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Reasoning Ways Scale: Validity and Reliability Study for Teachers

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This study investigated whether the Reasoning Ways Scale is a valid and reliable teacher measurement tool. The Reasoning Ways Scale, previously developed for pre-service teachers consist of seven sub-dimensions and 21 items. In this study, for the validity and reliability of the Reasoning Ways Scale for teachers, 520 teachers working in different cities and in different branches in the 2022-2023 academic year were reached by appropriate sampling method. The study data were analyzed using SPSS 25.0. Exploratory and Confirmatory Factor Analyses were conducted for the construct validity of the Reasoning Ways Scale for teachers. As a result of these analyses, it was determined that the instrument had a structure consisting of seven sub-dimensions and 21 items. The reliability coefficients of the sub-dimensions of the measurement tool were obtained as Verbal, 0.85; Historical, 0.81; Algebraic, 0.78; Intuitive, 0.77; Analogical, 0.72; Inductive, 0.67 and Deductive, 0.61. The statistical results also supported acceptable goodness-of-fit indices for the seven-dimensional factor structure of the instrument/acceptable goodness-of-fit indices for the dimensional factor structure; ($\chi^2(210) = 3378.718$; $p<0.01$), RMSEA= 0.041; GFI= 0.947; AGFI= 0.928; CFI= 0.953. Cronbach's Alpha reliability coefficient of the overall scale was .74. The results obtained are statistically similar to those of the Reasoning Ways Scale. Therefore, the Reasoning Ways Scale is a valid and reliable instrument for Teachers.

Keywords: Reasoning, reasoning ways, scale validity, scale reliability

INTRODUCTION

Reasoning is an open, laborious, and negotiation-based process (Trippas, Handley, Verde & Morsanyi, 2016) because it involves arguments and mental reasoning between these arguments. Reasoning, which is a mental effort, has a teachable-learnable feature. In fact, researchers (Chen & She, 2015; Gillies, 2011; Gillies, 2019; Oaksford, & Chater, 2019) have started to look for ways to teach and develop this mental skill in formal learning experiences as a result of the understanding that reasoning is a developable skill. Thus, it was considered important to develop the personal and academic characteristics of teachers, who are the most important stakeholders in the education process, due to their high multiplier effect in the formal learning process, and in this study, the validity and reliability study of the Reasoning Ways Scale was investigated. Because, reasoning is an important quality serving both personal and academic development. At the same time, what and how the student needs to learn shapes what and how the teacher learns, and this cycle continues (Wilson, Schweingruber, & Nielsen, 2015). Therefore, it is a widely accepted reality that increasing teachers' qualifications will increase their students' qualifications. For this reason, teachers who can use different reasoning skills at high levels are influenced by their students' competencies and qualifications in this regard (Gillies, 2019; Karaçay, 2014) and offer inquiry-based learning experiences to their students (Benford, 2001).

Reasoning, which functions based on the principles of logic, involves a reasoning process in the form of "if this is so, then it can be so." Piaget (1953) described this process as compensation, serial organization, classification, and hypothetical-deductive arguments in the form of "if...then...therefore", while Kuhn and Pearsall (2000) defined it as the coordination of theory and evidence. In both descriptions, it is seen that there is a "questioning." Therefore, reasoning skills are expressed as skills that directly affect the inquiry process and are used in the inquiry process (Kuhn, 2004; Zimmerman, 2000). In the process of questioning while solving problems or making decisions in life, reasoning methods are used. In the reasoning process, there is a "premise" proposition, which is in the state of evidence and justification, and a "conclusion" proposition, which is proven and justified. Conversely, logic examines the proof relation between the premise or premises and the conclusion in reasoning. Therefore, logic is not concerned with checking the propositions in reasoning in terms of content but with whether or not the reasoning yields a necessary result in terms of form. Thus, logic is used as a 'tool' in the process of correct reasoning, that is, in the process of expressing and checking inferences. Therefore, in the decision made by considering the rules of logic, logic acts as an intermediate variable that increases the accuracy of the conclusion. In short, logic, considered in the reasoning stage, which is the process of making inferences, enables a conclusion about propositions. For example, "Ayşe is a teacher". Ayşe studied at the faculty of education because all teachers study at the faculty of education" is an argument, that is, a thesis. The accuracy of the conclusion "Ayşe studied at the faculty of education" is based on the premises "Ayşe is a teacher" and "all teachers study at the faculty of education". Except for the items of the "intuitive reasoning" sub-dimension of the "Ways of Reasoning" measurement tool developed for the above reasons, all other items were developed within the logic framework exemplified in this paragraph. The argumentative items of the instrument are grouped into seven (7) sub-dimensions. These dimensions are grouped under seven different reasoning headings: deductive, inductive, analogical, intuitive, algebraic, historical, and verbal. All items of this measurement tool adapted for teachers consisted of propositions based on logic, except for "intuition."

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The meaning of "Deductive" which is one of the seven ways of reasoning in the Reasoning Ways Scale, is the process of concluding special cases by generalizing (Evans, 2013). In this process, it is to draw conclusions from the available information based on the available information (Siswono, Hartono, & Kohar, 2020). Thus, the conclusions reached must come from the information at hand.

The other way of reasoning, "inductive" is argued to aim at learning processes controlled by metacognition, as in associative learning (Shute, 1992). Unlike other learning processes, "inductive" reasoning is described as a cognitive ability (Heit, 2000; Molnár et al., 2013) affecting the success of acquiring and applying knowledge by generalizing and deducing rules from simple observation, analogies, examples or by using the way of "transcending knowledge."

In the "analogical" way, designers use information from previous concepts to form the basis of a new concept and are based on reasons about similarity. Human cognition perceives the relational and physical similarity between two elements and uses this information to create a new element (Gentner & Smith, 2012).

The other sub-dimension of the measurement tool, "Algebraic" reasoning is defined as the capacity to make the relationship between variables explicit by showing quantitative situations (Driscoll, 1999). In addition, Blanton and Kaput (2005) defined algebraic reasoning as generalizing forms using arithmetic, functional thinking, formulating formal generalizations, and generalizing the mathematical system based on relationships and calculations.

Within the scope of the "historical" reasoning way, there are experiences of explaining or expressing the change that has occurred by comparing the past with the present (Drie & Boxtel, 2008), which includes the steps of asking questions in a historical sense, using available resources, contextualization, argumentation based on examination and evaluation, and using substantive concepts.

"Verbal" reasoning, on the other hand, is more inclusive in that it requires reasoning and is considered across a broad spectrum of human activities and behaviors, including academic performance (Kotzeand Massyn, 2019) and work performance (Langetal, 2010). Verbal reasoning is defined in the literature as the ability to understand concepts expressed through language, to think constructively, and to reason to solve problems. In this context, it is evaluated in a wide spectrum ranging from how written and spoken language is understood, reasoned, and related to them. Verbal reasoning is, therefore, a skill that helps to use language to negotiate and explain environmental stimuli.

In this study, the "intuitive" way of reasoning is considered beyond the cognitive and affective conceptual framework based on the literature. Because it is said that intuitive reasoning does not have access to normative rules, and applying normative principles requires deliberative thinking (Morewedge & Kahneman, 2010). This is because people tend to base their thinking on faster intuitive impressions rather than more costly reasoning (Evans, 2008; West, 2000). Although intuition is sometimes useful, it can also conflict with logical, probabilistic, and mathematical evaluations (Evans, 2008; Frederick, 2005). In this regard, intuition is a method of reaching real knowledge without reasoning or evidence (Turkish Language Association, 2005), and intuition is described as an instinct, separate from cognitive reasoning by saying that intuition is not a work of intelligence independent of the cognitive process and externality (Hançerlioğlu, 1970).

Thus, the intuitive reasoning way, which is independent of the reasoning process, was evaluated as a variable that increases the comprehensiveness of the " Reasoning Ways" measurement scale.

Below, statistical analyses and the results of the study are presented to show whether the "Reasoning Ways" measurement tool is a valid and reliable tool for the teachers working in the system.

METHOD

The study employed a quantitative methodology, using Cronbach's alpha for internal consistency, construct validity, descriptive statistics, convergent validity, divergent validity, and composite reliability analyses.

Research Participant

The study involved 520 teachers employed in various schools and branches across different regions. The study sample was selected by the convenient sampling method, one of the non-probability sampling methods. The study sample was determined through a convenience sampling method, which expedited the research process (Kılıç, 2013). The demographic characteristics of the study group are summarized in Tables 1 and 2 below.

Table 1. Teachers' Gender, Marital Status and Age Distribution

	N	%
Female	410	78,8
Male	110	21,2
Single	160	30,7
Married	360	69,3
21-30	130	25,0
31-40	200	38,5
41-50	137	26,3
Over 50 years old	53	10,2
Total	520	100,0

According to Table 1, 79% of the teachers participating in the study were female, and 21% were male. It is seen that 31% of the participants are single, and 96% are married. The age ranges of the teachers were 21-30 (25%), 31-40 (39%), 41-50 (26%), and 50 years and above (10%) (Table 1).

Table 2. Teachers' Education Status Information

	N	%
Faculty of Education	385	74,03
Faculty of Science and Letters	101	19,4
Other	34	6,53
Undergraduate	423	81,34
Master's degree	97	18,66
Total	520	100,0

When the distribution of the schools that the teachers participating in the study graduated from is examined according to Table 2, it is seen that 74% of them graduated from the faculty of education, 19% from the faculty of science and literature, and 7% from different departments. In the same table, it is seen that 81% of the study participants have an undergraduate degree, and 19% have a master's degree (Table 2).

Procedures

In this study, the target population consisted of teachers working in public schools. Ethical approval was obtained from the Aydın Adnan Menderes Univesitiy ethics committee before the data collection. Participants were recruited through online survey tools, and their participation in the study was entirely voluntary. Before conducting the data collection instruments, the objectives of the study were explained, and informed consent was obtained from the participants. Same time it was observed that the necessary care was taken to ensure that the instruction of the measurement tool was quite explanatory in order to provide ethical rules. The participants of the research,who were reached online, were voluntarily asked to "check if you want to participate" and the scale items were marked after this option. For this reason, it is thought that the participants answered the scale items willingly and honestly.

Data Collection Tool

The study data were obtained with the "Reasoning Ways Scale" developed by Yalın Uçar et al. (2023). The scale was developed according to the data obtained from 378 pre-service teachers studying in different departments of different faculties of education in the spring semester of 2020-2021. The Ways of Reasoning Scale used in this study consists of seven dimensions of reasoning ways, each represented by three items. The scale is a five-point Likert-type response format, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The reliability of the scale, as measured by Cronbach's alpha coefficient, was .74, indicating acceptable internal consistency. In addition, all seven sub-dimensions of the scale were reliable and showed a normal distribution: Verbal (0.85), historical (0.81), algebraic (0.78), intuitive (0.77), analogical (0.72), inductive (0.67), and deductive (0.61). Noticeably, the verbal, historical, algebraic, intuitive, and analogical sub-dimensions demonstrated high reliability; however, the inductive and deductive sub-dimensions showed moderate reliability. Furthermore, a composite reliability (CR) value exceeding 0.60 is considered satisfactory regarding composite reliability standards (Hair et al., 2017).

Data Analysis

In order to investigate whether the Reasoning Ways Scale used in this research process is a valid and reliable tool for teachers, the following analyses were conducted. In this study, factor analysis was conducted to investigate univariate and multivariate normality. Skewness and kurtosis values were examined in order to evaluate univariate normality, Skewness and kurtosis values within the range of -3 to +3 were considered

acceptable for a normal distribution (Shao, 2002; Coakes and & Steed, 2003; Shao, 2002;). Multivariate outliers were identified using a significance level of $p < 0.001$, employing the Mahalanobis distance method (Tabachnick & Fidell, 2013).

The data obtained from the research were analyzed using SPSS 25.0 program. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were employed in order to evaluate the construct validity of the Reasoning Ways Scale. The suitability of the data for factor analyses was evaluated through the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's sphericity test. Additionally, a normality test was conducted on the entire scale and its sub-dimensions. The proportion of variance explained by the overall scale and individual sub-dimensions was calculated. Exploratory factor analysis was employed to determine the factors, factor loadings, and items associated with each factor. Subsequently, the factor structure derived from the exploratory factor analysis was evaluated using confirmatory factor analysis. In order to assess the adequacy of the Confirmatory Factor Analysis (CFA) to determine the construct validity of the scale, various indicators were employed, including the Chi-Square Goodness (χ^2/degrees of freedom (df)) for evaluate the DFA fit index and Root Mean Square Error of Approximation (RMSEA). Root is square of approximate errors. Same time, Standardized Root Mean Square Residual (SRMR) to find the goodness of fit of the model. Comparative Fit Index (CFI) to comparative fit index, Goodness of fit index (GFI), and Adjusted Goodness of Fit Index (AGFI) in order to make up for the lack of sample size. Additionally, the Cronbach Alpha coefficient was calculated for both the overall scale and its sub-dimensions to evaluate the internal consistency reliability of the scale.

FINDINGS

The findings obtained as a result of the analysis of the data obtained from 520 teachers were tried to be described in the tables below.

Construct Validity

Exploratory and confirmatory factor analyses were conducted for construct validity. In the principal components analysis, Kaiser-Meyer-Olkin Sampling Adequacy Measure (.718) and Bartlett's Test of Sphericity ($\chi2(210) = 3378.718$, $p < .001$) results showed that the data set was sufficient for factor analysis (Bartlett, 1954).

Exploratory Factor Analysis (EFA)

Table 3. Factor Analysis Results for the Reasoning Ways Scale

	Dimensions and Scale Items	Rotated Factor Loadings*	Explained Variance
	Deductive		%8,398
S2	Since olives grow in the Aegean region, olives also grow in Balıkesir.	0,454	
S3	Since all children are curious, three-year-old Deniz is curious too.	0,824	
S4	Hand-woven carpets are expensive. Since the carpet in Seyhan's house is hand-woven, Seyhan's carpet is expensive.	0,856	
	Inductive		%9,009
S6	Since Qatar has rich oil reserves, so all countries with good oil reserves are rich.	0,773	
S7	Since the Universe with higher education is intelligent, all people with higher education are intelligent.	0,763	
S8	Since writers, poets, and painters are creative, all artists are creative.	0,742	
	Analogical		%8,938
S11	As a farmer raises his seedlings, a teacher raises his students.	0,777	
S12	The brain works by storing data, like a hard disk in a computer.	0,797	
S13	Just as a critic analyzes a novel, a policeman similarly solves crimes.	0,723	
	Intuitive		%9,499
S14	In many situations, I usually make decisions based on my intuition.	0,856	
S15	In critical situations, I usually listen to my inner voice.	0,816	
S16	I ignore my rational mind and listen to my heart in most situations.	0,715	
	Verbal		%10,731
S17	In a paragraph, I find the sentence that breaks the integrity of meaning.	0,853	
S18	I sort the mixed plot sentences.	0,852	
S19	I fill the gaps in the paragraph with appropriate sentences.	0,805	
	Historical		%10,339
S20	I research a historical event from sources with different opinions.	0,792	
S21	When I encounter a problem, I look at its historical development to understand the problem.	0,875	
S22	I use historical information to build my future.	0,816	
	Algebraic		%10,015
S23	I learn most information easily by giving numerical values.	0,858	
S24	Using numerical expressions in my daily life makes my life easier.	0,900	
S25	I create my own formulas to solve problems in daily life.	0,665	
*** Rotation Method: Varimax**		**Total Variance Explained: %66,929**	
KMO =0,718; Bartlett's Sphericity Test $\chi2(210)$ =3378,718; (p) =0,000			

Before the exploratory factor analysis, Kaiser-Meyer-Olkin (KMO) test was applied to test whether the sample size was suitable for factor analysis. When Table 3 is examined, the KMO value obtained from the analysis is 0.718. This finding shows that the sampling adequacy is "good enough" for factor analysis. The KMO value between 0.5-1.0 is acceptable, and for the sample size to be adequate, the KMO value should be at least .60 and above, and the Barlett test should be significant ($p<.05$) (Tabachnick & Fidell, 2013). However, the general tendency of the researchers is that the KMO value is 0.7 and above (Altunışık et al., 2010:266). In addition, when Table 3 is examined, the results of Bartlett's test of sphericity show that the chi-square value obtained (χ^2 (210) =3378.718; $p<0.01$) is acceptable.

The reasoning scale consists of twenty-one (21) items and seven sub-dimensions. These dimensions are "Deductive," "Inductive," "Analogical" and "Intuitive," "Verbal," "Historical" and "Algebraic." In this framework, exploratory factor analysis was conducted to reveal the factor pattern of the tool.

In order to reveal the factor pattern of the reasoning scale, "principal component analysis" was used as a factorization method, and "Varimax," one of the orthogonal rotation methods, was used as rotation. In the analysis conducted for the seven sub-factors of the measurement tool, the items were evaluated in terms of whether the overlapping and factor loading values met the acceptance level, and it was determined that the factor loadings were at the desired level (Table 3). In the relevant table, it is seen that the factor loadings of the items are between 0.454 and 0.900 (Table 3). As a result of Varimax rotation, the items were again grouped under seven (7) factors. These factors explain 66.929% of the total Variance (Table 3). In this context, it is seen that the contribution of each factor to the total Variance is sufficient (Table 3). Again, as seen in Table 3, the first factor, "deductive" reasoning, explained 8,398% of the total Variance, and the second, "inductive" reasoning, explained 9,009%. The third factor, "analogical," explained 8.938%, "intuitive" explained 9.499%, "verbal" explained 10.731%, "historical" explained 10.339%, and finally, "algebraic" reasoning factor explained 10.015% of the total Variance.

Confirmatory Factor Analysis (CFA)

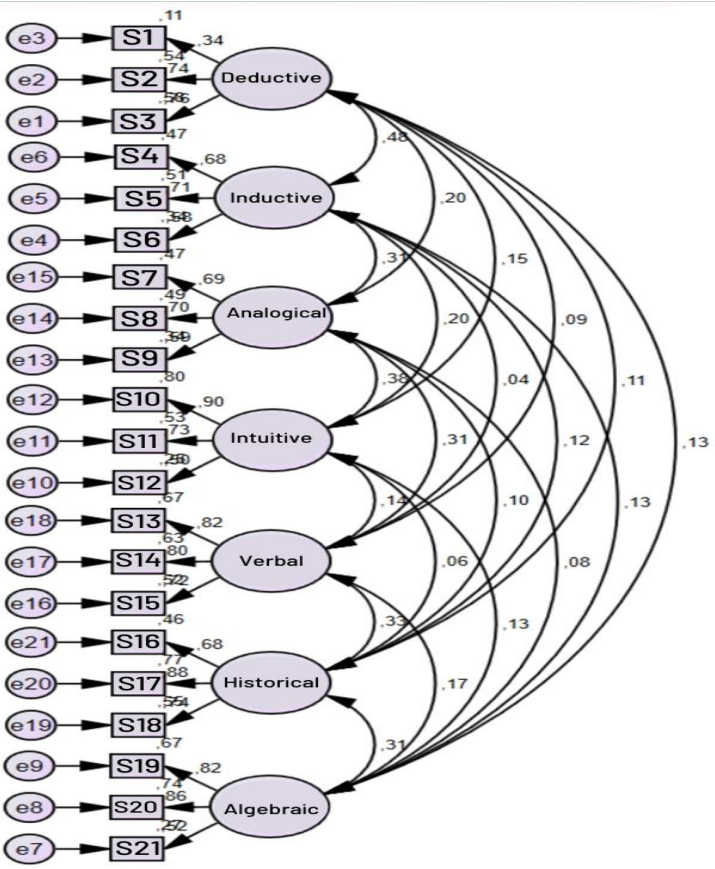
The construct validity of the instrument consisting of twenty-one items and seven factors, was tested by confirmatory factor analysis (CFA). The data obtained based on this analysis are presented in Table 4.

Table 4. Reasoning Scale First Level Multifactor Model Confirmatory Factor Analysis Fit Indices

RMESA	NFI	CFI	IFI	GFI	TLI	AGFI	CMIN	CMIN/df
0,041	0,907	0,953	0,953	0,947	0,941	0,928	320,026	1,905

According to the Confirmatory Factor Analysis (Table 4), it was determined that the scale was significant at the Structural Equation Modeling Results level and that the 21 items and seven sub-dimensions of the Reasoning Scale were related to the scale structure. In the fit index calculations of the model, it is shown in Table 4 that the accepted values for fit indices were met. According to the results of the first level multifactor model confirmatory factor analysis, the goodness of fit indices of the Reasoning Scale was RMSEA 0.041; GFI 0.947; AGFI 0.928; CFI 0.953; and df 1.905, which were at acceptable levels (Table 4).

Figure 1. Model for First-Level Multifactor Confirmatory Factor Analysis of the Reasoning Scale



Factor Loadings

Table 5. Factor Loadings Obtained as a Result of Confirmatory Factor Analysis of the Reasoning Scale

	Items	Factor Loadings
S1	Since olives grow in the Aegean region, olives also grow in Afyonkarahisar.	0,339
S2	Since all children are curious, six-year-old Ali is curious too.	0,736
S3	Hand-woven carpets are expensive, and since the carpet in Deniz's house is hand-woven, Deniz's carpet is expensive.	0,759
S4	Since Qatar is a rich country with high oil reserves, all countries with good oil reserves are rich.	0,685
S5	Since Deniz, who has a higher level of education, is intelligent, all people with a higher education level are intelligent.	0,714
S6	Since writers, poets, and painters are creative, all artists are creative.	0,583
S7	A teacher raises his students in the same way as a farmer raises his seedlings.	0,687
S8	The brain works by storing data, like a hard disk in a computer.	0,698
S9	Just as a critic analyzes a novel, a policeman similarly solves crimes.	0,587
S10	In many situations, I often make decisions based on intuition.	0,897
S11	In critical situations, I usually listen to my inner voice.	0,730
S12	In most cases, I ignore my rational mind and listen to my heart.	0,501
S13	I find a sentence that breaks the unity of meaning in a paragraph.	0,818
S14	I order mixed plot sentences.	0,796
S15	I fill the gaps in the paragraph with appropriate sentences.	0,722
S16	I research a historical event from sources with different opinions.	0,682
S17	When faced with a problem, I look at its historical development to understand the problem.	0,879
S18	I use historical information to build my future.	0,742
S19	I learn most information easily by giving numerical values.	0,818
S20	Using numerical expressions in my daily life makes my life easier.	0,862
S21	I create my own formulas to solve problems in daily life.	0,524

As seen in Table 5, the factor loadings of the scale ranged between 0.339 and 0.862. The model for the confirmatory factor analysis of the Ways of Reasoning Scale for teachers is given in Figure 1.

Table 6. Reliability Coefficients of the Measurement Scale and its Subscales

Scales and subscales	Number of Items	Cronbach's Alpha (α)
Reasoning scale	**21**	**0,766**
Deductive	3	0,608
Deductive	3	0,609
Analogical	3	0,682
Intuitive	3	0,738
Verbal	3	0,820
Historical	3	0,805
Algebraic	3	0,770

Cronbach's Alpha reliability coefficient was calculated for the internal consistency of the scales and sub-dimensions used in the study (Table 6).

As seen in Table 6, Cronbach's Alpha reliability coefficient of the overall Reasoning Ways Scale was found to be 0.766. The deductive sub-dimension of the scale had a Cronbach's Alpha reliability coefficient of 0.608; Inductive sub-dimension, 0.609; Analogical sub-dimension, 0.682; Intuitive sub-dimension, 0.738; Verbal sub-dimension, 0.820; Historical sub-dimension, 0.805 and Algebraic sub-dimension, 0.770 (Table 6). It can be said that these results have high-reliability levels for social sciences research. Indeed, it is possible to say that the results obtained from the data produced by scales with high-reliability levels will be consistent and stable.

CONCLUSION and DISCUSSION

This study statistically revealed that the "Reasoning Ways" Scale is also a valid and reliable instrument for teachers. The results of this study were consistent with the results obtained from prospective teachers (Yalın Uçar et al., 2023).

Reasoning is an important opportunity in formal learning environments because it can be taught and learned. Therefore, it is considered that this measurement scale is important for teachers to know their own ways of reasoning and develop awareness about different ways of reasoning. The " Reasoning Ways Scale" is thought to be used effectively in the education process, especially because it includes seven different ways of reasoning. This measurement tool is crucial because teachers who can use different and multiple ways of reasoning are both role models and have the potential to teach their students. In fact, reasoning skills are a prerequisite for problem-solving, decision-making, and higher-level thinking skills. This is because it is necessary to create options for different situations, conditions, and experiences by approaching each variable with multiple reasoning and to make decisions or solve problems by choosing the appropriate one from these options. Therefore, the different schemas created in the reasoning process and the relationships or differences between schemas also serve mental development. Moreover, the multiplier effect of the educational investment in teachers on the reality of society remains valid in every period and under every condition.

As a result of this study, this measurement tool, which aims to determine the level of use of reasoning ways by teachers working in different branches and which reasoning ways they prefer more or less intensively, is useful, valid, and reliable. The instrument, which consists of seven different reasoning sub-dimensions with an ideal number of items (21) and three items for each sub-dimension, is inclusive in this respect. At the same time, it is a practical tool that requires 15 to 20 minutes of respondents' and researchers' time.

The Reasoning Ways Scale for Teachers showed acceptable internal consistency and a unidimensional factor structure. The factor loadings derived from the exploratory factor analysis and the item load values of the regression coefficients obtained from the confirmatory factor analysis indicated satisfactory levels of the Reasoning Ways Scale developed in this study.

The confirmatory factor analysis revealed that the Reasoning Ways Scale for Teachers showed satisfactory fit indexes based on various criteria. The χ^2/df ratio was below 3, indicating a perfect fit according to Sümer (2000) and Kline (2005). The p-value was below .05, further confirming a perfect fit as per Pallant (2001) and Çokluk, Şekercioğlu, and Büyüköztürk (2010). Additionally, the CFI, GFI, AGFI, IFI, TLI, and NFI values, exceeding 0.90, indicated a good fit according to Hu and Bentler (1999), Kline (2005), and Tabachnick and Fidell (2000). These findings supported the notion that the seven factors of the Reasoning Ways Scale for

Teachers exhibited satisfactory fit indexes. In conclusion, these results revealed that single-factor structure of the measurement tool fit the dataset at a desirable level.

The Cronbach's alpha coefficient for the overall scale was calculated as .77, indicating acceptable internal consistency. Moreover, all seven sub-dimensions of the scale, namely Verbal Reasoning (α = 0.82), Historical Reasoning (α = 0.80), Algebraic Reasoning (α= 0.77), Intuitive Reasoning (α = 0.74), Analogical Reasoning (α = 0.68), Inductive Reasoning (α = 0.60), and Deductive Reasoning (α = 0.60), demonstrated reliability and exhibited a normal distribution. Additionally, a composite reliability value higher than 0.60 is considered adequate according to Hair et al. (2017). As each sub-dimension of the Reasoning Ways Scale exceeded this threshold, the composite reliability of the scale was confirmed.

The Reasoning Ways Scale for Teachers (RWSfT) sample consisted of teachers from different branches. However, the items of this instrument were not specific to the teaching profession but included items related to daily life. Therefore, this instrument may also be suitable for adults.

At the same time, except for Intuitive Reasoning, which is one of the sub-dimensions of the scale, the items of the other six (6) sub-dimensions identify and reveal the "Reasoning" skills of the teachers and, therefore, the reasoning path that is the reason for the preference for this reasoning. The Intuative Reasoning sub-dimension is thought to add a special value to this measurement tool. Because while the other sub-dimensions are completely argument-based, the intuitive reasoning items are structured completely outside of this logic. This is because studies (Ghasemi, Handley, Howarth, Newman, & Thompson, 2022) show a similar conflict model for intuitive reasoning in arguments without valid results. In the literature, empirical studies including mental processes such as intuitive logic, deliberation, reasoning, and heuristics have shown that people tend to make decisions based on intuitive reasoning, avoiding the reasoning process that they find costly (Evans, 2008; Kahneman, 2011; Thompson, Turner, & Pennycook, 2011; Stanovich & West, 2000).

This measurement tool was applied to pre-service teachers studying in different departments in 2021. It was found to be a valid and reliable tool (Yalın Uçar et al., 2023), and the reliability of the measurement tool was obtained as .74. When the reliability of the sub-dimensions of the instrument (verbal, 0.85; historical, 0.81; algebraic, 0.78; intuitive, 0.77; analogical, 0.72; inductive, 0.67; deductive, 0.61) are examined, it will be seen that they have relative values with the results obtained from the participants of this study, teachers. Thus, the Reasoning Ways Scale worked at a "good" level in both pre-service and in-service teachers. In addition, although the "Hypothetical-Creative Reasoning Skills Scale" developed by Duran (2014) is similar in name to this study, it shows quite different theoretical and structural features.

In the local and foreign literature reviews, it was observed that studies on reasoning are generally conducted in a discipline-specific manner. For example, the 6th-8th Grades Reasoning Skill Scale (Özpınar, 2012), Mathematical Reasoning Skill Test (Poçan, Yaşaroğlu, İlhan 2017); Early Mathematical Reasoning Skills Assessment Tool (Ergül, 2014); Validity and Reliability of a Korean Version of Nurse Clinical Reasoning Competence Scale, (Jiyoung and Narae, 2017). Also Developing a Two-Tier Proportional Reasoning Skill Test: Validity and Reliability Studies (Açıkgül, 2021) and Assessing statistical reasoning (Garfield, 2003); Styles of Scientific Reasoning: A Cultural Rationale for Science Education? (Kind and Osborne, 2017) are mostly focused on mathematics and science/nature.

On the other hand, this measurement tool shows a unique structure in terms of content validity as it includes both natural and social sciences and especially instinctive reasoning.

Thinking, feeling, and willing behaviors that constitute cognition are transformed into thinking, "reasoning"; feeling, "intuition," and willing behavior, "will" as a result of educational experiences (Paul & Elder, 2008). For this reason, reasoning ways have to be an important parameter of formal learning processes as they can be taught, changed and developed. This is because creative science, art, and technology products are produced through "reasoning". At the same time, the reasoning process involves making informed decisions in daily life and reveals that without reasoning, previously acquired knowledge and experience cannot be applied to new situations (Bhat, 2019).

It is thought that the Reasoning Ways Scale for Teachers (RWSfT), for which validity and reliability studies were conducted, will significantly affect students' academic achievement through teachers. Studies showing the effect of reasoning ability on academic achievement (Ertepmar, 1995; Cavallo, 1996; Johnson & Lawson, 1998; Sungur et al., 2001; Kuhn & Holling, 2009; Tekkaya & Yenilmez, 2006; Oloyede, 2012, Gupta, 2012; Nnorom, 2013; Kanchan & Sharma, 2013), it has also been concluded that individuals who reason successfully are more successful than other individuals because they make more accurate and effective decisions in their

lives (Erdem & Gürbüz, 2015). In addition, the research is limited to seven different ways of reasoning and the responses of the participants. Therefore, more participants should be reached and qualitative data should be obtained and the results should be discussed.

Declarations

Conflict of Interest

No potential conflicts of interest were disclosed by the author(s) with respect to the research, authorship, or publication of this article.

Ethics Approval

The formal ethics approval was granted by the Social and Human Sciences Research and Publication Ethics Committee of Aydın Adnan Menderes University Education Faculty. We conducted the study in accordance with the Research Ethics Committee dated 27.10.2021; V. decision; number, 2021/24 and numbered E-84982664-050.01.04-95460.

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Research and Publication Ethics Statement

The study was approved by the research team's university ethics committee of the Aydın Adnan Menderes University (Approval Number/ID: V/2021/24. The manuscript " Reasoning Ways Scale: Validity and Reliability Study for Teachers " the following is fulfilled:

- This material is the authors' own original work, which has not been previously published elsewhere.
- The paper reflects the authors' own research and analysis in a truthful and complete manner.
- The results are appropriately placed in the context of prior and existing research.
- All sources used are properly disclosed.

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