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# Development of inquiry skills scale for life studies: Validity and reliability study

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**ABSTRACT**

This study aims to develop a scale that can measure primary school students' inquiry skills for life studies as valid and reliable. The research consisted of 511 primary school students studying in 15 different schools in the city center in a province in the south of Turkey in the February-May semesters of the 2021-2022 academic year. In the study, the participants were selected by chance, and each participant took part voluntarily. In the study, expert opinion was consulted for the scope and appearance validity of the scale, and exploratory factor analysis (EFA) and confirmatory factor analysis were applied for structure validity. As a result of EFA, a structure consisting of 26 items and four factors explains 40.903% of the total variance. The resulting factors are inquiry ability, asking questions, making sense of the answers to these questions, and recognizing the problem in the middle.

**Keywords:** life studies, inquiry scale, primary education

## INTRODUCTION

In today's world, where concepts such as information societies, technology age, and science age are frequently used, accumulated information has reached incredible levels. So much so that it can be said that today's children have more knowledge than even past scientists. This accumulation of knowledge brings with it new questions every time, and these questions enable the production of new information. This cycle leads to an exponential increase in knowledge and the emergence of new questions every time. Today, this rapid change and development significantly affect the education and educational components, which are an integral part of society. In order to keep up with this change in educational components such as curriculum, course contents, teaching methods, and techniques used, students need to acquire some basic skills. Individuals who acquire these skills adapt to the changes in their immediate environment and find quick solutions to their problems (Gokturk-Ince, 2014).

It is possible to solve the problems encountered in life when questions such as "why," "how," and "when" are answered. Among the essential features expected from individuals in today's societies are reaching for information, using information, producing information, and using inquiry skills. Since the inquiry is based on curiosity, problem-solving, and critical thinking, it is considered a skill individual will need throughout their lives (Branch & Solowan, 2003). Inquiry is essential in forming meaningful learning, especially for students. Thier and Daviss (2001) state that it is much easier to internalize and make sense of what is learned with the ability to inquire.

For this reason, students need to activate their inquiry skills instead of traditional behaviors such as memorization, listening, and repetition to increase their academic success. However, through the ability to inquire, the teacher acts as a facilitator of the learning activity, encourages the student to be active, and provides guidance rather than directly conveying the educational activity (Herron, 2009; Wood, 2009). As highlighted by previous scientific studies on educational settings in the last decade, there has been a change towards an inquiry-based model in primary schools (Harlen & Qualter, 2009; Rönnebeck et al., 2016). The inquiry skills in primary schools help students learn new concepts and develop learning skills by performing their tasks (Harlen & Qualter, 2009; Harlen, 2013; Kirschner et al., 2006).

Asking questions is at the core of inquiry-based learning, allowing students to observe and examine various valid information or collect different information by asking questions to strengthen their "self-learning" skills (Carnesi & DiGiorgio, 2009). The ability to inquiry includes the knowledge of asking questions, making sense of the answers to these questions, recognizing, comprehension, evaluating, interpreting the problem in the middle, and finally producing solutions (Abali-Ozturk et al., 2017; Un-Acikgoz, 2014; Aldan-Karademir, 2013). In inquiry-based activities, students actively develop their understanding by answering questions, designing, applying, and interpreting the results of scientific research (Bell et al., 2005). Primary schools' students often

lack the experience, strategy, and knowledge of different science skills to conduct effective scientific research (Solé-Llussà et al., 2020). In addition, children have limited cognitive information processing capacity, which prevents them from performing complex tasks such as the inquiry process. (D'Costa & Schlueter, 2013; Flavell, 1992; Solé-Llussà et al., 2018). Thus, introducing inquiry-based activities in primary school is a challenging issue. The ability to question is also defined as a process by which students make observations, ask questions, search for existing information from books and other sources, plan their research, analyze, interpret, discuss, and use tools to formulate, explain, and draw conclusions (NCR, 2000, as cited in Bogar, 2019). In inquiry-based activities, students examine events and facts individually and in groups and reach conclusions. Because inquiry is one of the best ways to learn information in depth. Students manage research activities, ask questions, plan new activities, draw conclusions, and validate their learned information (Branch & Oberg, 2004; Gunes, 2016). Some previous research (Chen & Tseng, 2011; Schmid & Bogner, 2017) has found that students who engaged in inquiry-based learning showed more significant improvements in learning outcomes than those who used traditional learning models. As can be seen, the ability to inquire is a multidimensional concept that includes skills such as recognizing, analyzing, producing solutions, making inferences, comparing with some variables, evaluating thoughts, in any event, acquiring information about a new situation, and making decisions and establishing relationships. It can be said that using these skills in daily life has become necessary. However, these high-level cognitive skills should be acquired at an early age. Because the permanence of the behaviors gained, especially in primary school ages, can be high. For this reason, it is essential to include inquiry and inquiry skills in some basic subjects in primary school. Inquiry-based learning (IBL) is currently one of the essential teaching models in education settings (Alake-Tuenter et al., 2013) that focuses on "inquiry" and "discovery," as well as a "student-led, teacher-directed" learning model (Alberta Learning, 2004). Learning based on inquiry skills can be combined with other disciplinary areas to provide effective teaching (Schallert et al., 2022). Although inquiry-based learning is often emphasized in the literature in subjects such as science and mathematics, it is an option that can be used in other disciplines to encourage research, exploration, and recognition of one's immediate surroundings (Smallhorn et al., 2015; Schallert et al., 2022). In particular, the Life studies lesson, which includes daily life knowledge, is thought to be more critical than other lessons in acquiring, testing, and transferring these skills to daily life. Because according to Kabapinar (2019), the life studies lesson is an essential lesson where social studies and science lessons are combined, and this lesson centers on the child's experience of how he makes sense of the world. Life studies lessons primarily prepare children for life and provide them with the necessary knowledge, skills, and attitudes (Oker & Tay, 2019). A Life studies lesson is a lesson that includes different disciplines. It provides the student with information about daily life, enabling them to become good individuals and citizens with student-centered teaching techniques and preparing them for the following educational process (Tay & Yildirim, 2013).

As it can be understood from the definitions made above, it can be said that the most crucial purpose of the life studies lesson is to prepare the student for life and to gain life skills, which are among the most basic skills. According to Yagci et al. (2016), the life studies lesson undertakes the function of preparing children for life and creating life consciousness by selecting and organizing the most basic knowledge, skills, attitudes, thoughts, and values required by the age in the fields of natural and social sciences. In addition, it can be said that it is one of the most effective lessons in which students develop themself, get to know their culture and the environment they live in, adapt to the environment they live in, gain creative thinking and problem solving, and inquiry skills (Ekmen, 2019). When the life studies curriculum is examined, it enables them to make observations about nature, create questions, and exhibit a scientific understanding through separation, grouping, and comparison of the results of observations (MEB, 2015). The MEB 2018 Life studies curriculum states that inquiry is an essential critical thinking skill (Bektas et al., 2019). This lesson aims to teach students essential life skills (Karakas, 2021). Its primary functions are preparing individuals for life and raising well-equipped individuals by gaining the most basic knowledge, skills, behaviors, attitudes, values, and thoughts required by today's world. Life studies lesson aims to develop the individual holistically in terms of social, communication, morality, etc., aspects. For this purpose, all issues related to life are handled by methods such as problem-solving, inquiry, and discussion (Akinoglu, 2004; Ozturk & Dilek, 2004; Sonmez, 2005). Based on all this information, it can be said that life studies and inquiry skills are closely linked to each other in terms of content. For this reason, developing a measurement tool that can measure the inquiry skills for life studies is essential.

## METHOD

In this part of the scale development study with quantitative methods to improve the scale of inquiry skills for life studies. The research study group is provided with information about the procedures performed during the scale development.

### Workgroup

In the research process, there is a study group of primary school students with face-to-face scale application (n=511). In the study, descriptive information of a total of 511 participants in study group according to some variables is presented in **Table 1**.

### Data Collection Process

Within the scope of the research, different working groups were worked within the application of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) processes. It is stated in the relevant literature that it would be more appropriate to apply EFA and CFA to different groups (Fabrigar et al., 1999; Worthington & Whittaker, 2006). Out of the working group consisting of 511 participants in total, the EFA process was operated with 245 participants, and then the CFA process was operated with 266 participants. Compliance validity and reliability studies were carried out with all 511 participants, while test-retest reliability was initially carried out with 60 participants. The form of the participant who did not participate in any of the test-retest studies applied

**Table 1.** Percentages and distributions of the working group according to some variables

| Gender | Grade | Number of people | Percentage (%) |
|---|---|---|---|
| Female | Grade 1 | 43 | 16.2 |
| | Grade 2 | 66 | 24.9 |
| | Grade 3 | 156 | 58.8 |
| Total | | 265 | 100.0 |
| Male | Grade 1 | 47 | 19.1 |
| | Grade 2 | 48 | 19.5 |
| | Grade 3 | 151 | 61.3 |
| Total | | 246 | 100.0 |

**Table 2.** Working groups included in the analysis process

| Analysis groups | Grade | f | Percentage (%) |
|---|---|---|---|
| Exploratory factor analysis | Grade 1 | 46 | 18.3 |
| | Grade 2 | 50 | 20.4 |
| | Grade 3 | 149 | 61.3 |
| Total | | 265 | 100.0 |
| Confirmatory factor analysis | Grade 1 | 44 | 16.5 |
| | Grade 2 | 64 | 24.0 |
| | Grade 3 | 158 | 59.5 |
| Total | | 246 | 100.0 |
| Test-retest reliability | Student | 45 | 100.0 |

at intervals of two weeks was eliminated and analyzes were made on the remaining 45 students. In order to match the scales in the first and last application, a section was opened on the scale, and the students were asked to write their school numbers. This method was used to increase the reliability of the research. The workgroups described are shown in **Table 2**.

In the literature, studies stated that a size of 5 times the number of items of a 3-point Likert-type scale would be sufficient for the sample size in EFA studies and that a total of 100 participants would be less, 500 participants would be outstanding, and 1,000 participants would be excellent (Cattell, 1978; Everitt, 1975). Regarding the process of confirmatory factor analysis, it is stated that a participant number 10 times the number of items will be sufficient (Kline, 2011). From this point of view, it can be said that the number of participants reached in this research (n=511) is sufficient for both EFA and CFA processes.

## Scale

The inquiry skills for life studies have been developed by examining the current information in the field literature related to the life studies lesson. The ability to question includes the knowledge of asking questions, making sense of the answers to these questions, recognizing, comprehension, evaluating, interpreting the problem in the middle, and finally producing solutions (Abali-Ozturk et al., 2017; Un-Acikgoz, 2014; Aldan-Karademir, 2013). A pool of 45 items was created by scanning the literature on questioning skills and selecting the appropriate propositions. The form containing the items related to the dimensions expressed is arranged in the 3-point Likert type, and the definitions 1-never, 2-sometimes, and 3-always are used for the rating.

## Process

In the first stage of the scale development, appropriate propositions were determined by searching the inquiry skills for life studies literature. The literature review was followed by creating the scale item pool. Interviews were conducted with one academician from the education programs and teaching field, one from the measurement and evaluation field, three from the field of primary school teaching, and two academicians in the Turkish language regarding the items in the scale pool. Experts have expressed a positive opinion that the items in the scale pool include items related to all of the skills, including the ability to ask questions, make sense of the answers to these questions, notice, comprehend, evaluate, and interpret the problem in the middle and finally to produce solutions. 45 items in the article pool have been reviewed and edited.

Afterward, there were ten people, including five primary school teachers, two curriculum and teaching field experts, two assessment and evaluation experts, and a Turkish field expert. 19 items were eliminated considering the experts' opinions, and some were adjusted. The final version of the draft form, which has 26 items, has been examined by a Turkish linguist and adapted in terms of spelling and punctuation marks, grammar rules, and expression disorders.

In the second stage of the scale development process, the draft form of the scale was applied to the participants in the study group. A province in the south of Turkey, where face-to-face scale application was made in primary schools in February-May 2022, consists of 245 (48%) primary school students studying in 15 schools in the city center. In the study, the participants were selected by chance, and each participant took part voluntarily.

The scale's validity in the analysis process initiated after the scale application; structure, appearance, scope, and compatibility are examined in the context of validity. The construction validity studies on the scale started with EFA and continued with the CFA process. The structural features of the draft form prepared with EFA were examined, and the sub-dimensions were tried to be determined. With the CFA made later, the correctness of this structure was tested. In other words, the CFA process was carried out to support the scientific validity of the structure put forward in EFA and to place the model on firmer foundations. Expert opinion was consulted for the validity of appearance and scope. Within the scope of the reliability study, internal consistency coefficients were calculated, and test-retest reliability was examined.

**Table 3.** KMO and Bartlett test results

| | | |
|---|---|---|
| **KMO sampling adequacy measure** | .926 | |
| **Bartlett sphericity test** | ~$x^2$ | 2968.825 |
| | sd | 227 |
| | p | .00 |

**Table 4.** Factor loads

| Item no | Post-rotation load values | | | |
|---|---|---|---|---|
| | **Factor 1** | **Factor 2** | **Factor 3** | **Factor 4** |
| M25 | .636 | | | |
| M22 | .625 | | | |
| M23 | .604 | | | |
| M20 | .603 | | | |
| M19 | .552 | | | |
| M15 | .548 | | | |
| M26 | .543 | | | |
| M16 | .537 | | | |
| M17 | .512 | | | |
| M14 | .470 | | | |
| M13 | .457 | | | |
| M18 | .417 | | | |
| M7 | | .645 | | |
| M11 | | .603 | | |
| M2 | | .516 | | |
| M4 | | .466 | | |
| M6 | | .423 | | |
| M1 | | .321 | | |
| M9 | | | .708 | |
| M10 | | | .604 | |
| M21 | | | .557 | |
| M8 | | | .315 | |
| M3 | | | | .672 |
| M12 | | | | .487 |
| M5 | | | | .441 |
| M24 | | | | .428 |
| Explained variance total: 40.90% | 16.87% | 9.61% | 7.31% | 7.10% |

## FINDINGS/RESULTS

The findings obtained in the context of validity and reliability in developing the scale will be presented under separate headings.

### Validity Findings

The degree to which the scale can measure students' inquiry-based teaching competence was examined in structure, adaptation, scope, and appearance. The construct validity was checked by CFA, which EFA determined. Exploratory and confirmatory factor analyses checked the construct validity of the scale. Explanatory factor analysis: To determine whether the items in the draft form of the scale reveal a certain structure, the data were first subjected to KMO and Bartlett's test to make EFA, and it was decided that the data were suitable for EFA (**Table 3**).

The KMO value was found to be .926, and the Bartlett test was statistically significant ($\chi^2$=2968.825, SD=227, p<.01). According to this result, it is seen that the data are suitable for factor analysis. The factor load values of the substances subjected to EFA were first examined, and the substances below .45 were eliminated. Afterward, attention was paid to the fact that each substance had a high factor value in only one factor. In this respect, it has been accepted as a criterion that the substance in any factor should have a difference of at least .10 from the load value in another factor (Buyukozturk, 2016; Kline, 2011). When these criteria are considered, the 26-item scale of the draft form is obtained. **Table 4** shows the factors and factor loads of the scale.

As a result of the varimax-vertical rotation performed in the EFA process, a four-factor structure was obtained. Factors explain 40,903% of the total variance on the scale. It is seen that the single-factor structure is preserved after factor rotation.

### *Confirmatory factor analysis*

CFA was performed to control the structure revealed by exploratory factor analysis with a different statistical method and in a different study group. In the process of confirmatory factor analysis, some concordance indices are used to reveal the adequacy of the tested model. For the confirmatory factor analyses performed in this study, Hu and Bentler (1999) stated; Standardized value of $\chi^2$ according to sample size ($X^2/SD$), GFI (goodness fit index), AGFI (adjusted goodness fit index), CFI (comparative fit index),

**Table 5.** CFA results

| Model fit indices examined | Perfect fit criteria | Acceptable fit criteria | Values for scale |
|---|---|---|---|
| $X^2/SD$ (CMIN/DF) | $0 \leq X^2/SD \leq 2$ | $2 \leq X^2/SD \leq 3$ | 1.44 |
| GFI | .95≤GFI≤1.00 | .80≤GFI≤95 | .94 |
| AGFI | .90≤AGFI≤1.00 | .85≤AGFI≤.90 | .93 |
| CFI | .95≤CFI≤1.00 | .90≤CFI≤.95 | .91 |
| NNFI | .95≤NFI≤1.00 | .90≤NNFI≤.95 | .90 |
| IFI | .95≤IFI≤1.00 | .90≤FI≤.95 | .91 |
| RMSEA | .00≤RMSEA≤.05 | .05≤ RMSEA≤.08 | .04 |
| SRMR | .00≤SRMR≤.05 | .05≤SRMR≤.10 | .04 |

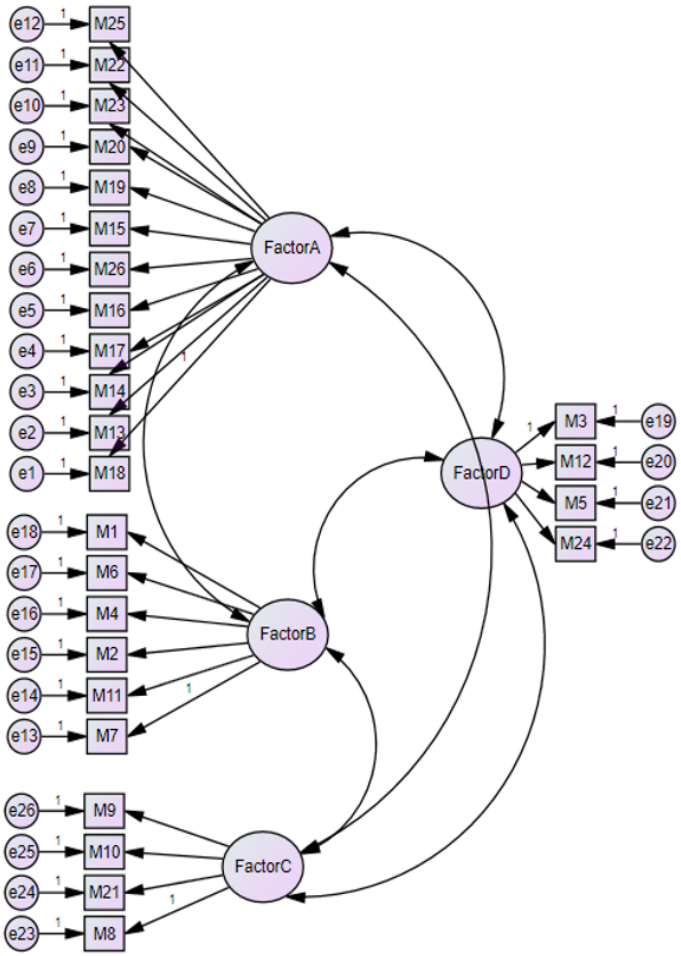


**Figure 1.** Model plot

NNFI (non-normative fit index), IFI (excess fit index), RMSEA (square root of the mean of prediction errors), and SRMR (square root of the mean of standardized error squares) compliance indices were used.

There are many indices used in the evaluation of model fit. Therefore, there are various opinions about which indices should be reported. Kline (2016) suggests reporting at least RMSEA and 90% confidence interval, $\chi^2$ value, CFI, and SRMR values in CFA studies. Brown (2015) states that fit indices are divided into three groups absolute fit indices ($\chi^2$, SRMR, and RMR), parsimony fit indices (RMSEA), and comparative fit indices (CFI-IFI, TLI-NNFI) and that at least one from each group is reported. Recommended the use of the index. According to Hu and Bentler's (1999) two-index strategy, NNFI (min. 0.96) and SRMR (up to 0.09) recommend using any of the binary criteria. Although GFI and AGFI fit indices are frequently used in studies, they are not recommended due to their poor performance in simulation studies (Hu & Bentler, 1999). Crowley and Fan (1997) suggested reporting as many indices as possible since each fit index provides information about a different aspect of model fit. In general, it will not be appropriate to express exact criteria since fit indices are affected by many factors such as sample size, the complexity level of the model, estimation method, data type, normality of data, and misidentification of the model and its quantity (Brown, 2015).

Exploratory factor analysis was used to test the four- and 26-item and four-dimensional structure revealed by exploratory factor analysis. To demonstrate the adequacy of the model, the perfect and acceptable fit value ranges for the fit indices examined and the values obtained from the CFA are shown in **Table 5**.

Results from CFA; show that all fit indices are within the acceptable range. It reveals that the level of adaptation of the four-dimensional structure of this scale is sufficient. In addition, the factor loads related to the four-dimensional model obtained because of CFA are shown in **Figure 1**.

**Table 6.** Cronbach's alpha internal consistency coefficient values for the scale

| Scale | Cronbach's alpha | Number of items |
|---|---|---|
| Total | .88 | 26 |
| Factor 1 | .85 | 12 |
| Factor 2 | .80 | 6 |
| Factor 3 | .73 | 4 |
| Factor 4 | .71 | 4 |

Factor loads range from .24 to .51, and these values can be put forward as evidence that the model is appropriate. When the figure is examined, it is seen that the error variances of some substances are combined. These corrections were made by applying the opinion of the field expert among the substances with high modification indices based on the analysis results.

#### *Appearance and scope validity*

The opinions of five educational sciences field experts were consulted for the validity of appearance and scope. Experts have stated that the 26-item form of the scale is suitable in terms of general appearance. Experts also agree that, as expected, the items on the scale cover situations in which the program is targeted for inquiry skills for life studies.

### Reliability Findings

The studies on the reliability of the measurements include consistency and stability studies. In the consistency part of the reliability studies, data collected from the study group of 511 students were used, and 45 students were studied for stability. Cronbach's Alpha coefficient, an internal consistency measure, was calculated for consistency, and the test-retest stability value was calculated for stability.

#### *Consistency*

The Cronbach's alpha coefficient, which is the internal consistency value of the 26-item initial version of the scale applied, was .88 (**Table 6**). The Cronbach's alpha coefficients of the dimensions are .85 in the first dimension; .80 in the second dimension; .73 in the third dimension; it was calculated as .71 in the fourth dimension.

Cronbach's alpha coefficient, the internal consistency value for the first version of the applied scale of 26 items, is.88; The Cronbach's alpha coefficient for its final version of 26 items was calculated as .86. Considering that measurements with an internal consistency coefficient of .70 and above are considered reliable (Bernardi, 1994), it can be said that the measurements are reliable.

#### *Stability*

In the test-retest method, which is another reliability test method, the scale was applied to 45 students with two-week intervals, and it was determined that there was a high level of positive and significant ($r=.89$, $p<.01$) relationship between these applications. These data also show that the measurements are stable.

## DISCUSSION AND CONCLUSION

The study, which aimed to develop a valid and reliable inquiry skills for life studies scale, was carried out by following the scale development steps. Within the scope of the research, the validity of the scale structure (EFA and CFA), compliance, appearance, and scope were examined; For reliability, Cronbach's alpha internal consistency coefficient and test-retest stability value were calculated. The stub form of the measurement tool consisted of 26 items, of which four were eliminated in the EFA process. As a result of the validity and reliability studies, a valid, reliable, and usable scale consisting of 26 items and four factors was revealed. The scale, which does not have negative substances, that is, the substance that needs to be coded reversely, is prepared in the triple Likert type. The scoring interval varies between 1=never, 2=sometimes, and 3=always, and at least one and at most three points can be obtained from each item. The scale where at least 26 and 78 points can be obtained can be used as a total score. The final version of the scale is presented in the appendix. Since the scale is developed with primary school students, conducting a validity and reliability study is recommended before it is used in a different group. The scale will also examine how primary school students use their inquiry skills in the life studies lesson.

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**Ethics committee approval:** This study was approved by the Social and Human Sciences Ethics Committee of Gaziantep University on May 6, 2022 (Decision no: 11).

**Declaration of interest:** No conflict of interest is declared by authors.

**Data sharing statement:** Data supporting the findings and conclusions are available upon request from the corresponding author.

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