution to variance was about 4–6%. This was taken as an evidence for the two-factor structure of the scale (Tabachnick & Fidell, 2007, p. 657). An analysis of the Scree plot displayed a smooth vertical decline in the first two factors, which is broken then and changed direction horizontally. This evidence, too, verified the decision about two-factor structure of the scale (Pallant, 2007).
2007, p.182). Pre-repetition component matrix, however, had high factor loadings mainly in the first factor and partially in the second. Although this provides some proof for an alternative single-factor model (Buyukozturk, 2010, p. 137; Pallant, 2007, p. 192), given the low item-total correlations (<.50) (Hair et al., 2006, p. 137) and low communality values (<.30) (Pallant, 2007, p. 196) of several items in the single-factor model, it was decided to test the two-factor model only.

In order to test the two-factor model of SBAS, principal components analysis was repeated after fixing the factor number to two and using the Direct Oblimin oblique rotation technique. The main reason to use rotation techniques in multi-factorial structures is to interpret the results more easily (Pallant, 2007; Tabachnick & Fidell, 2007). Since it is highly likely that factors are correlated (r = .32) due to the nature of factor analysis, it is recommended to start the analysis with oblique rotation (Tabachnick & Fidell, 2007, p. 646). Yet, since the component correlation matrix produced a low correlation (r = −.276) between two factors in the first attempt, analysis was repeated with Varimax, an orthogonal rotation technique, which assumes that underlying constructs are independent, i.e. not correlated. As a result, the model had two fixed factors each having six items after discarding those with factor loadings under .40. In the model, one factor comprised items (7, 13, 17, 19, 2, and 18) which were found to express negative attitudes towards SB, whereas second factor comprised items (5, 9, 4, 21, 8, and 6) expressing positive attitudes. An analysis of the communalities, which indicate whether variables are well described in the solution (Tabachnick & Fidell, 2007, p. 660), revealed that 6th (.298) and 18th (.361) items had relatively low communality values. Pallant (2007, p. 196) suggests that “low [communality] values (e.g. less than .3) could indicate that the item does not fit well with the other items in its component.” In the same vein, the corrected item-total correlations for 6th (.404) and 18th (.382) items were found to have relatively low, as values >.50 are considered ideal as a rule of thumb (as cited in Hair et al., 2006, p. 137). In order to avoid the detrimental effects of these items and to improve the model it was decided to remove the items 6 and 18 from the model. After removing these items, factor analysis was repeated with remaining 10 items. The results of principal component analysis and internal consistency reliability measures (Cronbach Alpha and Guttman Split-Half Coefficients, and corrected item-total correlations) are shown in Table 2.

### Table 2
Results of principal component analysis and internal consistency reliability measures for two-factor model of SBAS.

<table>
<thead>
<tr>
<th>Item</th>
<th>Communalities</th>
<th>Loadings for 1st factor</th>
<th>Loadings for 2nd factor</th>
<th>Corrected item-total correlations (N = 203)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>.684</td>
<td>.821</td>
<td>−.099</td>
<td>.702</td>
</tr>
<tr>
<td>19</td>
<td>.659</td>
<td>.798</td>
<td>−.148</td>
<td>.689</td>
</tr>
<tr>
<td>13</td>
<td>.668</td>
<td>.791</td>
<td>−.148</td>
<td>.689</td>
</tr>
<tr>
<td>2</td>
<td>.621</td>
<td>.757</td>
<td>−.219</td>
<td>.649</td>
</tr>
<tr>
<td>17</td>
<td>.483</td>
<td>.680</td>
<td>−.140</td>
<td>.547</td>
</tr>
<tr>
<td>5</td>
<td>.697</td>
<td>.123</td>
<td>0.826</td>
<td>.704</td>
</tr>
<tr>
<td>9</td>
<td>.633</td>
<td>−.086</td>
<td>.791</td>
<td>.643</td>
</tr>
<tr>
<td>4</td>
<td>.581</td>
<td>−.226</td>
<td>0.728</td>
<td>.614</td>
</tr>
<tr>
<td>21</td>
<td>.536</td>
<td>−.113</td>
<td>.724</td>
<td>.574</td>
</tr>
<tr>
<td>8</td>
<td>.506</td>
<td>−.201</td>
<td>0.682</td>
<td>.557</td>
</tr>
</tbody>
</table>

**Eigenvalues**

<table>
<thead>
<tr>
<th>Total variances accounted for</th>
<th>1.955</th>
<th>1.891</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Total – 60.457%)</td>
<td>30.986%</td>
<td>29.472%</td>
</tr>
</tbody>
</table>

**Cronbach alpha and Guttman Split-Half Coefficients**

<table>
<thead>
<tr>
<th>Cronbach alpha</th>
<th>Guttman Split-Half Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>α = .816</td>
<td>.811</td>
</tr>
</tbody>
</table>

As it is seen in Table 2, the loadings of items in the 1st factor ranged between .821 and .680, and those in 2nd factor ranged between .826 and .682. No cross loading items, i.e. items loading high in multi–factors, were observed. 1st and 2nd factors accounted for the 30.986% and 29.472% of the total variance, respectively. All 10 items accounted for 60.457% of the total variance. In social sciences this rate is expected to be 60% (Hair et al., 2006, p. 120). Also it was seen that the same two-factor structure was preserved even when the factor number was not fixed.

The estimated Cronbach Alpha and Guttman Split-Half coefficients were .816 and .811 for 1st factor, and .821 and .768 for the second factor, respectively (see Table 2). According to Kline (2011, p. 70) “generally, reliability coefficients around .90 are considered ‘excellent’, values around .80 are ‘very good,’ and values around .70 are ‘adequate.’” So, the internal consistency coefficients here can be considered very good for both factors. Moreover, corrected item-total correlations were found ranging between .702 and .547 (see Table 2). This indicates that items tend to measure the same behavior with the relevant scale as a whole (Buyukozturk, 2010, p. 181; Pallant, 2007, p. 98) and are good components of the factor they belong to (Leech, Barrett, & Morgan, 2005, p. 67).

### 3.3. Results of confirmatory factor analysis (CFA)

To test whether the two-factor model obtained in EFA fit to the data, confirmatory factor analysis was used. So the data set for 203 cases used in EFA was loaded in LISREL statistic program (Jöreskog & Sörbom, 1993) and a covariance matrix was prepared.

First, path diagrams and goodness of fit statistics were produced for the two-factor model with 10 items (Negative attitudes = 7, 13, 17, 19, and 2 Positive attitudes = 5, 9, 4, 21, and 8). The model was checked to have significant t values (p < .01) and not too high error variances (.35–.63). Moreover, standardized factor loadings were checked to be between .50 and 1. These values verify the absence of serious problems in the model and signal convergent validity of the model (Çokluk et al., 2010, p. 246; Hair et al., 2006, p. 777; Kline, 2011, p. 237; Şimşek, 2007, p.86). Next, the CFA output was examined for fit indices. In evaluating the results the criteria generally accepted in the literature were used and the values were qualified as perfect or acceptable (see Brown, 2006; Çokluk et al., 2010; Hair et al., 2006; Şimşek, 2007; Tabachnick & Fidell, 2007). Table 3 shows the goodness of fit statistics for pre-modification model and post-modification (final) model comparatively.

The CFA of two-factor solution produced a nonsignificant X² test (X² = 47.20, p = .065), which means no significant difference between expected and observed covariance matrices. Although that can be interpreted as the model is confirmed, it is recommended to refer to the other indices (Brown, 2006, p. 29). The analysis of the other indices yielded perfect values except for acceptable RMR, AGFI and NFI values (see pre-modification in Table 3). At this stage, to improve the fit of the model, the modification indices were examined. Modification indices
suggested adding a path between 2nd and 17th items, both in negative attitudes factor. A chi-square difference test was performed to check whether the addition of modification significantly improved the model. The test revealed a significant improvement [Chi-Square Difference with 1 Degree of Freedom = 9.39 (p = .0022)]. The repeated CFA yielded better goodness of fit statistics (see post-modification in Table 3) most of which Perfect and two Acceptable: \( \chi^2 / df = 37.81 / 33 = 1.15 \) (P); RMSEA = .027 (P); Raykov, 1997; p.174). While CR is an estimate of the extent to which a set of latent construct indicators share in their measurement of a construct, AVE is the amount of common variance among latent construct indicators (Hair et al., 2006). For a robust construct, the lower threshold for composite reliability must be .70 (Hair et al., 2006; p. 778) and average variance-extracted measures should be equal to or exceed .50 (explaining at least the 50% of the variance) (Hair et al., 2006; p. 777). Standardized loadings, squared standardized loadings, t values and the results of CR and AVE calculations for SBAS are presented in Table 4.

As the standardized loading estimates are between .65 and .81, all statistically significant \((t > 2.576)\); the reliability estimates exceed .70 \(\text{CR(NEG)} = .96 \) and \(\text{CR(POS)} = .95\); the average variance-extracted estimates exceed 50% \(\text{AVE(NEG)} = 52.8 \) and \(\text{AVE(POS)} = 50.2\), and the model fits relatively well, all the items are retained and adequate evidence of convergent validity is provided (Hair et al., 2006, p. 777, 779). Besides, as the AVEs are greater than the squared correlation between two constructs \(\gamma^2 = .23\), discriminant validity of the SBAS is also proved, suggesting that both constructs of the SBAS measure distinct concepts (Fornell & Larcker, 1981, p. 46; Hair et al., 2006; p. 777).

### 3.4. Test-retest temporal reliability of SBAS

In order to test whether SBAS is resistant to random errors due to temporal factors between two applications (Kline, 2011, p. 70), SBAS was administered on 40 students from different classes of the same schools over a one-week period. The test-retest reliability analysis produced correlations of \(r = .885\) for the 1st factor and \(r = .883\) for the 2nd factor. These high levels of test-retest correlation coefficients can be regarded as proofs for the scale's ability to make stable measurements in time (Büyüköztürk, 2010, p. 170).

### 3.5. Interpreting scores obtained from SBAS

SBAS was prepared in 5-point Likert type. The responses included 5-Strongly Agree, 4-Agree, 3-Slightly Agree, 2-Disagree, and 1-Strongly Disagree each represented by Smiley Faces considering the ages of the participants. The minimum and maximum possible scores obtained from each subscale range between 5 and 25. Higher scores from the 1st subscale (Negative Attitudes) indicate more negative attitudes towards SB use in education, whereas lower scores refer to less negative attitudes. On the other hand, higher scores from 2nd subscale (Positive Attitudes) means more positive attitudes towards SB use in education, whereas lower scores refer to less positive attitudes.
4. Conclusions and recommendations

This study intended to develop an attitude scale [Smart Board Attitude Scale-SBAS] to evaluate elementary students’ (4th to 8th classes) views about Smart Board use in their classes. To this end, first a draft form containing 24 items was prepared using qualitative techniques. The draft form was administered on 203 students studying at the 4th to 8th classes of Kale Izolli and Arguvan Cumhuriyet elementary schools for construct validity and reliability studies. The initial exploratory factor analysis revealed a two-factor solution with adequate Cronbach’s Alpha (α1st factor) = .816 and α2nd factor) = .821 and Guttman Split-Half (1st factor = .811 and 2nd factor = .768) coefficients and item-total correlations (between .702 and .547). The factor loadings ranged between .821 and .680 for 1st factor, and between .826 and .682 for the second factor. 1st and 2nd factors accounted for the 30.986% and 29.472% of the total variance, respectively. The entire scale accounted for 60.457% of the total variance. Next, the model was subjected to confirmatory factor analysis to check the models’ fit to data, and convergent and discriminant validity estimations. As a result of CFA, the two-factor solution was confirmed as the CFA yielded a nonsignificant difference in the Chi-square test (p = .26) between expected and observed covariance matrices, and other goodness of fit statistics yielded perfect to acceptable results. Furthermore, the convergent validity and discriminant validity of SBAS were proved based on the results of CR (NEG = .96 and POS = .95) and AVE (NEG = .528 and POS = .502) estimations. Finally, results of test-retest analysis (rNEG = .885 and rPOS = .883) proved that SBAS is resistant to random errors due to temporal factors i.e. able to make stable measurements in time.

Consequently, both qualitative and quantitative results of this study verified that Smart Board Attitude Scale-SBAS is able to make valid and reliable measurements about the 4th to 8th grade elementary school students’ attitudes about Smart Board use in their lessons. Yet, it is recommended that other researchers check the psychometric properties of SBAS in different populations and different stages of education (e.g. 9th to 12th classes).

It is reported in the relevant literature that teachers and pupils generally have positive attitudes towards SBs (Smith et al., 2005). But, it was also understood that there is little systematic research about the effect of SBs on student attainment (Levy, 2002; Smith et al., 2005). Moreover, the literature also highlighted some problematic issues about teacher training (e.g. Elaziz, 2008; Somayrek et al., 2009); proper instructional strategies, methods and techniques to be used with SBs (Türel & Demirli, 2010); the compatibility of software and materials teachers use with SBs (Armstrong et al., 2005); and source of sustainable motivation with SBs (Moss et al., 2007; Torff & Tirotta, 2010). Thus, researchers are recommended to investigate the relationship between students’ attitudes towards SB use in education and student attainment; teachers’ background of having pre- or in-service training about SB use; instructional strategies, methods and techniques used by teachers with SBs; or suitability of software or materials used with SBs. On the other hand, teachers as practitioners and school administrators are recommended to use SBAS to have feedback from students about the productivity of SB use in their classes or schools.

Appendix. Smart Board Attitude Scale-SBAS

Dear students, below is a survey to learn about your attitudes towards smart board use in your lessons. Please tick the response that best expresses you. Note that this survey is for research purposes only and not a part of your lesson. Thanks for your interest.

Personal information form:
1. Gender : Girl () Boy ()
2. Class : 4th () 5th () 6th () 7th () 8th ()

You can response to the survey using the following smiley faces and explanations.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Slightly Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 I enjoy learning with a Smart Board.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>2 I am fed up with teachers’ teaching with a Smart Board.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>3 When lessons are taught with a Smart Board, I learn better.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>4 I can concentrate better when lessons are taught with a Smart Board.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>5 I study harder thanks to Smart Board.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>6 I learn many new things thanks to Smart Board.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>7 I cannot understand anything when a Smart Board is used.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>8 I enjoy lessons taught with a Smart Board.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>9 As the Smart Board is used in lessons I come to school more willingly.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>10 It is very important for me to learn how to use a Smart Board.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>11 I feel comfortable while using the Smart Board.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>12 I enjoy doing things on the Smart Board.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
<tr>
<td>13 Using a Smart Board in lessons causes waste of time.</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
<td>![Smiley Face]</td>
</tr>
</tbody>
</table>

(continued on next page)
24 I prefer a normal black/whiteboard to a Smart Board.

Note: The items involved in the final form of the scale are written in bold letters. Items were translated for international audience.

References


