RESEARCH ON EDUCATION AND PSYCHOLOGY (REP)

Received: April 15, 2022
Accepted: April 30, 2022
http:// dergipark.org.tr/rep

e-ISSN:2602-3733
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April 2022 ◆ 6(Special Issue) ◆ 69-91

Research Article
Doi:10.54535/rep.1104114

Development of Data Driven Decision Making Scale: A Validity and Reliability Study

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Abstract

In this study, it was aimed at developing a valid and reliable evaluation tool with the purpose of evaluating the Data Driven Decision Making Skills of teachers who work in primary school, middle-school and high-school levels. 534 teachers were included in the study (256 for EFA and 278 for CFA) (63 % female and 37 % male). For the scale development process, 730 teachers constituted the whole study group. In order to determine the structural validity of the scale, exploratory factor analysis and confirmatory factor analysis were used. As a result of the exploratory factor analysis, it was determined that the scale consisted of 10 items and 2 sub-dimensions. In the light of the literature, these dimensions were titled “Data literacy” and “Decision making”. The 2 sub-dimensional structure of the scale was subjected to the confirmatory factor analysis and as a result of the CFA, 1 item was excluded from the scale. The 2 sub-dimensional model created as a result of the EFA of DDDMS was tested with CFA and the adaptive values are at an acceptable level. In addition, the t values related to the high and low group difference of the scale showed that DDDMS is able to assess the structure in a distinctive manner. In order to determine the reliability of the scale, the Cronbach alpha internal consistency coefficients were calculated. When the reliability analyses results were viewed in the light of Data Driven Decision Making Scale’s factors, 0,782 value was obtained for the “Data Literacy” sub-dimension and 0,672 value was obtained for the “Decision Making” sub-dimension. The inner consistency coefficient of DDDMS is 0,790. As a result of the findings, it was determined that Data Driven Decision Making Scale is a valid and reliable assessment tool to evaluate the DDDM skills of teachers.

Key Words

Data • Data driven decision making • Data literacy

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Citation: Yılmaz, E., & Jafarova, G. (2022). Development of Data Driven Decision Making Scale: A validity and reliability study. *Research on Education and Psychology (REP)*, *6*(Special Issue), 69-91.

Although numerous factors have an important effect on the realization of educational objectives, teachers are in a key position (Gujjar & Naoreen, 2009, Ozkan & Arslantas, 2013), because teachers are the individuals who plan, implement (Bahar, 2019) and evaluate (Sahin, 2011) the education process which makes students acquire the planned knowledge and skills (Calık & Arslan, 2019). As teachers manage these processes, they encounter certain problems and are forced to choose one of the different methods in terms of the selection of materials, methods, resources and this procedure requires the decision making skill (Eskiocak, 2005). In this respect, it can be stated that the decision making skill of teachers is important in terms of realizing educational objectives (Mazlumoglu, 2019). Decision making is choosing one of two or more alternatives in a given situation in a conscious manner (Gunduz et al., 2020). The developments experienced in the recent times in information and communication technologies have put data to the fore as an important factor in terms of the effectiveness of the decisions taken (Karabacak, 2019, Murrell, 2012). Data Driven Decision Making (DDDM) is the use data, instead of relying on intuition or incomplete information to make conscious decisions for the development of students (Jr, 2016).

Taking the results of scientific studies which show that students' characteristics influence their success (Arici, 2007; Considine & Zappala, 2002; Cubuk, 2019; Olufemioladebinu et al., 2018; Perger & Takacs, 2016, Yildiz, 2016) as a starting point, it can be stated that teachers' taking data into consideration when making decisions may give better educational results. In this regard, it has a great importance that teachers have Data Driven decision making skills. In order to determine teachers' level in these skills, there is a need for assessment tools which can be used in scientific studies.

When the literature is reviewed, it can be seen that there are numerous studies which analyze Data Driven decision making in the area of education from different angles (Anderson, 2015; Bouchard, 2018; Corey, 2016; Halverson et al., 2006; Harris, 2011; Luo, 2005; Mandinach, 2012; Markarian, 2009; Moriarty, 2013; Simpson, 2011; Starks, 2014; Teigen, 2009; Wagaman, 2015; White 2008; Yao, 2009). However, it was seen that the "Statewide Data-Driven Readiness Study: Teacher Survey" developed by McLeod and Seashore (2006) has been used in various studies in different ways with the purpose of collecting quantitative data. The items in the original assessment tool were separated into 4 parts as "State Assessments", "Acting upon data", "Support Systems" and "School Culture." The scale is a 6-point Likert type assessment tool (Anderson, 2015). When the Turkish literature was reviewed, it was observed that there is a limited number of studies on this subject. In addition, it was determined that a majority of these studies (Altun & Karasu, 2021; Dilekci et al., 2020; Demir, 2019; Tabak et al., 2020) were carried out through qualitative methods. Besides these studies, a study by Dogan (2021) which mixed method was used, was also found in the literature. Within the scope of this study titled "Evaluation of Data Driven decision making process in school administration in terms of the views of administrators", the "Data Driven Decision in Schools Scale" was developed with four dimensions, "chronological infrastructure and equipment", "data usage culture", "data usage purpose" and "data literacy". However, it was seen that this study involved school administrators and that there were no data collection tools which could be used in quantitative studies related to teachers' making data driven decisions. It can be stated that there is a need to develop an assessment tool to assess data driven decision making skills with the purpose of contributing to the literature. In addition, it is considered that the scale to be developed will facilitate the implementation of various studies on the subject. In terms of developing the scale, the use of vignettes which are typically used in other assessment tools and make it possible to obtain more reliable and valid participant answers compared to "simple" abstract questions (Alexander & Becker, 1978) was found suitable for this purpose. Vignettes are designed as simulated texts (short stories), pictures, etc. and are presented to the participants to obtain answers related to the subject (Hughes & Huby, 2002). Vignettes (short stories) differ from question types in other assessment tools as they are able to concretize the context of the studied subject (Alexander & Becker, 1978). In this respect, it can be stated that vignettes can be more useful assessment tools to obtain quality data in the analysis of individuals' attitudes, perceptions and beliefs (Hughes & Huby, 2002). Since "data driven decision making" is a newly accepted concept in schools (White, 2008), it is considered that concretization of the questions to be asked to the teachers in the assessment tool through vignettes will allow obtaining participant answers with better quality. In the study carried out with this thought and the fact that there are no assessment tools based on vignettes in domestic literature, it was aimed at developing a valid and reliable assessment tool based on vignettes to assess teachers' data driven decision making skills.

Theoretical Framework

Data can be defined as information collected to be analyzed, considered, and used to help in decision making, in particular information such as facts, numbers, or electronic information which can be stored and used in an electronic environment (Cambridge Dictionary, 2022). Davenport and Prusak (1998) have defined data as basic raw material to create knowledge, "a series of separate, objective facts about events" (Luo, 2005). Recent technological developments have made data an indispensable part of the decision making process (Jr, 2016). Data in the field of education provides benefits in areas such as determining curriculum objectives (Ediger, 2010), determining education strategies, establishing effective communication, making assessments (White, 2008) and identifying the strong and weak characteristics of students (Starks, 2014). In this respect, it can be stated that making decisions based on data emerges as a need.

When the literature is reviewed, it can be seen that various definitions have been made on the data driven decision making process. Data driven decision making is the process of taking information and data into consideration when making decisions (Cemaloglu, 2019). Data driven decision making means the use of data in making conscious decisions on education (Wagaman, 2015). Data driven decision making in education means the process of collecting and analyzing data which will provide information to increase the success of students and schools (Marsh et al., 2006). In a wider sense, Data driven Decision Making (to be referred to as DDDM from this point on) is a concept related to the systematic collection, analysis, study and interpretation of data to guide policies and implementations in educational environments (Mandinach, 2012). According to another definition, data driven decision making is a process in which educators analyze assessment data to identify the strong and weak points of students, and use the obtained findings in educational applications (Mertler, 2014). In the current literature, there are various approaches which are similar to each other that related to the stages of the DDDM process. It can be stated that the DDDM process takes place in a cycle of data collection, analysis, decision making, implementation and assessment (Anderson, 2015). According to Ikemoto and Marsh's (2007) framework on the data driven decision making process, the initial stage of this process is the collection and organization of raw data. In this stage, different types of educational data are collected and included in the process. In the second stage, raw data are merged through related methods in the analysis and summary process to be transformed into information. In the third stage, data users turn information into knowledge which can be transformed into action and the implementation decision is taken. In the next stage, new data may be required to be collected to assess the effectiveness of actions and this in turn creates a continuous cycle of collecting, organizing and synthesis of data. The data types to be used to realize this cyclical process in line with the aims have an important effect (Ikemoto & Marsh, 2007).

The realization of data driven decision making in the area of education at the state, school/local and classroom levels (Kaufman et al., 2014), diversifies the data types to be used in this process. Although the required data type is determined in line with the quality of the decision to be taken, in general standardized data, in other words data such as end of the year assessments, test data, and success scores are considered when making decisions on the basis of districts and schools (Ediger, 2010; Starks, 2014). At the classroom level, data obtained as a result of identification, observation (formation) and result assessments are underlined (Kaufman et al., 2014). However, many researchers (Corrigan et al., 2011; Starks, 2014; Turan, 2019) maintain that data driven decision making related to the success of students in education should not be limited with these data. Besides quantitative data such as report cards, tests, and comparison scores, qualitative data such as student portfolios, demographic information, surveys, observation, homework, interviews, etc. should be taken into consideration, as well. When the literature is reviewed, it can be seen that data needed to be collected to determine the current state of school success are grouped under 4 headings. These data types and groups can be expressed as below:

“student learning data”- notes, lessons taken, standard test scores, etc.

“student demographic information”- ethnic roots, gender, etc.

“perception data”- school personnel, feedback from parents or community, etc.

“school process data” – programs offered by schools, educational applications, strategies used, etc. (Bernhardt, 2001; Schwartz, 2002; Wagaman, 2015; White, 2008).

Besides all these, scientific studies show that skills such as emotional intelligence, motivation level (Erdogdu & Kenarli, 2008; Seyis, 2011), time management (Durmaz et al., 2016), critical thinking and problem solving (Sahin Kolemen & Erisen, 2017) also have positive effects on the success of students. In this respect, it can be stated that taking such data into consideration in the decision making process on students can give better educational results.

Data cannot make an organization successful on its own. For an organization to be based on data, the individuals in the organization need to be employees who can accurately interpret, use and infer data (Anderson, 2015). Ikemeto and Marsh (2007) have expressed that Data Driven Decision Making in education means teachers, school principals and other administrators who systematically collect and analyze data to make beneficial decisions with the aim of increasing the success of students and schools. When in particular it is taken into consideration that practical use of data in the classroom level is significant in terms of the success of improving education to gain continuity (Wagaman, 2015), it is important that teachers who work in schools, which are a type of organization, analyze and interpret student data accurately (White, 2008).

Method

Participants

The population of the study consists of 6000 teachers who work in central districts of the city of Konya. Bryman and Cramer (2001) have stated that sample size in the sample development process is related to the number of items and that the number of individuals in the sample should be at least five times, or even ten times the number of items in the scale. Whereas Comrey and Lee (1992) have stated that there should be 200 individuals in the medium level in the sample development process and that 300 individuals is a good number. There are 11 items in the draft scale. It was considered that the number of individuals for each of the exploratory factor analysis and confirmatory factor analysis could be achieved as a sample size of at least 250-300 individuals in the sample development process. Separate samples were determined for exploratory factor analysis and confirmatory factor analysis. It was decided that there should be 250 individuals in the sample for exploratory factor analysis. While determining samples for EFA and CFA, the multi-stage sampling method was used. The teachers in the population were separated into classes based on the types of primary, middle and high-schools they work in. Schools in each sub-class were accepted as clusters. Schools were determined with the random sampling method and the draft scales were applied to the teachers who work in those schools.

There are 256 teachers in the sample determined for EFA. 61,8 % of the participants is female and 38,2 % is male. 7,5 % of the teachers in the sample have work experience of 1-5 years, 19 % have work experience of 6-10 years, 30,4 % have work experience of 11-15 years, 22 % have work experience of 16-20 years, 15,9 % have work experience of 21-25 years and 5,2 % have work experience of 26 years and more. There are 278 teachers in the sample determined for CFA. 63,7 % of the teachers in this sample is female and 36,6 % is male.

In order to achieve the comprehensibility of the items in the draft scale form (25 teachers) and to determine the response time for the scale (11 teachers), 36 teachers who work in two of the selected school were chosen randomly from the sub-class of the population. For scale stability, 85 teachers chosen through the random sampling method from the sub-class of the population formed the study group in the test-retest process. The criteria validity of the final scale was tested in the group consisting of 75 teachers who were chosen through the random sampling method from the high-school sub-class of the population. The clusters included in the sample development process stages were excluded from the population to prevent them from being included in another study group in a different stage. Together with the participants in all of these stages, the study group consists of 730 teachers.

Data Collection Tools

In order to determine the criteria validity of the developed Data Driven Decision Making Scale (will be abbreviated as “DDDMS” from this point on), Digital Data Security Awareness Scale developed by Yilmaz et al. (2015) was used as criteria.

Digital Data Security Awareness Scale

Digital Data Security Awareness Scale was developed by Yilmaz et al. (2015) with the purpose of determining the digital data security awareness of teachers. As a result of literature review and focus group interviews with critical shareholders, an item pool consisting of 93 items was created. After receiving the views of 12 field experts, the preliminary testing of the draft scale form was carried out with 79 teachers. For structural validity of the scale, exploratory factor analysis (EFA) was done using the data collected from 529 teachers, and a structure with a single factor, consisting of 32 items was created. The 5-point Likert scale which has acceptable internal consistency (α: 0.945) and explanatory variable (36.1 %) values was applied to 335 different participants and the confirmatory factor analysis (CFA) was done. The awareness expressions were rated through the 5-point Likert scaling. The Likert type ratings are: “Strongly agree (1)”, “Agree (4)”, “Neither agree nor disagree (3)”, “Disagree (2)” and “Strongly disagree (1)”. As the total score obtained from the scale increases, digital data security awareness also increases. All items in the scale consist of positive expressions. The structure with a single factor which reaches the ideal values through the help of modification indexes shows that Digital Data Security Awareness Scale (DDSAS) is valid and reliable.

Development of the Draft Scale

In the preparation of the draft form of DDDMS, the scale development process suggested by Seker and Gencdogan (2014) was followed. In this process, the literature, organizational structure and the results of the studies carried out in this field were analyzed (Anderson, 2015; Corey, 2016; Ikemoto & Marsh, 2007; Luo, 2005; Mandinach, 2012; Markarian, 2009; Moriarty, 2013; Simpson, 2011; Starks, 2014; Tabak et al., 2020; Wagaman, 2015; White, 2008; Yao, 2009). Based on these analyses, the first criteria on teachers’ data driven decision making were created. Then, suitable vignettes were designed for these criteria. The evaluations of experts (3 experts in their fields) who have academic studies in the area of decision making, teacher competencies and data driven decision making were asked for the designed characteristics and vignettes. A questionnaire was developed for the experts to communicate their evaluations. The experts in question evaluated the characteristics and vignettes which constitute the structure of the developed scale in terms of content, structure, applicability and meaning, and have communicated their replies. The experts were asked to make their evaluations between scores from 1 to 4 for each item formed by a vignette in the draft scale (1=not suitable, 2=too many corrections are required, 3=small corrections are required, 4=very suitable). The existence of concordance in the experts’ evaluations was predicted with the Kendall’s Coefficient of Concordance. As a result of Kendall’s analysis, a statistically significant difference was not found between the views of the experts. (Kendall’s W =,333, p =.450). According to the evaluations of the experts, the necessary changes and corrections were made. The vignettes in the draft scale were analyzed by four linguistics experts in terms of language, narration, exemplification of the characteristics teachers need to have and expression style and their views were asked. According to the evaluations of the linguistics experts, the vignettes were rearranged. As a result, the 14 items of the draft scale were reduced to 11 items based on the expert evaluations and anticipated arrangements.

In terms of how the 11 vignette based items of the DDDMS should be answered, the views of assessment and evaluation experts were asked. It was decided to answer the vignette based items of the draft scale in the 5-point Likert style and to create and score the answers based on these expressions: “Highly reflects me (5 points)”, “Reflects me (4 points)”, “Neither reflects me nor does not reflect me” (3 points)”, “Does not reflect me (2 points)” and “It does not reflect me at all” (1 point)”. Then, the instruction part was prepared and the draft scale was created.

The draft scale was applied to the group consisting of 25 teachers. During the application, the teachers were asked to mark the items they did not understand and had difficulty reading and state their views. The indicated problems were taken into consideration and the vignettes were corrected in terms of grammar and spelling mistakes within the scope of the teachers' views. Prior to finalizing the last version of the draft scale, it was analyzed once again by linguistics experts, all the necessary corrections were made, and the draft form of DDDMS was finalized. The final draft scale was applied to 11 teachers. As a result of this application, it was observed that the teachers were able to answer the draft scale in about 11-13 minutes.

Data Analysis

The SPSS and AMOS packaged software were used in the analysis of the data. Prior to the analyses, the lost data related to the data collected for both EFA and CFA, and 9 lost data were excluded from the data sets. According to Acuna and Rodriguez (2004), if the excluded data are less than 5 % of the data set, then this is a tolerable level. Therefore, the excluded data is at a tolerable level. Then, the outliers in the data set were excluded based on the Z scores, because the one-way outliers in the data set can be controlled by transforming the scores related to the items into Z scores (Tabachnick & Fidell, 2007). The Z value of the scores in the data sets; 6 data outside of the +3 and -3 range were accepted as outliers with a single variable and were excluded. Lastly, the outliers in the data set and whether the multiple variable normality assumption was met were tested with the Mahalanobis distance values and 2 data were not included in the analyses ($p < 0.01$). In addition, the value with the single variable was assessed based on the normality assumption, kurtosis and skewness coefficients. When the kurtosis and skewness values of the data sets are within the +1 and -1 range, it can be assumed that the data sets meet the conditions for normal distribution (Morgan, Leech, Gloeckner and Barrett, 2004). The kurtosis and skewness values of the data sets collected for EFA and CFA were found within the +1 and -1 range and it was assumed that these data had normal distribution. The analyzed data sets were 256 for EFA and 278 for CFA.

In the analysis of the items of the DDDMS, exploratory factor analysis and confirmatory factor analysis were done. The conformity of the collected data for the exploratory factor analysis was tested with the Kaiser-Meyer Olkin (KMO) and Bartlett tests. Then, the full conformity of the scale items which were created based on vignettes was analyzed with item total score correlation values. The structural validity of DDDMS was attempted to be determined through factor analysis. The correlation coefficients between the determined sub-dimensions' scores were calculated. The structure with 2 factors which emerged as a result of the exploratory factor analysis was tested with the first order confirmatory factor analysis. The reliability of the scale and its sub-dimensions which was tested with the first order CFA was calculated with the Cronbach alpha internal consistency coefficient method. In order to be able to determine whether DDDMS's items differed in the sub-group and higher group, the t value, average of the scores received from the items, and standard deviation were calculated. Whether accurate calculations were made or not within the reliability of the scale was determined with the test-retest method and the Pearson product moment correlation coefficient method was used in this process. In order to be able to predict the criteria validity of DDDMS, Digital Data Security Awareness Scale was used as criteria. In order to predict the relationship between the scores of this scale and DDDMS scores, Pearson product moment correlation coefficient method was used. To test whether a total score can be received from DDDMS, second order confirmatory factor analysis was done. The scoring instructions for DDDMS were created with the summated ratings technique.

Results

The stages of DDDMS's validity and reliability prediction process are presented below.

Item Analysis

During the development process of DDDMS, after the data set was structured and it was understood that it complied with the conditions of normality, items' item-total score correlations and anti-image correlation matrixes were calculated with the purpose of testing the relevance of the items created based on the vignettes to the scale.

Table 1

The Anti-Image Matrix and Item Total Correlation Values of Data Driven Decision Making Scale

	Items	M1	M12	M3	M4	M5	M6	M7	M8	M9	M10	M11	İtems	Item Total Correlation
Anti-Image Correlation Values	**M1**	**,890a**	-,054	-,083	-,111	-,058	-,031	,070	-,091	-,046	-,066	-,226	M1	,449
	M2	-,054	**,846a**	-,257	-,097	,031	-,045	,051	,069	-,224	-,017	-,074	M2	,449
	M3	-,083	-,257	**,860a**	-,199	-,102	-,114	-,071	-,058	,105	-,110	-,088	M3	,545
	M4	-,111	-,097	-,199	**,842a**	-,274	-,031	,020	,023	-,167	-,231	,102	M4	,573
	M5	-,058	,031	-,102	-,274	**,840a**	-,095	-,063	,095	-,213	-,024	,061	M5	,458
	M6	-,031	-,045	-,114	-,031	-,095	**,918a**	-,123	-,121	-,119	-,023	-,024	M6	,466
	M7	,070	,051	-,071	,020	-,063	-,123	**,835a**	-,182	-,098	,002	-,212	M7	,357
	M8	-,091	,069	-,058	,023	,095	-,121	-,182	**,786a**	-,192	,002	-,345	M8	,409
	M9	-,046	-,224	,105	-,167	-,213	-,119	-,098	-,192	**,830a**	-,246	,077	M9	,609
	M10	-,066	-,017	-,110	-,231	-,024	-,023	,002	,002	-,246	**,882a**	-,140	M10	,559
	M11	-,226	-,074	-,088	,102	,061	-,024	-,212	-,345	,077	-,140	**,751a**	M11	,390

As it can be seen in Table 1, the scale items' item-total score correlations are between 0,357 and 0,609. In order to process the items of the developed scale, the item-total score correlation should be over 0.30 (Buyukozturk, 2015). The scale items' all diagonal values in the anti-image matrix are higher than 0.50. When the diagonal value of the anti-image correlation matrix of the developed scale is below ,5, then those items need to be excluded from the analysis (Can, 2018). The items of the draft scale can be included in the analysis based on these values and explanations.

Sample Size

In order to be able to decide on the sample size of the data collected for DDDMS, the Kaiser-Meyer-Olkin (KMO) and Bartlett test values were checked, as Alpar (2013) has suggested that sample size sufficiency in the scale development process should be checked with the Kaiser-Meyer-Olkin (KMO) value. In addition, Buyukozturk (2015) has stated that KMO coefficient being higher than 0.60 and the results of the Bartlett test being significant means that sample size is sufficient. The KMO coefficient calculated for DDDMS was determined as 0.842. Additionally, the Bartlett test Chi-square value was statistically significant (X2= 687,354; p<0.01). According to these results, it was accepted that the data collected for Data Driven Decision Making Scale met the requirement for factor analysis.

Structural Validity

Exploratory factor analysis (EFA) of the Data Driven Decision Making Scale (DDDMS) (EFA):

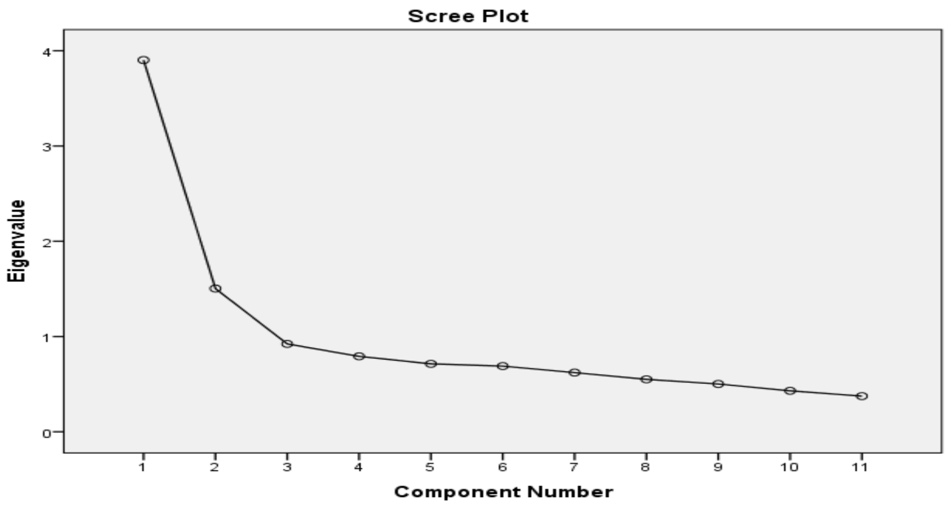
The primary statistical methods used to test the structural validity of a scale which is being developed are exploratory and confirmatory factor analyses. In order to be able to demonstrate DDDMS's structure and produce structural validity proof, the Exploratory Factor Analysis (EFA) was used. Factor analysis is a multivariate statistics which brings numerous variables which are related to each other and aims at presenting less, significant and new variables (Buyukozturk, 2015). Therefore, varimax, which is the principal components analysis in the calculation of factor loadings and the rotation technique, was Exploratory Factor Analysis (EFA), because this method reveals factors with simple meanings by rotating factor variances to be maximum with a small number of variables (Tavsancil, 2005).

As a result of the factor analysis, factor number was decided according to its eigenvalues. If a factor's eigenvalues are higher than 1, it means that the factor contains the required information about the structure which is to be assessed (Thompson, 2008). According to Guris and Astar (2015), the eigenvalues should be higher than 1.0 when deciding on the factor number. In addition, in order for an item to fall under a factor, at least 0.45 is a good value for the factor load. When necessary, this value can be lowered down to 0.30 (Buyukozturk, 2015). The factor loads were assumed to be at least 0.40 in order for DDDMS's factor eigenvalues to be higher than 1 and for its items to fall under a factor.

As a result of EFA, Scree-Plot (Figure 1) was analyzed. According to Scree-Plot (Figure 1), it can be seen that the X axis component number is two at the break point where the slope disappears. Therefore, it was decided that DDDMS's factor number was at least two.

Figure 1

Scree-Plot of Data Driven Decision Making Scale



As a result of the factor analysis, it was accepted that it can be a structure with two factors when the factors with eigenvalues higher than 1 and the theoretical bases were taken into consideration. Among DDDMS's 11 items, co-occurring item M1 which its factor load was higher than 0.40 but loaded on more than one factor was excluded from the analysis. The experts were consulted when item M1 of the still developing DDDMS was excluded from the analysis. It was decided that there was another item which assessed the same characteristic with the item related to the expert opinion assessed, the related item was ambiguous, and the exclusion of the related item would not make the scale insufficient in terms of evaluating the scope of the scale. After the exclusion of item M1, EFA was repeated. According to EFA results, a structure with 2 sub-factors with an explained total variance rate of 51,369 % was achieved. The factors achieved as a result of EFA and the items' factor loads are presented in Table 2.

Table 2

Varimax of Data Driven Decision Making Scale

	Components	
Items	1	2
M2	,600	
M3	,599	
M4	,807	
M5	,714	
M6	,436	
M9	,698	
M10	,648	
M7		,682
M8		,795
M11		,794

Total Variance Explained: 51,369, Factor 1: 36,402 % and Factor 2: 14,968 %

When Table 2 is analyzed, it can be seen that the factor loads achieved from the Exploratory Factor Analysis are between .436 and .807. It can be seen that the factor loads are higher than 0,40 which is indicated as a threshold. When the factor load values of the items were analyzed, it was assumed that the items loaded on the factors assessed the desired structure. As a result of the analyses, the factors were named in line with the items they contained. As a result of the analyses, the first factor consisting of 7 items (M2, M3, M4, M5, M6, M9 and M10) was named "Data Literacy" and the second factor consisting of 3 items (M7, M8 and M11) was named "Decision Making."

Table 3

Correlation coefficients between the factors of Data Driven Decision Making Scale

		Decision Making
Data Literacy	r	,369**

(**: p<.01)

If the correlation coefficient value of the relationship between the sub-dimensions of the scale is higher than .60, then it can be stated that all dimensions are dependent and all dimensions assess a conceptual structure (Sencan, 2005: 778). When Table 3 is analyzed, it can be seen that the correlation between the sub-dimensions of the scale have a .369 significant relationship. In this regard, it can be stated that the sub-dimensions of the scale do not assess the same conceptual structures and can be used independently.

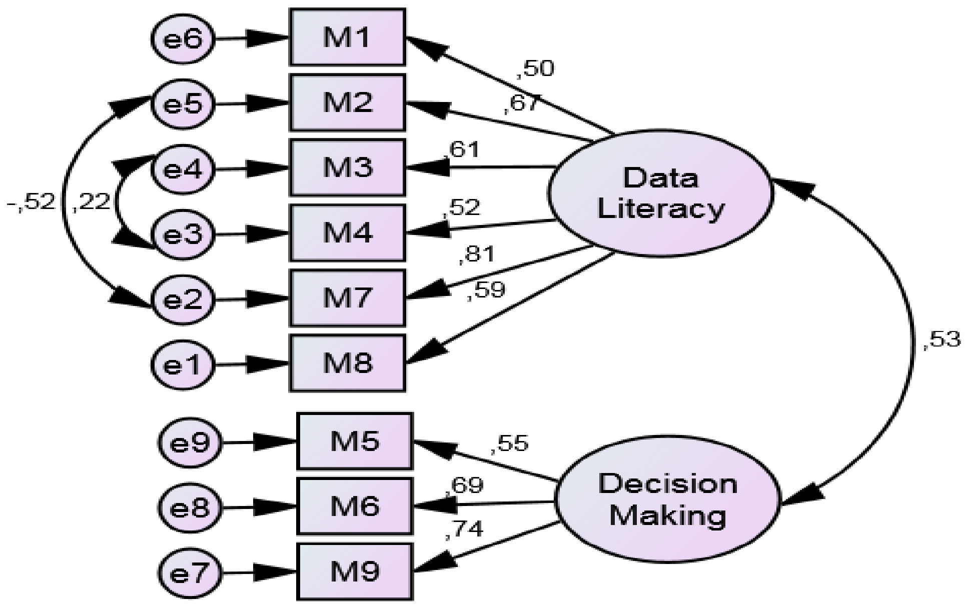
The confirmatory factor analysis (CFA) of the model, which emerges after the exploratory factor analysis (EFA), should be done to assess structural validity (Kline, 2011). Therefore, the model which emerged after EFA was tested with CFA.

Confirmatory Factor Analysis (CFA) of Data Driven Decision Making Scale (DDDMS)

Confirmatory factor analysis was used with the purpose of testing the accuracy of the two dimensional structures which was determined in accordance with the results of exploratory factor analysis to test the validity of DDDMS. As a result of the confirmatory factor analysis, it was seen that the model adaptive values of the 10 items in the scale were not at an acceptable level. Since the error variance of an item in the model created as a result of the CFA was quite high and its regression weight was very low, it was considered that it was incompatible with the scale structure of the items. This item was excluded from the model and the model was retested. Through the analysis with the exclusion of an item, the fit index calculations were renewed and the values accepted for the fit indexes were achieved. The experts were consulted when excluding this item. The experts stated that the related item could be excluded, because there were more inclusive items which assessed the characteristic that this item assessed, and the exclusion of the item would not cause the scale to be insufficient in assessing the scope of the scale. The item numbers of DDDMS, which now consisted of 9 items with the exclusion of an item in the light of these views, were revised. The model was created with the revised item numbers of DDDMS and the accepted fit index values were achieved in the renewed fit index calculations of the created model. As a result of all the revisions, the diagram achieved from CFA done for the validity of DDDMS is given in Figure 2.

Figure 2

CFA Results of Data Driven Decision Making Scale; Standardized path diagram



When DDDMS's path diagrams related to CFA are analyzed in Figure 2, it can be seen that the standardized path coefficients of the items range between 0.50 and 0.81. Kline (2005) stated that items' standardized path coefficients being 50 and over predictive quality means that they represent the variable. When the items' related path coefficients in the model are analyzed, it can be stated that the items have sufficient predictive quality. The fit index values related to this model are given in Table 3.

Table 3

Fit Index Values of the CFA Results of Data Driven Decision Making Scale and Their Comparison

Model	χ2/sd	GFI	CFI	IFI	AGFI	NNFI	RMSEA
	59,877/24=2,495	,966	,958	,959	,936	,933	0,061
Fit comment*	Perfect fit	Perfect fit	Perfect fit	Perfect fit	Perfect fit	Acceptable fit	Acceptable fit

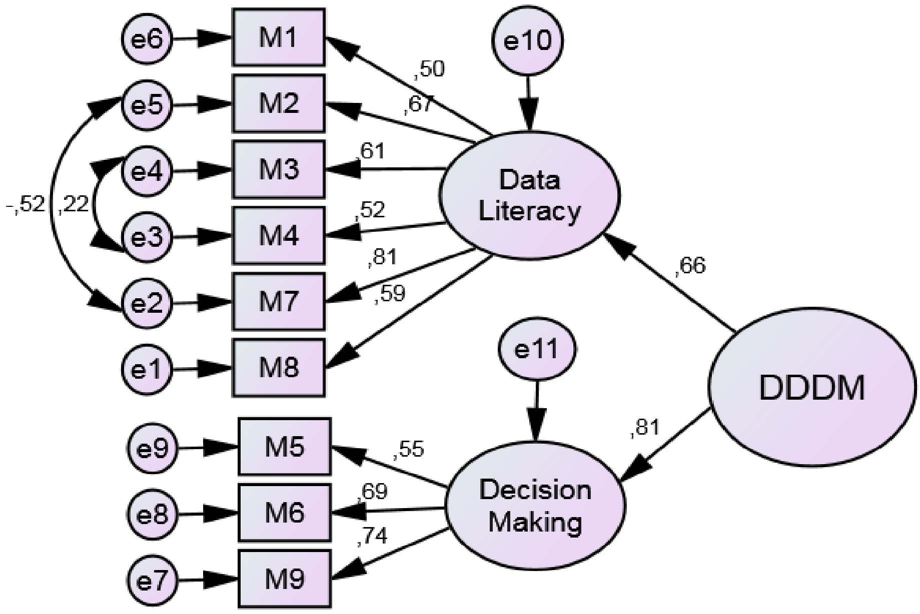
(*:SimSek, 2007; Yılmaz and Celik, 2009*)*

It can be seen that in general the fit indexes of the scale, which was obtained with 2 factors as a result of the CFA of DDDMS, have good values. The rate of Chi-square value to the degree of freedom was found as (χ2/sd=2,495. GFI (Goodness of Fit Index), CFI (Comparative Fit Index), IFI (Incremental Fit Index) and NNFI (Non-Normed Fit Index) fit indexes being close to 0.95 value and the RMSEA value being lower than 0.07 can be accepted as an indication that the model has good fit to the data. The fit indexes achieved for the scale in this study can be accepted as proof that the suggested model and the data in hand have good fit (Simsek, 2007; Yilmaz and Celik, 2009). When some calculated modification values were analyzed, correlation was found between (M2-M7; M3-M4) error covariances.

Meydan and Sesen (2011) state that the second order multi-factored models of multi-dimensional scales should also be tested when doing the confirmatory factor analysis. The components of a latent variable of the two factors of DDDMS were tested with the second order multi-factored model. The second order CFA results related to this two sub-dimensional and one dimensional model are shown in Figure 3.

Figure 3

Second order CFA results of Data Driven Decision Making Scale: Standardized path diagrams



With the purpose of showing that the Data Literacy and Decision Making dimensions of DDDMS, achieved through the first order confirmatory factor analysis, represent Data Driven Decision Making suggested theoretically in the next dimension, the second order confirmatory factor model was created (Figure 3). DDDMS was tested with the second order factor model, by adding a latent variable named Data Driven Decision Making to the first order confirmatory structure which was tested with two latent and 9 indicator variables. As a result of the testing of the second order factor model, the goodness of fit values are shown in Table 4.

Table 4

The fit index values of second order CFA results of Data Driven Decision Making Scale and their comparison

Model	χ2/sd	GFI	CFI	IFI	AGFI	NNFI	RMSEA
	59,877/24=2,495	,966	,958	,959	,936	,933	0,062
Fit Comment*	Perfect Fit	Perfect Fit	Perfect Fit	Perfect Fit	Perfect Fit	Acceptable Fit	Acceptable fit

(:*Simsek, 2007; Yılmaz and Celik, 2009*)*

When the first order and second order confirmatory factor analyses results are analyzed, it can be stated that, based on the structural validity result of the scale, DDDMS is an assessment tool which can be used to determine the total Data Driven Decision Making levels.

Table 5 shows the factor loads, t value for high and low group difference, average and standard deviation of the received scores.

Table 5

T value for high and low group difference, item averages and standard deviations of ***Data Driven Decision Making Scale***

	Madde no	T value for high and low group difference	İtem averages	Standard deviations
Data literacy	M1	12,358**	3,92	,843
	M2	15,154**	3,69	,918
	M3	16,135**	3,41	1,072
	M4	14,997**	3,15	1,035
	M7	19,476**	3,56	1,050
	M8	14,369**	3,45	,943
Decision making	M5	11,175**	3,80	,879
	M6	10,010**	4,36	,797
	M9	11,919**	4,33	,866

(**: p<.01)

It was seen that there is a significant difference between the item score averages of DDDMS. According to this, it can be stated that DDDMS can distinguish individuals who receive high scores and who receive low scores from the scale.

Data Driven Decision Making Scale's scale related validity: In the scale validity study of DDDMS which was done using the Digital Data Security Awareness scale, the correlation coefficients between the total scores achieved from the scales were calculated and the results are given in Table 6.

Table 6

Scale validity results of Data Driven Decision Making scale

		Digital data security awareness
Data Driven Decision Making	r	,305**

(**: p<.01)

As it can be seen in Table 6, a positive significant relationship was found between Data Driven Decision Making Scale scores and Digital Data Security Awareness scores (p<05). These results show that Data Driven Decision Making Scale has scale validity.

Findings related to the reliability of Data Driven Decision Making Scale: Within the scope of DDDMS's reliability study, firstly the items' total scores and correlations were calculated. Within the scope of DDDMS' dimension and sub-dimension reliability study, the internal consistency of the items which constitute the scale were predicted with the Cronbach-Alpha Coefficient method. All the results are given in Table 7.

Table 7

Some reliability analysis values related to the scale items of Data Driven Decision Making Scale

	İtem no	Item-total score correlation	Cronbach alpha internal consistency coefficients	
Data literacy	M1	,453	,782	,790
	M2	,527		
	M3	,567		
	M4	,449		
	M7	,636		
	M8	,519		
Decision making	M5	,393	,672	
	M6	,365		
	M9	,416		

When Table 7 is analyzed, the calculated Cronbach alpha internal consistency coefficients to determine DDDMS's reliability can be seen. According to the reliability analyses, DDDMS's "Data Literacy" sub-dimension was calculated as 0,782 and "Decision Making" sub-dimension was calculated as 0,790.

Test-retest results: For DDDMS's stable assessment quality, the test-retest method was used. For this purpose, DDDMS was applied to 85 teachers twice with a four week interval. The relationship between the two application scores was calculated with the Pearson Product Moment Correlation Coefficient method. The results are presented in Table 8.

Table 8

Results related to the test-retest results of Data Driven Decision Making Scale

			2nd Application Scores		
			Data Literacy	**Decision Making**	**Data Driven Decision Making**
1st Application Scores	**Data Literacy**	r	,777**		
	Decision Making	r		,570**	
	Data Driven Decision Making				,738**

(**: p<.01)

In the analyses done with the purpose of determining the reliability of the scale through the test-retest method, a positive significant relationship was found between the first and second application scores of DDDMS's dimensions. According to these results, it can be stated that DDDMS can make strong, stable assessments. All of these analyses, done within the reliability of DDDMS, show that the reliability of the scale is sufficient.

According to DDDMS's structure with two sub-dimensions' (Data Literacy and Decision Making) being a component of an upper dimension (Data Driven Decision Making) and the second order CFA results related to the receivability of a total score from the scale (see, Table 4), it was seen that the fit indexes are at an acceptable level. These values show that the items with the factors are a part of represent a higher dimension. In the light of all these results, it can be stated that a total score can be received from the scale. The score evaluations on the scoring of Data Driven Decision Making Scale are shown in Table 9.

Table 9

Score table of Data Driven Decision Making Scale

Sub-dimensions of Data Driven Decision Making Scale	Items	Score which can be received from the whole of the sub-dimensions	
		Lowest score possible	Highest score possible
Data Literacy	1, 2, 3, 4, 7 and 8	6	30
Decision Making	5, 6 and 9	3	15
Data Driven Decision Making	1, 2, 3, 4, 7, 8, 5, 6 and 9	9	45

DDDMS is scored with the summated rating technique. According to the summated rating technique, a score received from a scale being scored is the sum of the scores given to the reactions to the items in the scale

(Tezbasaran, 1996). In the application process of DDDMS, the reaction given by the scorer to each item in the scale indicates the scorer's level of attitude towards the items. The score which indicates this level is the participant's score for that item. DDDMS's total and sub-dimension scores is calculated by adding the scores of the related items.

DDDMS can be scored separately with its sub-dimensions. While a score between 6 and 30 can be received from DDDMS's Data Literacy sub-dimension, a score between 3-15 can be received from its Decision Making sub-dimension. In order to receive a total score from the scale, the scores received from items 1, 2, 3, 4, 5, 6, 7, 8 and 9 of the scale are added to each other. There are no items in the scale which require reverse scoring. A high score received from each dimension and sub-dimensions shows that the individual has a high level of sufficiency in the related dimension and sub-dimension, whereas a low score indicates that the individual has a low level of sufficiency in the related dimension and sub-dimension. This assessment is also valid for the score received from the total scale.

As a result, the results of the EFA showed that the scale has a structure with two sub-dimensions. The model created by EFA was tested with CFA and it was determined that the fit values are at an acceptable level. It was determined with second order CFA that the Data Literacy and Decision Making sub-dimensions are represented in the Data Driven Decision Making higher dimension. It was observed that the scale achieved scale validity. In the results related to the reliability of DDDMS, it was determined that the internal consistency coefficients were at a good level and that the scale made stable assessments. When all values related to DDDMS are analyzed, it can be stated that it is a reliable and valid scale.

Discussion

The technological developments we experience around us have made the use of data an important factor in the decision making process. The results of scientific studies show that the characteristics of students have significant effects on their academic success. In this regard, it can be suggested that teachers' taking student data into consideration when making decisions related to students will improve educational results. There might be a need for assessment tools to be used in studies which deal with identifying teachers' state of taking data into consideration in the decision making process.

When the related literature was reviewed, it was determined that there was no Turkish scale which can describe teachers' Data Driven decision making skills. It was observed that a scale which was developed in another country involved an evaluation on a state scale (McLeod and Seashore, 2006). Taking the view that each country might have a different educational policy as a starting point, it was considered that developing another scale other than the scale in question might contribute to the literature.

With the purpose of concretizing subject content and achieving a higher quality of participant replies in Data Driven Decision Making Scale (DDDMS), which involves teachers' identifying their own characteristics according to their own perceptions, vignettes (short studies) were used in the study. The scale, which consists of a total of 9 vignettes, has two sub-dimensions. The first sub-dimension named "Data Literacy" consists of items based on vignettes 1, 2, 3, 4, 7 and 8. The items based on the vignettes in the first sub-dimension involve teachers' knowing the importance of data related to the DDDM process, data collection, description, knowing data types, separating, storing, analyzing, interpreting data, etc. skills. The second sub-dimension named

"Decision Making" involves items based on vignettes 5, 6 and 9. The vignettes under the "Decision Making" sub-dimension assess teachers' characteristics such as making Data Driven assessments rather on the education process, establishing communication and identifying goals.

When the validity and reliability values of DDDMS were analyzed, it was determined that the scale items were able to assess the characteristic as they aimed at. According to the views of the experts and scope validity, it can be stated that DDDMS represents the population which is desired to be assessed. According to the values of the exploratory factor analysis done to test the structural validity of DDDMS, it was assumed that the items loaded on the factors assessed the desired structure. The t values related to the scale's high and sub group difference proved that DDDMS is able to assess the structure in a distinguishing manner.

The model with two sub-dimensions created as a result of DDDMS's EFA results was tested with CFA and it was seen that the fit values are at an acceptable level. With the second order CFA, it was determined that Data Literacy and Decision Making sub-dimensions are represented in the Data Driven Decision Making higher dimension. It was observed that the scale was able to provide scale validity. According to the results related to DDDMS's reliability, it was determined that the internal consistency coefficients are at a good level and the scale is able to make stable assessments. In the light of all the values related to DDDMS, it can be concluded that it is a reliable and valid scale.

It is considered that DDDMS can be used by field experts who wish to study the DDDM skills of teachers who work in primary, middle and high-school levels.

Ethic

In this study, all rules indicated within the scope of "Higher Education Institutions Scientific Research and Publication Ethics Regulation" were followed. None of the actions indicated in the second part of the regulation under the heading, "Actions Contrary to Scientific Research and Publication Ethics" were carried out.

Author Contributions

All stages of the study were organized and conducted by the authors.

Conflict of Interest

The authors declare that they have no conflict of interest.

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