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Examination of map reading skills with orienteering activity: An example of Many Facet Rasch Model

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Abstract: The purpose of the current study is to examine the map reading skills of Social Studies pre-service teachers with orienteering, which is an activity-based and more active practice. To this end, a total of 10 students attending the Department of Social Studies Teaching in the Education Faculty of Burdur Mehmet Akif Ersoy University and taking the course of Map Skills and Applications were selected. An analytical rubric consisting of four criteria and scored in four categories was used to collect data in the study. The content validity of the developed rubric was calculated with the Davis Technique and it was thought that sufficient evidence was obtained for the content validity. During the orienteering activity, the map reading skills of the students were scored by 5 raters with this rubric in terms of four criteria, direction/location, recognizing signs/symbols, using landforms and managing time. They were examined with the many-facet Rasch model (MFRM). Map reading skills were evaluated according to the severity/leniency of the raters and the difficulty of the students in exhibiting the behavior. The results of the analysis showed that the agreement between the raters was found to be good. It was also concluded that the most difficult skill is determining direction/location and the easiest skill is using landforms.

1. INTRODUCTION

It is very important for students to gain map reading skills in terms of making sense of the space (Kızılçaoğlu, 2007). This is because space refers to places where people conduct activities and gain experiences. It has different meanings according to the way it is perceived and evaluated by the individuals living in it (Tümertekin *et al*., 2019, p.49). One of the indispensable indicators of perceiving the space and constructing it in the best way is the skill of reading a map (Kızılçaoğlu, 2007). In this sense, spatial perception is an important step for individuals in the concrete interpretation and evaluation processes and is presented as a skill in the educational environment. Subjects related to the perception of space in the elementary education period are generally included in the scope of social studies courses (Sönmez, 2010). Given that the

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attitudes and behaviours acquired in this period will be the basis for students throughout their life, it can be seen that social studies courses have an important area of influence in the development of spatial perception (Öcal, 2007). In order for students to acquire basic information such as determining routes and directions and locations, comprehending the geographical information in the place where they are located, and adapting to the place they live in, their spatial perceptions should be improved (Safi, 2010).

To make sense of and use spatial perception the most basic and most used tools are maps (Ertuğrul, 2008). Therefore, it is very important to understand and interpret maps as educational materials (Dong *et al*., 2018). In the social studies course; materials such as maps, graphics and tables are expected to be used in terms of using, organizing and developing the information. In order to understand the given information easily, students should be able to read maps, graphics and tables (Kıroğlu, 2006; Pala & Başıbüyük, 2019). A map is a tool that is frequently used not only in teaching the subjects in the social studies course, but also in daily life (Abbak, 2021). For example, the coordinate system is the basis of navigation used by many groups of people such as travelers, hikers, and mountaineers, to reach their destinations. In addition, the excess of opportunities provided by unmanned aerial vehicles and satellites and the transition from paper maps to maps with digital content (Carbonell-Carrera & Bermejo Asensio, 2016; Carbonell-Carrera *et al*., 2017) has increased the inclination of the cognitive field experts interested in geography, psychology and spatial thinking (Bednarz *et al*., 2006; Newcombe *et al*., 2013). In today's world, it is more important for individuals to know how to do it than to know everything. For this reason, it is expected from schools to raise the number of individuals who enjoy learning, creating, producing, thinking critically, and making connections between events (Pala & Başıbüyük, 2019. The importance of this issue is noticed with the intensity of the studies on map skills in the field of social studies (Aksoy & Ünlü, 2012; Aktürk *et al*., 2013; Alım & Girgin, 2012; Bahar *et al*., 2010; Buğdaycı & Bildirici, 2009; Darakçı, 2014; Demirci *et al*., 2013; Güneş & Öztürk Demirbaş, 2020; İncekara *et al.,* 2008; Kaymakçı, 2015; Kızılçaoğlu, 2007; Kızılçaoğlu & Ünlü, 2008; Koç & Karatekin, 2016; Koç *et al*., 2017; Özcan & Uzun, 2016; Sönmez & Aksoy, 2012; Sönmez & Aksoy, 2013; Taş, 2006; Taşlı *et al*., 2007).

When the studies are examined, it can be said that the mapping skills of the students are at a moderate level, therefore, there is a need for applications and materials that can improve their mapping skills. Akengin *et al*. (2016), in a study in which Social Studies teachers' opinions were taken, stated that teachers use narrative and question-answer methods to improve their mapping skills in lessons. In the study, he stated that in the 21st century, in accordance with the constructivist approach, more active learning methods should be included in which more students will be active. Orienteering can be considered one of these applications because orienteering, due to its nature, has the potential to provide map reading skills within the scope of geographical skills while having fun and racing (Arıkan & Aladağ, 2019).

1.1. Map and Map Skills

Maps, graphs and diagrams take an active role in the design and presentation of learning in today's education system. (Schnotz & Kulhavy, 1994). In addition, it is seen that maps are also used in the visual presentation of certain elements and data in many fields such as industry, politics, tourism, agriculture, etc. (Sarıgül, 2021). Due to the wide coverage of the maps and the differentiation in the way each area of expertise uses maps, it makes it very difficult to come up with a common definition of the map. According to ICA (International Cartographic Association), a map is a symbolized representation of geographical reality, representing selected features or characteristics resulting from the creative effort of its author’s execution of choices, and is designed for use when spatial relationships are of primary relevance (URL 1).

Map skills are classified with different terms in the literature (Borich & Bauman, 1972; Carbonell-Carrera & Medler, 2017; Stumpf & Eliot, 1999;). With the use of maps and different

forms of cartographic representation and geo-referenced information, spatial orientation has become the most widely used one of these terms (Carbonell-Carrera & Medler, 2017). Spatial orientation is defined as the ability to navigate physically or mentally (Carbonell-Carrera & Medler, 2017; Maier, 1996;). Another commonly used term is spatial thinking (Atayeter *et al*., 2018; Bednarz, 2001; Gersmehl & Gersmehl, 2007; Jo, 2011; Lee, 2005; Sönmez, 2019, p. 219; Şanlı, 2021; Şanlı & Sezer, 2019). The report prepared by the National Research Council (NRC) has made an important contribution to the formation of the theoretical background of this subject. In this report, spatial thinking is defined as "a skill consisting of spatial concepts, representation tools and cognitive processes" (Şanlı, 2021). Spatial concepts refer to the terminology used for the description, perception and association of objects (Jo, 2007; Jo & Bednarz, 2014a; 2014b). The concepts frequently used in this terminology are "location, map, region, distribution, information, scale, navigation, symbology, coordinate, distance, area, direction, geographic data, overlay, buffer, contour, aspect" (Huynh & Sharpe, 2013; Şanlı, 2019; 2020; Ünlü & Yıldırım, 2017). Sönmez (2010) classified mapping skills under six sub-headings from concrete skills to abstract skills. These are the ability to understand and interpret symbols, to read and interpret maps, find directions, determine location coordinates, to use scales and measure distances.

1.1.1. *The ability to understand and recognize symbols*

Maps contain a whole consisting of points, lines and symbols (Sönmez, 2010). Various colors and symbols are also used while creating maps (Ünlü, 2021, p. 388). This whole consisting of colors and symbols is called the symbology of the map (Wiegand, 2006, p. 10). Abstract thinking and generalizations must be made in order to make sense of symbols by individuals (Bednarz *et al*., 2006). Thus, individuals can interpret the information encoded on the map in a whole sense in the context of events, facts and features (Ünlü, 2021, p. 388).

1.1.2. *Map reading and interpretation skills*

Map reading is the process of obtaining simple information from the map as a result of a complex process such as getting information from the map and using the map as a result of this mental process by using map skills at the same time (Sönmez, 2010; Ünlü, 2021, p. 388; Wiegand, 2006, p. 10). Map reading skills are seen as a cognitive process that enables the interpretation of information in the mind by including the information on the map with psychological processes, interests, purposes, abilities and external factors in the process (Koláčný, 1969; Ooms *et al*., 2016).

1.1.3. *The ability to find direction*

While traveling on a little-known or unknown route, the desire to seek in the process between the start and the destination is the ability to find direction (Golledge, *et al*., 2000; Wiegand; 2006, p. 19). It is seen that the wayfinding process occurs in three stages: cognitive mapping, wayfinding planning and movement (Chen & Stanney, 1999). The way-finding process, which occurs as a result of these three stages, is realized by the accumulation of geographical knowledge in the immediate environment of individuals and by systematic knowledge production (Murakoshi, 1997).

1.1.4. *Determination of coordinate position skill*

Location is the holistic evaluation of latitude, longitude, parallel, meridian and equator points together with the numerical and angular value components given on the maps. They are the processes of making inferences by associating the current location on the map and its immediate surroundings (Çepni, 2019, p. 367; Sönmez, 2010; Ünlü, 2021, p. 388; Wiegand, 2006, p. 150).

1.1.5. *The ability to use scale*

Maps are tools that systematically represent the distances between different spaces (Bartz, 1970). The ability to use scales is one of the most important sub-dimensions of the map skill that guides map reading in reaching the right distance and understanding spatial relationships as a result of the ratio of the real distance in the world and the distance on the map (Meyer, 1973; Ünlü, 2021, p. 388; Wiegand, 2006, p. 10).

1.1.6. *Distance measurement skill*

It is the reduction of the distance values given between two or more points by the map ratio, converting or proportioning them to the actual distance with the help of calculations using the map scale (Demiralp, 2006; Ünlü, 2021, p. 388).

1.2. Orienteering

Orienteering is defined as a sports activity in which individuals interpret the cartographic symbols given for a particular terrain, and during this interpretation, skills such as spatial perception, environmental cognition, analytical thinking and critical understanding are used in an integrated manner (Wilson, 2017). Orienteering is actually a branch of sport but it can also be considered an educational game to be used in educational activities. Orienteering not only makes it possible for students to have a good and productive time, but also enables them to develop their geographical skills (Candan, 2019). According to Baitan (2022), it has been emphasized that the use of maps and compasses, map perception and map comprehension skills are more developed in individuals dealing with orienteering from a young age. Orienteering activities, which are effective tools in out-of-school learning environments and map studies (Adams, 1972), also provide students with environments of learning by doing and experiencing, provide the opportunity to achieve objectives set for geography subjects in an enjoyable way and make permanent learning more effective (Candan, 2019).

1.3. The Purpose and importance of the research

It is seen that studies have been carried out on many subjects such as map skills, location analysis, and spatial perception in higher education (Balcı, 2015; Koç & Karatekin, 2016; Özcan & Uzun 2017). In addition, in the literature, it is seen that map reading skills have been assessed mostly by using interview methods (Akkuş & Kuzey, 2018; Balcı, 2015), self-efficacy scales (Özcan & Uzun, 2017), achievement tests (Arıkan & Aladağ, 2019; Koç & Bulut, 2014; Koç & Karatekin, 2016; Sönmez & Aksoy, 2012). In international studies (Atit *et al*., 2016; Ooms *et al*., 2016), it was seen that map skills were examined with optional tests. However, no application has been found in higher education in which map skills activities are evaluated based on performance and scored with rubrics in out-of-school environments. In performance evaluation, the student is expected to create an answer, put forward a product or perform an activity, rather than choosing from predetermined options (Darling-Hammond *et al*., 2010). Since orienteering is defined as a sport that requires finding the targets marked on the map of the same terrain in the shortest possible time using the map and compass in unknown terrain, it can be considered to be related to the concept of performance. For this reason, raters need to make quick decisions in real time in the evaluation of performance. Unless the measurement tools used during the evaluation are objective, specific and reliable, the evaluation and interpretation of the performance remain essentially subjective (Carlin & Louis, 2008). In case of differences in the value judgments of raters, it is inevitable that unreliable scores will emerge in the scores (Baird *et al*., 2013). In order to eliminate this limitation of classical approaches, the researchers suggested using the Many-Facet Rasch Model [MFRM] in cases where there is more than one rater. MFRM is also considered to be a more powerful psychometric model than Classical Test Theory in terms of features such as determining the interactions between different error sources (Haiyang, 2010) and taking into account more than one error source at

the same time. It also provides information at the individual level rather than the group level for raters or students (Barkaoui, 2008).

In the current study, it is aimed to evaluate the map skills of the students studying in the Social Studies Teaching Undergraduate Program during the orienteering practice The skills were scored with a rubric and analysed with MFRM. In this context, the consistency, severity and leniency of more than one rater and the skills that students had difficulty in reading maps were examined. The limited number of studies worldwide, especially at the higher education level (Ooms *et al*., 2016), makes this study important. It is thought that this activity and performance-based study will contribute to the field in terms of providing measurement and evaluation opportunities in out-of-school environments. In addition, it is anticipated that the study will attract attention, since no study has been found on the use of MFRM in the evaluation of performance in the field of Social Studies. For this purpose, the questions to be answered in the research are as follows:

1) Which skills are difficult and easy for students in terms of map reading with oriente-ering?
2) What is the severity and leniency behavior of the raters in the evaluation of map rea-ding skills with orienteering?
3) What is the central tendency behaviour of the raters in the criteria taken into consi-deration for map reading skills?
4) What is the biased behavior of the raters?

2. METHOD

In this study, it was aimed to examine the map reading skills of Social Studies pre-service teachers with the Many-Facet Rasch Model. For this purpose, the skills in which the students had difficulty and the scoring behaviors of the raters were examined. Therefore, this is a descriptive study in which the existing situation is tried to be described (Büyüköztürk *et al*., 2019; Karasar, 2005).

2.1. Study Group

The study group of the current research is comprised of a total of 10 students attending the Department of Social Science Education in the Education Faculty of Burdur Mehmet Akif Ersoy University and taking the course of Map Skills and Applications. The ethical committee approval was obtained from the Non-interventional Clinical Research Ethics Committee at Burdur Mehmet Akif Ersoy University (GO 02/2022/472). The participants were randomly selected from among the students who take the Map Knowledge and Applications course in the Department of Social Science Education. Of the participating 10 students, 5 (50%) are females and 5 (50%) are males. In this study, orienteering activities were conducted in an area of approximately 5.7 hectares, where landforms were densely located, rather than a school garden or classroom due to the age level of the participants. The study was limited to 10 students because the area was large, and it took a long time to complete the track for each student and to prepare the next student. In the current study, 5 raters were included to evaluate map reading skills with orienteering activities. The raters are Social Science Education and Geography Department instructors and an orienteering specialist.

2.2. Data Collection Tool

In the current study, an analytic rubric was used. The use of an analytical rubric is recommended where the attribute to be measured can be broken down into components. In map reading, individuals are expected to be able to interpret, analyze and evaluate by establishing a relationship with the place on the map based on the signs (legends) and symbols on the map (Sönmez, 2010, p.105). This skill is important for individuals to perceive the space and establish a space-event connection (Akengin *et al*., 2016). At the same time, the speed in understanding

the map can be accepted as an indicator of the development of this skill. Speed is an important factor in map reading skills (Lobben, 2007). The studies on speed in map reading skills (Lobben, 2007) show that its effect on spatial orientation and positioning is also examined by making evaluations on eye movement measurements for the development of speed (Dong *et al*., 2018). In this respect, map literacy has a structure suitable for division into components. Therefore, it was found to be suitable to develop an analytic rubric in the current study.

In this study, a track was prepared to evaluate the map reading skills of the students through orienteering activities. In order to complete the track, the students were expected to reach a total of 5 targets. During this process, the students were expected to demonstrate basic skills in map literacy such as holding the map, finding location/direction, recognizing signs and symbols, using landforms, and managing time. In the literature, it is stated that individuals employ some competencies, when they come up with the map. These skills are map reading and interpretation (Ooms *et al*., 2016; Ünlü, 2021, p. 388), making sense of signs and symbols (Sönmez, 2010; Ünlü, 2021, p. 388), finding the direction (Golledge *et al*., 2000), coordinate and location determination through landforms (Çepni, 2019; Wiegand, 2006, p. 150), using the scale and measuring the distance (Ünlü, 2021, p. 388). Therefore, these skills were considered as the criteria expected from the students and a rubric was prepared accordingly. In addition to ensure the validity of the criteria, a pilot study was conducted with 2 different students who took the course before. During the pilot study, the competencies were classified by taking expert opinions according to the skills used by the students.

In the selection of the track, attention was paid to selecting the points where the students could apply their geographical skills, recognize the landforms in the area and calculate the distance between the targets, and the professional orienteering map drawn by the Orienteering Burdur Provincial Representative was used as the map. Legal permissions were obtained from the relevant unit for the use of the map. The students' ability to reach the targets by using the map along the track was scored with the rubric. The most important advantage of this tool is that it provides detailed information for each performance component.

The criteria to be used in the study are listed as items:

1) Basic skills (holding map, finding location/direction)
2) Recognizing signs and symbols (legends)
3) Using landforms and
4) Managing time (This skill was added as a criterion due to the nature of both map reading and orienteering).

In this study, it was decided to use 4 degrees in order to prevent overlap between degrees in the rubric and to reveal the difference between students. The lowest attribute regarding performance was defined as 1 point (beginner level), and the highest attribute was defined as 4 points (fully successful).

2.2.1. *Taking expert opinion and pilot application*

The prepared draft rubric was sent to 4 experts (1 specialized in the field of Social Science Education, 2 specialized in the field of Geography, and 1 specialized in the field of Turkish Education). In line with the suggestions from the experts, some corrections were made on some attributes and the rubric was given its final form. Afterwards, 2 students who had previously taken a map skills course were observed in the orienteering track and were scored with the draft rubric by two raters. In line with the results obtained from the pilot application, some corrections were made to the rubric. Opinions about the criteria and attribute in the rubric were received from 7 experts, including 1 measurement and evaluation expert, 3 geography faculty members, 1 orienteering specialist, 1 social studies faculty member and 1 social studies

graduate student. The experts were asked to evaluate the criteria and attributes in the following four categories;

1) The item represents the attribute measured
2) The item needs minor revision
3) The item needs major revision and
4) The item does not represent the attribute.

Davis' (1992) technique was considered for the content validity index (CVI). The CVI values were obtained by dividing the number of respondents to the 1st and 2nd categories among the experts by the total number of experts. As the CVI value was found to be higher than 0.80, it was concluded that the content validity is acceptable (Davis, 1992; as cited in Yurdugül, 2005). A minimum of 3 and a maximum of 20 experts are recommended for this technique.

Table 1. *Content validity index (CVI) of the rubric.*

Criteria	CVI
Basic skills	1.00
Recognizing signs and symbols	0.85
Using landforms	1.00
Managing time	1.00

According to Table 1 as a result of the content validity study, the experts mostly evaluated the items in the first or the second category. Only in the criterion of using landforms, corrections in the third category were suggested by an expert for the 2nd attribute, so the CVI value was found to be lower than the other criteria. However, since the CVI values were above 0.80, it was thought that sufficient evidence was obtained for the content validity of the rubric, and it was decided to include the criteria and attributes in the rubric. At this stage, minor revisions were made in line with the suggestions.

2.3. Data Collection Process

In order to examine the orienteering map reading skills of the pre-service social studies teachers, a track was prepared in the region located in the Burdur Central City Forest. Orienteering is a sport that aims to reach the targets positioned on the map of a place which is previously unknown with the help of a map and compass as soon as possible (Tanrıkulu, 2011). It is among the skills that individuals should have in line with some daily needs such as reading maps or finding a location on the map or reaching the target by finding direction in the land (Tuna & Balcı, 2013; Ünlü & Yıldırım, 2017). For this purpose, each student was taken to the track one by one. Any student did not see another student going to the track. Five raters observed the student who went on the track by moving simultaneously with the student on the track. The raters were not affected by each other at this stage; they only observed the student's state of reaching the targets and scored at the same time. In this study, the ideal time to complete the organized track was taken to be 18 minutes. This time was determined in the pilot study by the experts by taking the average of the students' time to complete the track.

The reason for the selection of this area was that it contained examples of many of the landforms. There were examples of landforms such as valleys, hills, streams and ridges in the area. The presence of these landforms in the area is important in terms of map reading skills, as they facilitate the determination of the reference point. In addition to using the landforms, the students were expected to complete the track according to the targets on the map by reasoning on the basis of the signs and symbols on the map, making quick decisions and determining the distance. Speed tests in map reading (Dong *et al*., 2018; Lobben, 2007) are important for decision-making, spatial perception and orientation through space. When there is no time limit,

it is possible for students to reach the end of the track knowingly or unknowingly. Considering this factor, a time limit was set for the completion of the track, and they were expected to reach the final target within this time limit.

Before implementation, the raters were trained by researchers on the use of analytical rubrics to ensure the validity and reliability of the scoring. At this stage, the use of criteria and attributes in the analytical rubric and the errors that may interfere with scoring were emphasized. Another point considered in the study is that raters do not communicate with students. Since 5 raters followed the students at the same time and the raters did not know the students, it was thought that the error regarding bias was reduced as much as possible.

2.4. Data Analysis

In this study, MFRM was used to analyze student ability, the difficulty of tasks, severity/leniency and bias of the raters in the analysis of data scored with a rubric. Three facets; student (n=10), task (n=4) and rater (n=5), were determined for the analysis of the data. For MFRM, Minifac (FACETS) program was used.

2.4.1. *Facet Rasch Model (MFRM)*

MFRM (Facet model, Linacre, 1994, p. 129) is a measurement model which is an extension of the one-parameter Rasch model and which enables a detailed analysis of the variables that may have a potential impact on testing or assessment. MFRM models the score given to the student as a function of more than one variable. In this respect, it is similar to regression models. In this model, each of the sources of variability (facets) that affects the performance of individuals, such as the student's probability of success in an item, the individual's ability, the difficulty of the item, or the severity/leniency of the rater, is included in the model as an independent variable (Randall *et al*., 2009). The model is expressed by the following formula for three facets (individual, task and rater) (Eckes, 2009; Linacre, 2021; Randall *et al*., 2009).

$$\ln\left(P_{nijk}/P_{nij(k-1)}\right) = B_n - D_i - C_j - F_k \quad (2)$$

P_{nijk}: the probability that the individual n will get the score k from the rater j in task i,

$P_{nij(k-1)}$: the probability that the individual n will get the score k-1 from the rater j in task I,

B_n: ability of the individual n,

D_i: item difficulty level of task i,

C_j: severity level of rater j,

F_k: difficulty of scale category k relative to scale category k-1.

MFRM summarizes the scoring patterns as the main effects of rater, task, individual, and other facets, if any. In this model, the contribution of each facet and whether it works as expected or not can be examined independently of the other facets. MFRM can show the effects of different elements on the facets at the individual level (Myford & Wolfe, 2003).

In more detail, it can provide information about which raters are more severe or lenient, which raters do not use the scoring criteria consistently, and which tasks are more difficult to score. At the same time, with the bias analysis, MFRM answers the questions of whether the rater's severity is constant in the subgroups, whether it changes with time, and whether the severity changes according to the rater type and the task/item type.

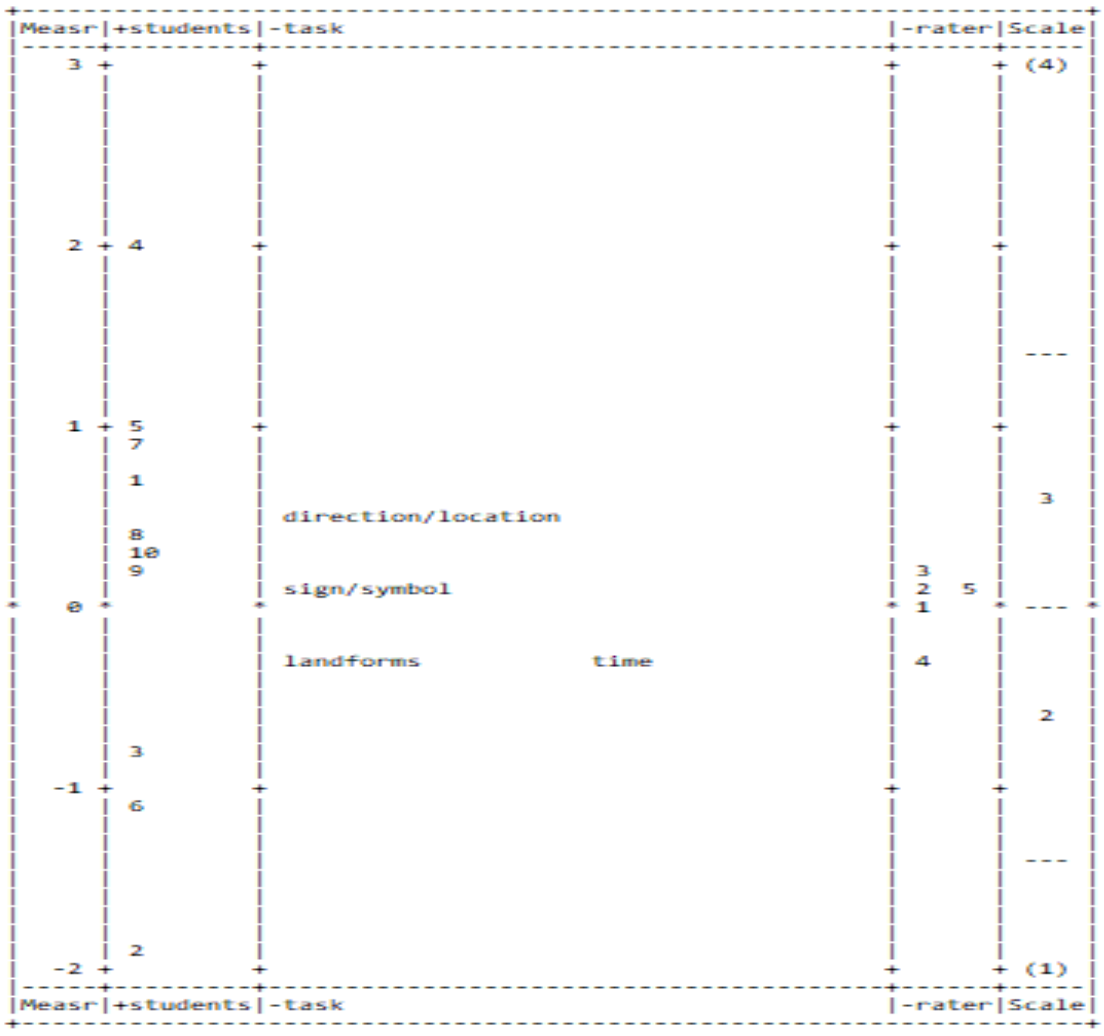
MFRM can cover many models such as rating scale, partial credit, the linear logistic, and mixed Rasch (Eckes, 2009). The Rating Scale Model (RSM; Andrich, 1978) was used in the current study.

3. FINDINGS

For model-data fit, less than about 5% of the standardized values (z-score) of the data used in the analysis must be greater than or equal to 2 in absolute value, or less than 1% of them must be greater than or equal to 3 in absolute value (Linacre, 2021). In this study, 0.5% of the total standardized values (standardized residual is 3.2) [1 out of 200 (10 students x 5raters x 4tasks)] are outside +/- 3 intervals. In addition, the ratio of the standardized value outside +/- 2 intervals is 3% (standardized residual are 2.36, -2.79, -2.21, -2.04, -2.63, -2.04) [6 out of 200 (10 students x 5raters x 4tasks)]. Therefore, it can be said that model data fit is achieved. The Facets program theoretically offers a logit scale (variable map) ranging from -∞ to ∞. On this scale, when the rater facet is negatively oriented, positive logit values indicate severe scoring (low score) and negative logit values indicate lenient scoring (high score) for the rater. When an individual facet is positively oriented, positive logit values for individuals indicate high ability. On the other hand, for the negatively oriented item or task facet, higher values indicate more difficult items (Güler, 2014; Randall *et al*., 2009).

In Figure 1, the logit scale obtained from the MFRM analysis is given as "Students", "Tasks (dimensions of expected behaviours from students)" and "Raters".

Figure 1. *Logit scale for three facets.*



In Figure 1, in the column where the students are located, it is seen that student number 4 is the most successful and student number 2 is the most unsuccessful. In the task (criteria/skills) column, which includes expected behaviours in students' map reading performances, it is seen

that the most difficult skill to be performed by students is the "basic skills (holding map/finding direction and location)", followed by the skills of "recognizing signs/symbols and calculating distance". It can be said that the skills most easily performed by students are "using landforms" and "managing time". According to the measurement results regarding the raters, the rater who scored the lowest and exhibited severe scoring behaviour was the 3rd rater, and the rater who scored the highest and showed lenient scoring behaviour was the 4th rater. Measurement reports related to all the facets are given in Table 2, Table 3 and Table 5 for individuals, tasks and raters, respectively.

Table 2. *Measurement report for the students.*

Students	Measure	St. error	Infit	Outfit
4	2.03	.41	.92	.77
5	.97	.28	.78	.77
7	.94	.27	.60	.58
1	.66	.26	.39	**.39**
8	.40	.25	1.35	1.35
10	.28	.25	2.20	**2.22**
9	.16	.25	.75	.76
3	-.83	.28	.38	**.38**
6	-1.08	.30	1.18	1.24
2	-1.89	.40	1.14	1.25
Mean	.16	.29	.97	.97
St. Deviation	1.15	.06	.54	.56
Reliability = .93, Separation index = 3.68, RMSE= .30, Chi-square = 97.7, SD = 9, p = .00				

In Table 2, the results of the analysis regarding the map reading skills of the students are listed from the most successful student to the most unsuccessful student. As Table 2 shows, the logit values of students measures vary between -1.89 and 2.03. The student with the highest map reading skill is number 4 and the student with the lowest map reading skill is number 2. The infit and outfit statistics in Table 2 show the degree of fit between the data and the model and the sensitivity to unexpected responses (Kaya Uyanık *et al*., 2019). Infit and outfit values are expected to be 1.00. However, it is stated in the literature that the range between 0.5 and 1.5 is acceptable (Linacre, 2021; Turner, 2003). Accordingly, it can be said that the infit and outfit indices of the students numbered 1, 10 and 3 are outside the specified range and thus, these students did not exhibit an acceptable performance. It is seen that the separation index obtained as a result of the analysis is 3.68 and the reliability index is .93. The reliability of the separation index for facets takes a value between 0 and 1, while the separation index ranges from 1 to infinity. The reliability of the separation index is similar to Cronbach's Alpha coefficient but the interpretation of these values varies according to the facets (Myford & Wolfe, 2003). For the student facet, the reliability of the separation index is expected to be close to 1.0 (Sudweeks *et al*., 2004). Reliability refers to how well the elements are discriminated against for reliable identification of a facet. The separation index refers to the values that show how much the elements on each facet are discriminated. Large differences between structures or elements within a facet provide high reliability of separation coefficients (Randall *et al*., 2009). The separation index and the reliability of this index are interpreted similarly. However, there is no upper limit for the separation index (Myford & Wolfe, 2003). The separation index for the student facet is expected to be large in order to reflect the difference between students (Sudweeks *et al*,2004). The results of the analysis show that the skill levels of the students can be reliably separated from each other. On the other hand, it can be said that there is a significant difference in the map reading skills of the students (χ^2= 97.7, p<.01).

Table 3. *Measurement report for the task (criteria/skills) included in the rubric.*

Criteria	Measurement	St. Error	Infit	Outfit
Basic skills (holding map/direction/location)	.45	.18	1.09	1.26
Recognizing signs and symbols	.15	.18	.96	.96
Managing time	-.28	.18	1.29	1.09
Using landforms	-.32	.18	.60	.58
Mean	.00	.18	.99	.97
St. Deviation	.37	.00	.29	.29
Reliability = .77, Separation index = 1.81, RMSE= .18, Chi-square = 12.9, SD = 3, p = .00				

As can be seen in Table 3, the most difficult criterion is "holding map/finding direction-location" (.45 logit). This value can also mean that this is the criterion most severe scored by the raters. According to Table 3, the easiest criterion is "using landforms". Infit and outfit indices for criteria are between 0.5 and 1.5. The separation index was found to be 1.81, and the reliability of the criteria in the rubric in terms of discriminating between the students was found to be 0.77. This measure indicates that raters are reliable to distinguish among criteria and the criteria were not equally challenging to the students (Sudweeks *et al*., 2004). Accordingly, it can be said that the difficulties related to the criteria differ significantly from each other (χ^2=12.9, p<.01). The measurement report regarding the scoring categories (1-4) of the analytical rubric is given in Table 4.

Table 4. *Category statistics.*

"	Frequency (*f*)	Percentage (%)	Mean Measurement	Expected Measurement	Outfit
1	40	20	-1.02	-1.07	1.0
2	53	27	-.28	-.21	.9
3	51	26	.50	.51	1.0
4	56	28	1.15	1.11	.9

Table 4 shows that the scoring categories of the task in the rubric were preferred at almost the same rate. The first category was preferred by 20%, the second category by 27%, the third category by 26% and the fourth category by 28%. This shows that there is no behaviour tending towards the centre (not overusing a certain category of the rubric) (Engelhard, 1994; Myford & Wolfe, 2003).

Table 5. *Measurement report for the raters.*

Rater	Measurement	St. Error	Infit	Outfit
3	.18	.20	.88	.78
2	.10	.20	1.04	1.07
5	.10	.20	.98	.89
1	-.04	.20	.95	.95
4	-.34	.20	1.09	1.17
Mean	.00	.20	.99	.97
St. Deviation	.20	.00	.08	.15
Reliability = .05, RMSE = .20, Discrimination index = .23, Chi-square = 4.1, *df* = 4, *p*=.39				
Inter-rater agreement opportunities: 400 Exact agreements: 269 = 67.2% Expected: 156.1 39.0%, Rasch-Cohen's Kappa = .46				

In Table 5, it is seen that the most severe rater is number 3 (.18 logit) and the most lenient rater is number 4 (-.34 logit). When the infit and outfit indices are examined, it is seen that they are between 0.5 and 1.5 and they are acceptable. Unlike the individual and item facets, the separation index on the rater facet is expected to be close to zero (Linacre, 2021). The reliability of the separation index, on the other hand, reflects undesirable variability between raters in terms of severity/leniency. It is preferred that the separation index reliability is low for the rater facet (Myford & Wolfe, 2003). When raters don't differ in terms of severity, the rater separation reliability will be close to 0. By contrast, when raters are of a highly dissimilar degree of severity, the rater separation reliability will be close to 1 (Eckes, 2015). In Table 5, the separation index for the rater facet is .23 and reliability is .05. This value indicates that the raters did not score differently from each other. In addition, the Chi-square value regarding whether there is a difference between the raters is not statistically significant (χ^2 = 4.1, p>.05). Accordingly, it can be said that there is no significant difference between the raters in terms of severity/leniency. In Table 4, the observed (67.2%) and expected agreement values (39%) between raters are given. The Rasch-Cohen's Kappa statistic calculated based on the difference between these percentages (Observed%-Expected%)/(100-Expected%) was found to be 0.46. In the Rasch model, these values are required to be close to 0.00. If the Rasch-Cohen Kappa statistic is between 0.2 and 0.4, it can be said that there is a little more agreement between the raters than modelled (Linacre, 2021).

3.1. Bias Interaction

One of the most important advantages of MFRM is that rater biases can be determined by analyzing the interaction effects between all the surfaces included in the study. In this respect, the fact that the Chi-Square value is meaningful and the t-value is outside the range of ±2 are indicators of the differentiated rater severity/leniency behaviour, that is, the rater bias (Eckes, 2009). In this study, the findings of 3 interaction types, rater x student, rater x task and student x task, were given. There were 50 interactions for the rater x student interaction (*N*=5 and *N*=10). The bias results showed that the t-values remained between the ±2 limits, with the smallest and largest -0.72 and 0.83 values, respectively, and that the rater x student interaction was not statistically significant (χ^2 = 9.1, d.f. =50 p>.05). For the rater x task interaction (*N*=5 and *N*=4), it was seen that the t values of a total of 20 interactions were in the range of ±2, the smallest and largest -0.81 to 1.39, and were not statistically significant (χ^2 = 6, d.f. =20 *p*>.05). Finally, it was observed that 5 (39.25%) of the 40 interactions (*N*=10 and *N*=4) for the student x task interaction were outside the ±2 range of the t-value. The interaction results obtained biased were given in Table 6.

Table 6. *The t-values that are meaningful in student x task interaction.*

Student	Task	Expected value	Observed value	Bias	St. error	*t* value
8	Basic skills (holding map/direction/location)	12.10	7	-1.66	.75	-2.20
5	Recognizing signs and symbols	15.67	11	-1.15	.50	-2.28
6	Basic skills (holding map/direction/location)	7.35	12	1.45	.49	2.98
2	Basic skills (holding map/direction/location)	6.13	9	1.47	.57	2.58
10	Managing Time	14.66	5	-3.76	1.44	-2.62

According to Table 6, it is seen that the 8th, 5th and 10th students performed lower than expected (*t* = -2.20, *t* = -2.28 and *t* = -2.62) in "basic skills", "recognizing signs and symbols" and "managing time" tasks, respectively. The 6th and 2nd students, whose t-values were obtained as 2.98 and 2.58, respectively, performed higher than expected in the task called basic skills.

4. DISCUSSION and CONCLUSION

In this study, it was aimed to evaluate the map skills of Social Studies pre-service teachers scored with a rubric during orienteering activity with the Many Facet Rasch Model. In this context, the data were evaluated according to the severity/leniency of the raters and the difficulty of the students in exhibiting the behaviour.

The result of the MFRM analysis in the study was related to the difficulty level of the criteria in the rubric. It was seen that the most difficult criterion in map reading skills (the most severe scored skill in map reading skills) is "basic skills (holding map, finding direction/location)". The first thing to do in reading maps is to hold the map correctly and place it in the space according to the direction of the map. A map that is not placed according to its direction in the space is difficult to help the individual. It is essential for individuals to be able to determine their exact location in order to make geographical applications in the space. The results obtained from this study showed that students had difficulties in determining direction/location. Tuna *et al*. (2012) similarly stated that individuals in different education, age and gender groups in Türkiye are poor at reading maps, determining the exact location and placing the map in its original position. In addition, Carswell (1971) in his study on map-based information interpretation in the TTMS [Test of Topographic Map Skills] test related the deficiencies and problems in the students' ability to interpret maps with the inadequacy of teaching processes in educational environments. Streeter & Vitello (1986) stated that in map reading skills, students correctly form the direction and route they aim according to situations such as their daily preferences, habits, experiences and needs. Thus, it was seen that the individual needs of the students directly affect the creation of directions and routes in the use of maps. In line with the findings obtained in the current study, it was concluded that the second most difficult skill to be acquired by students is "recognizing signs and symbols". Balcı (2015) argues that the individual should be able to read the scales of the maps he/she uses during his/her practices in the space. Individuals should be able to adapt the scale values on the map to the actual values in the space. The mistake made at this stage can create inconsistency in estimating distances. However, in his study, he stated that most of the pre-service geography teachers did not have difficulty in establishing a relationship between the scale of the map and the actual values during the field applications. The contradiction between the finding of the current study and the finding of Balcı (2015) is thought to be due to the fact that the number of geography courses taken by the pre-service social studies teachers is less than the number of students receiving education in the field of geography education. Ooms *et al*., (2012) stated that when the studies on eye tracking between students who took map skills courses and novices who had not previously received training on maps were examined, recognizing signs and symbols and mastering them (having taken the map skills course) had a positive effect on rapid decision-making and interpretation processes in individuals. It was seen that the skill found to be the easiest by the students in map reading skills or scored most lenient by the raters is "using landforms". In the studies (Çalışkan, 2015; Özgen, 2010), it is stated that the landforms in geomorphology, which is one of the basic disciplines of physical geography, are difficult to recognize and comprehend in the classroom environment. The reflection of topography on the map to make sense of the space is essentially related to spatial thinking skills (Yayla, 2019). Studies have shown that orienteering practices improve the ability to accurately recognize landforms (Tuna & Balcı, 2013). According to Wiegand (2006), since orienteering and scouting activities are generally voluntary activities, map education in these areas is limited. However, geography education given within the scope of a curriculum and map education in schools plays an active role in map teaching because they are systematic and programmed. At the same time, according to Gilhooly (1988), it is claimed that maps that provide contour information, provide permanence in the minds of individuals for longer periods in the process of learning the map and in developing mapping skills. The effective use of maps and the determination of landforms

with the isohypse method are also possible through orienteering applications (Görmez, 2021). Similarly, Balcı (2015) stated that most of the participants did not have difficulty in reading the landforms. The finding obtained in the current study is consistent with the literature.

Another result of the study is that the skill of "managing time" was found to be easy by the students (scored lenient). In the current study, the students were asked to reach 5 targets in a period of 18 minutes in an area of approximately 5.7 hectares. While some participants used this time very effectively and quickly to reach the target and to complete the track, some participants could not complete it within the time limit and continued to search for the targets. In this connection, it was observed that there was a speed difference between the participants in terms of perceiving the space and interpreting it on the map. In some studies conducted on the basis of these differences, it has been seen that differences in quick thinking are an important parameter that creates individual differences in relation to neuro-physiological processes (Akcan, 2016; Sperdin *et al.,* 2009). The time elapsed between the time the stimulus triggers and the time the response appears is called the "reaction time". Reaction time reveals the ability to make quick decisions during the performance exhibited under the effect of space, time and other parameters in the environment (Akcan, 2016; Tamer, 2000). The existing research on the quick decision-making is focused on quick reading of maps by individuals (Lobben, 2007), eye movement measurement (Dong *et al*., 2018) and the importance of speed for map reading skills. In the current study, the skill of managing time was found to be easy by the students, which is thought to be because of the fact that the students used their eye movements effectively to use the orienteering map and tried to code the space in their minds in order to reach the targets quickly.

As a result of the MFRM analysis, although raters were selected from different fields such as geography, tourism and orienteering, the reliability of the inter-rater separation index was found to be close to zero (.05). This result indicates that there is no difference between the raters. At the same time, the fact that the Rasch-Cohen's Kappa statistic, calculated with the help of the values obtained from the model, had a value greater than 0.00, showed that the raters made consistent assessments and that the agreement between the raters was moderate (Eckes, 2009; Linacre, 2021). Thus, it was concluded that the reliability between the raters was established (Şata, 2019; Tobaş, 2020). Based on the results of the current study, it can be said that the use of analytical rubrics increases the level of objectivity by increasing the consistency between the scores and that it is a valid and reliable tool in assessing map reading skills.

Another result reached in this study was that the raters behaved almost equally in the categories included in the rubric. Range narrowing is observed when raters overuse any category of a rating scale (Wind, 2018). On the other hand, in the central tendency behaviour, aggregation occurs at the midpoint of the scoring scale (Myford & Wolfe, 2003). The central tendency behaviour and narrowing of the range threaten the validity of assessments as they prevent students from separating their performance correctly (Saal *et al.,* 1980). For this reason, it can be said that the analytical rubric developed in the study gives valid results in distinguishing successful and unsuccessful students (Tobaş, 2020).

As Stemler (2004) points out, getting average scores among raters may cause a systematic difference. Therefore, before calculating a summary score, it should be demonstrated that there is no rater bias. According to the results of the MFRM analysis, there was no finding indicating bias in rater-task and rater-student interaction. That is, raters behaved at the expected level in the criteria. According to Hung *et al*. (2012) such a result indicates that raters' interpretation of the rating scale is not different. In this case, it can be said that the opinions, beliefs or personality traits of the raters do not interfere with the scoring (Myford & Wolfe, 2003). However, student-by-task interaction results showed that 5 (39.25%) of them were biased. This result indicates that some tasks are easier or more difficult for these students (Engelhard & Myford, 2003).

5. DISCUSSION and CONCLUSION

Within the framework of the difficulties experienced by the students in their map reading skills, it is seen that some deficiencies in education in terms of geographical skills continue even at the higher education level. When the map reading skill is not imparted in a quality manner in educational environments, its reflections in society are clearly visible. For this reason, it can be said that practical activities aimed at imparting map reading skills to students should be integrated into curricula. It is stated that map reading skills are attempted to be imparted to students by teachers through lecturing and question-and-answer methods. However, in the 21st century, it is stated that there is a need for new methods in which the student will be active through the constructivist approach (Akengin *et al*. 2016). Large map activities (Anthamatten *et al*., 2018), field studies (Artvinli, 2021), and orienteering activities (Ayuldeş, 2021; Tanrıkulu, 2011; Tuna & Balcı, 2013; Yiğit, 2021) are examples that can be used in classroom assessment. In the current study, it was observed that the pre-service teachers had difficulty with some of the criteria in the rubric. Determining the factors affecting the map skills of the students or on which roads these skills can be raised to the highest level should be investigated. In cases where students have difficulty in understanding signs and symbols in reading maps, it can be contributed to recognizing symbols with digital games (Da Silva, 2015) and increasing imagination with simulation. On the other hand, students can be introduced to the findings in various applications such as GPS and satellite images about holding the map and finding directions, and it can be provided to create environments where students will encounter them more. The current work, of course, is about observing the current situation of students. Various experimental studies and studies that will reveal how these skills are affected can be included.

In the current study, an analytical rubric was used to assess map reading skills by means of orienteering activities. Rubrics are powerful tools as they not only improve student performance, but also clarify teacher expectations. Scores are expected to be more reliable when rubrics are used (Goodrich, 1997; Li & Lindsey, 2015). The results provided evidence of scoring rubric reliability with MFRM. In light of the results obtained, it can be said that the MFRM can be used to measure map reading skills. In addition, there is a need to develop appropriate tools (rubrics, checklists, rating scales) for the assessment of these performance-based practices. It can be suggested to researchers that similar tools should be developed for younger age groups (preschool, primary school).

The biggest limitation of this study is that the number of students included in the study was low because orienteering is time-consuming. Similar studies can be carried out by increasing the number of students or raters. It is expected that increasing the rater or students' number may contribute to the reliability and consistency of scores (Erguvan & Dünya, 2020).

Although the criteria in the rubric in this study overlapped with the international literature (Wiegand, 2006, p. 1), map reading skills with orienteering activity were examined only in a particular institution and in one area. Similar studies can be designed for more easily accessible environments such as the schoolyard or school environment. However, it should be noted that it may not be easy to find all landforms in these areas. However, it is considered appropriate to use the analytical rubric developed in the study in the field conditions where suitable geographical elements are available.

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The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the authors. **Ethics Committee Number**: Mehmet Akif Ersoy University, GO 02/2022/472.

Authorship Contribution Statement

Seyma Uyar: Investigation, Resources, Methodology, Supervision, Validation, Formal Analysis, and Writing-original draft. **Onur Yayla**: Investigation, Resources, Participant recruitment, Structuring and application of the orienteering process and Writing-original draft. **Hidayet Zunber**: Investigation, Resources, Participant recruitment, application of the orienteering process.

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REFERENCES

Abbak, A. (2021). Harita okuma ve yorumlama becerisinin incelenmesi. *Journal of Social Sciences And Education, 4*(1), 158-180. https://doi.org/10.53047/josse.829665

Adams, W.P. (1972). Geography and orienteering. *Journal of Geography, 71*(8), 473-480. https://dx.doi.org/10.1080/00221347208985332

Akcan, İ.O. (2016). *Orienteering elite athletes of the relationship between the visual reaction time with decision-making styles* [Unpublished Master's Thesis, Gazi University]. Publication No. 426905. https://tez.yok.gov.tr/UlusalTezMerkezi/giris.jsp

Akengin, H., Tuncel, G., & Cendek, M.E. (2016). Öğrencilerde harita okuryazarlığının geliştirilmesine ilişkin sosyal bilgiler öğretmenlerinin görüşleri [The social sciences teachers' opinions about developing map literacy of students]. *Marmara Geographical Review, 34*(1), 61-69. https://dergipark.org.tr/en/pub/marucog/issue/24661/260863

Akkuş, Z., & Kuzey, M. (2018). Ortaokul öğrencilerinin harita ve yön becerilerine sahip olma ve bu becerileri yaşama aktarabilme durumları üzerine bir değerlendirme [An examination on having map students and implementing these skills to their life]. *Journal of National Education, 47*(218), 201-234. https://dergipark.org.tr/en/download/article-file/556496

Aksoy, H., & Ünlü, M. (2012). Coğrafya derslerinde harita becerisine yönelik uygulamaların öğrenci tutumlarına etkisi [Effect of student attitudes applications ability maps in geography]. *Marmara Geographical Review, 26*(1), 16-41. https://dergipark.org.tr/tr/pub/manucog/issue/473/3875

Aktürk, V., Yazıcı, H., & Bulut, R. (2013). Sosyal bilgiler dersinde animasyon ve dijital harita kullanımının öğrencilerin mekân algılama becerilerine yönelik etkileri [The effects of using maps in social studies class on students' space perception skills]. *Marmara Geographical Review, 28,* 1-17. https://dergipark.org.tr/tr/pub/marucog/issue/475/3922

Alım, M., & Girgin, M. (2012). Coğrafya dersleri için kabartma harita yapımı [Relief map making for geography lessons]. *Eastern Geographical Review, 16*(25), 183-192. https://dergipark.org.tr/tr/pub/ataunidcd/issue/2453/31238

Andrich, D. (1978). A rating formulation for or dered response categories. *Psychometrika, 43*(1), 561-573.

Anthamatten, P., Bryant, L.M., Ferrucci, B.J., Jennings, S., & Theobald, R. (2018). Giant maps as pedagogical tools for teaching geography and mathematics. *Journal of Geography, 117*(5), 183-192. https://doi.org/10.1080/00221341.2017.1413413

Arıkan, A., & Aladağ, E. (2019). The effect of orienteering course on map literacy skills of students at school of physical education and sports. *International Journal of Geography and Geography Education (IGGE), 40*(1), 124-138.

Artvinli, E. (2021). *Development of map skills of students with orienteering social studies course in secondary school*. In E. Artvinli (Ed.) IGU proceedings of geographical education sessions (pp. 105-109). https://igc2021.org

Atayeter, Y., Yayla, O., Tozkoparan, U. & Sakar, T. (2018). Sosyal bilgiler öğretmen adaylarının mekânsal düşünme becerilerinin incelenmesi (Burdur ili örneği) [Examination of spatial thinking skils of social studies teacher candidates (example of Burdur province)]. *Multidiscipliner Studies 4 (Educational Sciences), 1*(1), 29-45.

Atit, K., Weisberg, S.M., Newcombe, N.S., & Shipley, T.F. (2016). Learning to interpret topographic maps: Understanding layered spatial information. *Cognitive Research: Principles and Implications, 1*(1), 1-18. https://doi.org/10.1186/s41235-016-0002-y

Ayuldeş, M. (2020). *The effect of the application of orienteering practices in primary education 6th grade social studies education on students' academic achievement and map literacy levels* [Unpublished Master's Thesis, Trabzon University]. Publication No. 652851. https://tez.yok.gov.tr/UlusalTezMerkezi/giris.jsp

Bahar, H.H., Sayar, K. & Başıbüyük, A. (2010). İlköğretim öğrencilerinin kroki okuma becerilerinin incelenmesi (Erzincan örneği) [The study of sketch map reading skills of the students in primary school (Erzincan sample)]. *Fırat University Journal of Social Sciences, 20*(1), 229-246. https://dergipark.org.tr/tr/pub/firatsbed/issue/45190/565886

Băiţan, G.F. (2022). Orienteering–a necessary sports discipline for training the military. *Bulletin of "Carol I" National Defence University, 11*(1), 110-116. https://doi.org/10.53477/2284-9378-22-67

Baird, J.A., Hayes, M., Johnson, R., Johnson, S., & Lamprianou, I. (2013). *Marker effects and examination reliability: A comparative exploration from the perspectives of generalizability theory, Rasch modelling and multilevel modelling*. Oxford University Centre for Educational Assessment.

Balcı, A. (2015). Coğrafya öğretmen adaylarının coğrafi arazi uygulamalarındaki harita okuryazarlıklarını tespitine yönelik bir araştırma [A study on the determination of map literacy of geography teacher candidates in geographical land applications]. *The Journal of Academic Social Science, 10*(3), 16-35.

Bartz, B.S. (1970). Maps in the classroom. *Journal of Geography, 69*(1), 18-24. https://doi.org/10.1080/00221347008981738

Bednarz, S.W., Acheson, G., & Bednarz, R.S. (2006). Maps and map learning in social studies. *Social Education, 70*, 398-404. https://www.socialstudies.org/system/files/publications/articles/se_700706398.pdf

Bednarz, W.S. (2001). Thinking spatially: ıncorporating geographic information science in pre and post secondary education. In L. Teoksessa Houtsonen and M. Tammilehto (Eds.), *Innovative practices in geographical education* (Pp. 3-7). Helsinki: Proceedings of The Helsinki Symposium of The IGU Commission on Geographical Education.

Borich, G.D., & Bauman, P.M. (1972). Convergent and discriminant validation of the french and spatial visualization factors. *Educational and Psychological Measurement, 32*(4), 1029-1033. https://doi.org/10.1177/001316447203200418

Buğdaycı, İ., & Bildirici, İ.Ö. (2009). Harita kullanımının coğrafya eğitimindeki önemi [The ımportance of map usage in geography education]. *TMMOB Harita ve Kadastro Mühendisleri Odası, 12*(1), 11-15.

Büyüköztürk, S., Kılıç-Çakmak, E., Akgün, O.E., Karadeniz, Ş., & Demirel, F. (2019). *Bilimsel araştırma yöntemleri* [Scientific research methods] (26th Ed.). Ankara: Pegem Akademi Publication.

Candan, G. (2019). Coğrafya eğitiminde oryantiring etkinliklerinin kullanımı [Use of orienteering activities in geography education]. *Geography For All, 1*(2), 19-26.

Carbonel-Carrera, C. & Hess Medler, S. (2017). Spatial orientation skill ımprovement with geospatial applications: report of a multi-year study. *ISPRS International Journal of Geo-Information, 6*(9), 278. https://doi.org/10.3390/ijgi6090278

Carbonell-Carrera, C., & Bermejo Asensio, L.A. (2016). Augmented reality as a digital teaching environment to develop spatial thinking. *Cartography and geographic information science, 44*(3), 259-270. https://doi.org//10.1080/15230406.2016.1145556

Carlin, B.P., & Louis, T.A. (2008). *Bayesian methods for data analysis*. CRC Press.

Carswell, R.J. (1971). The role of the user in the map communication process: Children's abilities in topographic map reading. *Cartographica: The International Journal for Geographic Information and Geovisualization, 8*(2), 40-45. https://doi.org/10.3138/UV32-7523-G562JKJ4

Chen, J.L., & Stanney, K.M. (1999). A theoretical model of wayfinding in virtual environments: proposed strategies for navigational aiding. *Presence, 8*(6), 671-685. https://doi.org/10.1162/105474699566558

Çalışkan, O. (2015). *Coğrafya eğitimi ve arazi çalışmaları* [Geography education and field studies]. Pegem Academia Publication.

Çepni, O. (2019). Location analysis. In B. Aksoy, B. Akbaba & B. Kılcan (Eds.). *Social studies skills education* (1st ed.) (pp. 367-386). Pegem Academia Publication.

Da Silva, C.N. (2015). Interactive digital games for geography teaching and understanding geographical space. *Creative Education, 6*(1), 692-700. http://dx.doi.org/10.4236/ce.2015.67070

Darakçı, S. (2014). Sosyal bilgiler öğretim programı ve ders kitaplarında harita kullanımı [Use of map in the social studies teaching program and textbooks]. *Mehmet Akif Ersoy University Journal of The Institute of Educational Sciences, 4*(3), 15-31. https://dergipark.org.tr/tr/pub/ebed/issue/22328/239289

Darling-Hammond, L., Adamson, F., & Abedi, J. (2010). *Beyond basic skills: The role of performance assessment in achieving 21st century standards of learning* (p. 52). Stanford Center for Opportunity Pollcy in Education.

Demiralp, N. (2006). Coğrafya eğitiminde harita ve küre kullanım becerileri [Map and globe usage skills ingeography education]. *Turkish Journal of Educational Sciences, 4*(3), 323-343. https://dergipark.org.tr/en/pub/tebd/issue/26119/275163

Demirci, A., Karaburun, A., & Ünlü, M. (2013). Ortaöğretim kurumlarında cbs tabanlı projelerin uygulanması ve etkinliği [Implemantation and effectiveness of GIS-based projects in secondary schools]. *Journal of Geography, 112*(5), 214-228. https://doi.org/10.1080/00221341.2013.770545

Dong, W., Jiang, Y., Zheng, L., Liu, B., & Meng, L. (2018). Assessing map-reading skills using eye tracking and bayesian structural equation modelling. *Sustainability, 10*(9), 1-13. https://doi.org/10.3390/su10093050

Eckes, T. (2009). Many-facet rasch measurement. In S. Takala (ed.), *Reference supplement to the manual for relating language examinations to the common european framework of reference for languages: Learning, teaching, assessment* (section H). Council Of Europe/Language Policy Division

Engelhard, G.Jr. & Myford, C.M. (2003). Monitoring faculty consultant performance in the advancedplacement English literature and composition program with a many-faceted

Rasch model. *College Board Research Report, 2003*(1), ETS RR-03-01. http://dx.doi.org/10.1002/j.2333-8504.2003.tb01893.x

Engelhard, G.Jr. (1994). Examining rater errors in the assessment of written composition with a many-faceted rasch model. *Journal of Educational Measurement, 31*(2), 93- 112 https://doi.org/10.1111/j.1745-3984.1994.tb00436.x

Erguvan, I.D., & Aksu Dunya, B. (2020). Analyzing rater severity in a freshman composition course using many facet Rasch measurement. *Language Testing in Asia 10*(1), 1-20. https://doi.org/10.1186/s40468-020-0098-3

Ertuğrul, Z. (2008). *The determination of 6th grade primary school students? map and globe usage skills* [Unpublished Master's Thesis, Gazi University]. Publication No. 219055. http://tez.yok.gov.tr/UlusalTezMerkezi/giris.jsp

Gersmehl, P.J., & Gersmehl, C.A. (2007). Spatial thinking by young children: neurologic evidence for early development and "educability". *Journal Of Geography, 106*(5), 181-191. https://doi.org/10.1080/00221340701809108

Gilhooly, K.J., Wood, M., Kinnear, P.R., & Green, C. (1988). Skill in map reading and memory for maps. *The Quarterly Journal of Experimental Psychology Section A, 40*(1), 87-107. https://doi.org/10.1080/14640748808402284

Golledge, R.G., Jacobson, R.D., Kitchin, R., & Blades, M. (2000). Cognitive maps, spatial abilities, and human wayfinding. *Geographical review of Japan, Series B., 73*(2), 93-104. https://doi.org/10.4157/grj1984b.73.93

Goodrich, H.G. (1997). Understanding rubrics. *Educational Leadership, 54*(4), 14-17.

Görmez, E. (2021). Ortaokul öğrencilerinin harita okuryazarlık becerisi yeterlilikleri üzerine bir çalışma [A study on map literacy skill competences of secondary school students]. *Journal of Van Yüzüncü Yıl University Faculty of Education, 18*(2), 712-733. https://doi.org/10.33711/yyuefd.1029178

Güler, N. (2014). Analysis of open-ended statistics questions with many facet rasch model. Eurasian Journal of Educational Research, 55(1), 73-90. https://dx.doi.org/10.14689/ejer.2014.55.5

Güneş, G. & Öztürk-Demirbaş, Ç. (2020). Sosyal bilgiler öğretmen adaylarının harita kullanabilme beceri düzeylerinin farklı değişkenler açısından incelenmesi [Investigation of social studies teacher candidates' level of map using skills in terms of different variables]. *MANAS Journal of Social Studies, 9* (4), 2145-2158. https://dergipark.org.tr/tr/pub/mjss/issue/57186/675955

Haiyang, S. (2010). An application of classical test theory and many-facet rasch measurement in analyzing the reliability of an english test for non-english major graduates. *Chinese Journal of Applied Linguistics (Foreign Language Teaching & Research Press), 33*(2), 87-102.

Hung, S., Chen, P. & Chen, H. (2012). Improving creativity performance assessment: A rater effect examination with Many Facet Rasch Model. *Creativity Research Journal, 24*(4), 345-357. https://doi.org/10.1080/10400419.2012.730331

Huynh, N.T., & Sharpe, B. (2013). An assessment instrument to measure geospatial thinking expertise. *Journal of Geography, 112*(1), 3-17. https://doi.org/10.1080/00221341.2012.682227

International Cartographic Association (ICA) (2022,11). International Cartographic Association (ICA). https://icaci.org/

İncekara, S., Karatepe, A., & Karaburun, A. (2008). Ortaöğretim coğrafya derslerinde cbs yoluyla harita okuma becerisinin kazandırılmasına yönelik bir uygulama [An application about how to teach topographic map reading with gis in secondary school geography courses]. *Marmara Geographical Review, 17*(1), 97-110. https://dergipark.org.tr/tr/pub/marucog/issue/464/3735

Jo, I. & Bednarz, S.W. (2014-a). Dispositions toward teaching spatial thinking through geography: conceptualization and an exemplar assessment. *Journal of Geography, 113*(5), 198-207.

Jo, I. & Bednarz, S.W. (2014-b). Developing pre-service teachers' pedagogical content knowledge for teaching spatial thinking through geography. *Journal of Geography in Higher Education, 38*(2), 301-313.

Jo, I. (2007). *Aspect of spatial thinking in geography textbook* [Unpublished Doctoral Dissertation]. Seoul National University.

Jo, I. (2011). *Fostering a spatially literate generation: explicit instruction in spatial thinking for preservice teachers* (Unpublished doctoral dissertation). Office of Graduate Studies of Texas A&M University, Texas, USA.

Karasar, N. (2005). *Bilimsel araştırma yöntemi* [*Scientific research method*]. Nobel Publication Distribution.

Kaya Uyanık, G., Güler, N., Taşdelen Teker, G., & Demir, S. (2019). Fen bilimleri dersi etkinliklerinin çok yüzeyli rasch modeliyle analizi [The analysis of elementary science education course activities through many-facet rasch model]. *Kastamonu Education Journal, 27*(1), 139-150. https://doi.org/10.24106/kefdergi.2417

Kaymakçı, S. (2015). Tarih öğretiminde harita becerilerinin gerekliliği üzerine bir çalışma [A study on the necessity of map skills in history teaching]. *Ataturk University Journal of Social Sciences Institute,19*(3), 127-154. https://dergipark.org.tr/tr/pub/ataunisosbil/issue/45086/563148

Kıroğlu K. (2006). *Yeni ilköğretim programları (1-5. sınıflar)* [New primary education programs (1-5th grade)]. Pegem Academia Publication.

Kızılçaoğlu, A., & Ünlü, M. (2008). 9. sınıfta dilsiz haritaların kullanımına yönelik aktivite önerileri [Suggestions of outline map activities for the 9the grade geography course]. *Marmara Geographical Review, 17*(1), 45-67. https://dergipark.org.tr/tr/pub/marucog/issue/464/3732

Kızılçaoğlu, A. (2007). Harita becerilerine pedagojik bir bakış [A pedagogical look at map skills]. *Selcuk University Journal of Social Studies, 18*(1), 341-358. https://dergipark.org.tr/tr/pub/susbed/issue/61794/924246

Koç, H. & Karatekin, K. (2016). Sosyal bilgiler öğretmen adaylarının harita okuryazarlık düzeylerinin çeşitli değişkenler açısından incelenmesi [Investigation of social studies teacher candidates' map literacy levels in terms of various variables]. *Bolu Abant İzzet Baysal University Journal of Education, 16* (USBES Special Issue II), 441-461. https://app.trdizin.gov.tr/publication/paper/detail/TWpNNE5qSTRPQT09

Koç, H., & Bulut, İ. (2014). Gestalt kuramının öğrencilerin harita okuma ve yorumlama beceri düzeyleri üzerine etkisini belirlemeye yönelik bir inceleme [An investigation into the ımpacts of gestalt theory on learners map literacy skills]. *Marmara Geographical Review*, (30), 1-19. https://doi.org/10.14781/mcd.26337

Koç, H., Aksoy, B. & Çifçi, T. (2017). Farklı lisans programlardaki öğrencilerin harita okuryazarlık düzeylerinin çeşitli değişkenler açısından incelenmesi: Cumhuriyet üniversitesi örneği [An examination of map literacy levels of students from various undergraduate programmes according to several variables: Cumhuriyet university sample]. *Erzincan University Journal of Education Faculty, 19*(3), 301-321. https://doi.org/10.17556/erziefd.331083

Koláčný, A. (1969). Cartographic information—a fundamental concept and term in modern cartography. *The Cartographic Journal, 6*(1), 47-49. https://doi.org/10.1179/caj.1969.6.1.47

Lee, J.W. (2005). *Effect of gis learning on spatial ability* (Unpublished Doctoral Dissertation). A Dissertation Graduate Studies of Texas A&M University, Texas, USA.

Li, J. & Lindsey, P. (2015). Understanding variations between student and teacher application of rubrics. *Assessing Writing, 26*(1), 67–79. https://doi.org/10.1016/j.asw.2015.07.003

Linacre, J.M. (1994). Constructing measurement with a many-facet rasch model. In Wilson, M. (Ed.), *Objective measurement: Theory into practice*, (2nd Ed.) (pp. 129-144). Ablex.

Linacre, J.M. (2021). *A user's guide to facets rasch-model computer programs*. Available online www.winsteps.com

Lobben, A.K. (2007). Navigational map reading: Predicting performance and identifying relative influence of map-related abilities. *Annals of The Association of American Geographers, 97*(1), 64-85. https://doi.org/10.1111/j.1467-8306.200700524.x

Maier, P.H. (1996). *Spatial geometry and spatial ability–how to make solid geometry solid*. In selected papers from the annual conference of didactics of mathematics (pp. 63-75).

Meyer, J.M. (1973). Map skills instruction and the child's developing cognitive abilities. *Journal of Geography, 72*(6), 27-35.

Murakoshi, S. (1997). Navigational planning in orienteering. *The Journal of Navigation, 50*(2), 321-327. https://doi.org/10.1017/S0373463300023948

Myford, C.M., & Wolfe, E.W. (2003). Detecting and measuring rater effects using many facet rasch measurement: Part 1. *Journal of Applied Measurement, 4*(4), 386-422. https://researchgate.net

Newcombe, N.S., Uttal, D.H., & Sauter, M. (2013). Spatial development. In P. D. Zelazo (Eds.), *The Oxford handbook of developmental psychology (Vol. 1): Body and mind* (pp. 564–590). Oxford University Press.

Ooms, K., De Maeyer, P., Dupont, L., Van der Veken, N., Van de Weghe, N., & Verplaetse, S. (2016). Education in cartography: What is the status of young people's map-reading skills?. *Cartography and Geographic Information Science, 43*(2), 134-153. https://doi.org/10.1080/15230406.2015.1021713

Ooms, K., De Maeyer, P., Fack, V., Van Assche, E., & Witlox, F. (2012). Interpreting maps through the eyes of expert and novice users. *International Journal of Geographical Information Science, 26*(10), 1773-1788. https://doi.org/10.1080/13658816.2011.642801

Öcal, A. (2007). *Investigation of special cognition skills of 6th grade students in primary school social studies course* [Unpublished Doctoral Dissertation, Gazi University]. Publication No. 207102. http://tez.tok.gov.tr/UlusalTezMerkezi/giris.jsp

Özcan, F. & Uzun, F.V. (2016). Sosyal bilgiler öğretmen adaylarının çeşitli değişkenlere göre harita okuma özyeterlilik ve başarı düzeyleri [Review of map reading self-efficacy and success level of social studies teacher candidates according to several variables]. *Journal of Dicle University Ziya Gökalp Faculty of Education, 29*(1), 387-400. http://dx.doi.org/10.14582/DUZGEF.764

Özgen, N. (2010). Bilim olarak coğrafya ve evrimsel paradigmaları [Geography as a science and its evaluative paradigms]. *Ege Coğrafya Dergisi, 19*(2), 1-26. https://dergipark.org.tr/en/pub/ecd/issue/4872/66894

Pala, Ş.M. & Başıbüyük, A. (2019). Matematik becerisinin sosyal bilgiler derslerindeki harita grafik ve tablo okuma becerilerine etkisi. *Uluslararası Sosyal Bilgilerde Yeni Yaklaşımlar Dergisi, 3*(1), 41-56.

Randall, J. & Engelhard, G. Jr. (2009). Examining teacher grades using rasch measurement theory. *Journal of Educational Measurement, 46*(1), 1-18. https://doi.org/10.1111/j.1745-3984.2009.01066.x

Saal, F.E., Downey, R.G., & Lahey, M.A. (1980). Rating the ratings: Assessing the psychometric quality of rating data. *Psychological Bulletin, 88*(2), 413-428. https://doi.org/10.1037/0033-2909.88.2.413

Safi, H. (2010). *Teachers' views on the development of space perception skills in the social studies curriculum* [Unpublished Master's Thesis, Marmara University]. Publication No. 979907. http://tez.tok.gov.tr/UlusalTezMerkezi/giris.jsp

Sarıgül, O. (2021) Yaşantımızın vazgeçilmez araçları: Haritalar [Indispensable Tools of Our Lives: Maps]. Koç H., Ergün A. (Eds.), *Bilginin görsel ifadesi: Haritalar* [Visual Expression of Knowledge: Maps] (1st ed.) (pp. 2-31). Pegem Academy Publication.

Schnotz, W., & Kulhavy, R.W. (Eds.). (1994). *Comprehension of graphics.* Elsevier.

Sönmez, Ö.F. (2010). *Map skills in primary social studies education* [Unpublished Doctoral Dissertation, Gazi University]. Publication No. 298446. http://tez.tok.gov.tr/UlusalTez Merkezi/giris.jsp

Sönmez, Ö.F. (2019). *Map literacy*. In B. Aksoy, B. Akbaba & B. Kılcan (Eds.), *Social studies skills education* (1st ed.) (pp. 219-232). Pegem Academia Publication.

Sönmez, Ö.F., & Aksoy, B. (2012). İlköğretim ikinci kademe öğrencilerinin harita beceri düzeylerinin belirlenmesi [Determination of map skill levels of primary school second level student]. *Electronic Turkish Studies, 7*(1), 1905-1924. https://www.acarindex.com/dosyalar/makale/acarindex-1423933856.pdf

Sönmez, Ö.F. & Aksoy, B. (2013). Cumhuriyetten günümüze ilköğretim programlarında harita becerileri [Map skills in primary education curriculum from the republic to the present]. *Turkish Journal of Social Research, 171*(171), 269-288. https://dergipark.org.tr/en/pub/tsadergisi/issue/21497/230500

Sperdin, H.F., Cappe, C., Foxe, J.J., & Murray, M.M. (2009). Early, low-level auditory-somato sensory multisensory interactions impact reaction time speed. *Frontiers in Integrative Neureo Science, 3*(1), 1-10. https://doi.org/10.3389/neuro.07.002.2009

Stemler, S.E. (2004). A comparison of consensus, consistency, and measurement approaches to estimating interrater reliability. *Practical Assessment, Research, and Evaluation, 9*(1), 4. https://doi.org/10.7275/96jp-xz07

Stumpf, H., & Eliot, J. (1999). A structural analysis of visual spatial ability in academically talented students. *Learning and Individual Differences, 11*(2), 137-151. https://10.1016/S1041-6080(00)80002-3

Sudweeks, R.R., Reeve, S., & Bradshaw, W.S. (2004). A comparison of generalizability theory and many-facet Rasch measurement in an analysis of college sophomore writing. *Assessing Writing, 9*(3), 239-261. https://doi.org/10.1016/j.asw.2004.11.001

Şanlı C. (2021). Coğrafya öğretmen adaylarının mekânsal kavramlara ilişkin bilişsel yapılarının incelenmesi [Examining the cognitive structures of geography teacher candidates regarding spatial concepts]. *Journal of History School, 14*(51), 1060-1084. https://doi.org/10.29228/Joh.49537

Şanlı C. (2021). Mekânsal düşünme becerisi testinin geliştirilmesi [Developing a spatial thinking ability test]. *International Journal of Eurasia Social Sciences, 12*(43), 1-18. https://dx.doi.org/10.35826/ijoess.2858

Şanlı C., & Sezer, A. (2019). Coğrafya öğretiminde mekânsal düşünme ölçeği: Türkçe'ye uyarlama geçerlik ve güvenirlik çalışması [Teaching spatial thinking through geography disposition inventory: a validity and reliability study on its Turkish adaptation]. *Aegean Geographical Journal, 28*(2), 213-225.

Şanlı, C. (2019). Coğrafya öğretmen adaylarının mekânsal düşünme becerisine ilişkin görüşleri [Geography Teacher Candidates' Views on Spatial Thinking Skills]. J*ournal of Anatolian Cultural Research, 3*(3), 215-233. http://www.ankad.org/index.php/Ankad/article/view/59

Şanlı, C. (2020). Mekansal düşünme becerisinin sosyal bilgiler ders kitapları sorularında analizi [The analysis of spatial thinking skills in the questions included within social sciences

coursebooks]. *International Journal of Geography and Geography Education (IGGE), (42),* 118-132. https://doi.org/10.32003/igge.724028

Şata, M. (2019). *The investigation of the effect of rater training on the rater behaviors ın the performance assessment process* [Unpublished Doctoral Dissertation, Gazi University]. Publication No. 626117. https://tez.yok.gov.tr/UlusalTezMerkezi/giris.jsp

Tamer, K. (2000). *Sporda fiziksel-fizyolojik performansın ölçülmesi ve değerlendirilmesi* [*Measurement and evaluation of physical-physiological performance in sports*]. Bağırgan Publication.

Tanrıkulu, M. (2011). Harita ve pusulanın farklı bir kullanım alanı: oryantiring [A different use of maps and compass: orienteering]. *Journal of National Education, 41*(191), 120-126. https://dergipark.org.tr/en/pub/milliegitim/issue/36191/406895

Taş, H.İ. (2006). Coğrafya eğitiminde görselleştirmenin önemi: Mekânsal algılamaya pedagojik bir bakış [The ımportance of vitualizations in geographic education: an educational aproaches to spatial context]. *Eastern Geographical Review, 11*(16), 211-237.

Taşlı, İ., Çelik, H., & Taşlı, M. (2007). Yapılandırmacı öğretim ve sosyal bilgilerde harita kullanım durumlarının bazı değişkenler açısından incelenmesi (demirci-gördes örneği) [Investigation of map usage cases in constructivist teaching and social studies in terms of some variables (Demirci-Gördes sample)]. *Celal Bayar University Journal of Social Sciences, 5*(2), 57-68.

Tobaş, C. (2020). *Examination of the differential rater behaviours in performance evaluation with many facet rasch measurement* [Unpublished Master's Thesis, Gazi University]. Publication No. 629923. https://tez.yok.gov.tr/UlusalTezMerkezi/giris.jsp

Tuna F., Demirci, A., & Gültekin, N. (2012). Temel coğrafi bilgi ve beceriler toplumda ne ölçüde kullanılıyor? yön, konum ve harita becerilerinde mevcut durum analizi [To what extent are basic geographic ınformation and skills used in society? current situation analysis in direction, location and map skills]. *Journal of National Education, 42*(195), 211-227. https://dergipark.org.tr/en/pub/milliegitim/issue/36172/406706

Tuna, F., & Balcı, A. (2013). Oryantiring uygulamalarının coğrafya öğretmen adaylarının özyeterlik algılarına etkisi [The effects of orienteering on prospective geography teachers' selfefficacy perceptions]. *Marmara Geographical Review, 27,* 1-14. https://dergipark.org.tr/tr/pub/marucog/issue/474/3890

Turner, J. (2003). *Examining an art portfolio assessment using a many-facet rasch measurement model* [Unpublished Doctoral Dissertation, Boston College]. https://www.proquest.com/pagepdf/305343181?accountid=37161

Tümertekin, E., & Özgüç, N. (2019). *Beşeri coğrafya: İnsan, kültür, mekân* [*Human geography: People, culture, spatial*]. Çantay Kitabevi.

Ünlü, M. (2021). *Harita becerileri.* In H. Koç & A. Ergün (Eds.). *Bilginin görsel ifadesi: Haritalar* [*Map Skills*. In H. Koç & A. Ergün (Eds.). *Visual Expression of Knowledge: Maps*] (1st ed.) (pp. 388-418). Pegem Academia Publication.

Ünlü, M., & Güncegörü Aksoy, H. (2013). Coğrafya derslerinde harita becerilerine yönelik uygulamaların öğretmen tutumlarına etkisi [The influence of the applications for maps teachers' attitudes in geography lessons]. *Marmara Geographical Review, 27,* 58-71. https://dergipark.org.tr/tr/pub/marucog/issue/474/3893

Ünlü, M., & Yıldırım S. (2017). Coğrafya dersi öğretim programına bir coğrafi beceri önerisi: mekânsal düşünme becerisi [A geographical skill suggestion to geograp teaching curriculum: spatial thinking skill]. *Marmara Geographical Review, 35*(1), 13-20. https://doi.org/10.1478/mcd.291018

Wiegand, P. (2006). *Learning and teaching with maps.* Routledge.

Wilson, J.A. (2017). *Orienteering, the map and child development* (Organised outdoor play with maps). Department of Natural and Built Environment.

Wind, S.A. (2018). Examining the impacts of rater effects in performance assessments. *Applied Psychological Measurement, 43*(2), 159-171. https://doi.org/10.1177/0146621618789391

Yayla, O. (2019). *The effect of spatial thinking skills and academic achievements of teaching applications based on spatial technologies in social studies education* [Unpublished Master's Thesis, Trabzon University]. Publication No. 568309. https://tez.yok.gov.tr/UlusalTezMerkezi/giris.jsp

Yiğit, T. (2020). *Effect of spatial thinking skills of students orienteering application in social studies* [Unpublished Master's Thesis, Kastamonu University]. Publication No. 647306. https://tez.yok.gov.tr/UlusalTezMerkezi/giris.jsp

Yurdugül, H. (2005). *Ölçek geliştirme çalışmalarında kapsam geçerliği için kapsam geçerlik indekslerinin kullanılması* [*Using content validity ındices for content validity in scale development studies*]. XIV. National Educational Sciences Congres, 1, 771-774. https://yunus.hacettepe.edu.tr/~yurdugül/3/indir/PamukkaleBildiri.pdf

APPENDIX

Appendix 1: A Rubric for Orientiring Map Reading Skills

A Rubric for Orientiring Map Reading Skills					
Criteria	**Categories**				
	1	**2**	**3**	**4**	**Score**
Holding map and finding direction and location	He/She hold the map upside down, unable to find direction and location.	He/She hold the map right but could not find direction or location.	He/She hold the map right, finded the direction, found the approximate location using triangulation.	He/She holds the map right, finded the direction, pinpointed multiple triangulation points and found the exact location.	
Recognizing signs and symbols	…….	He/She recognized the signs and symbols given on the map, but could not calculate the distance.	…….	He/She recognized the signs and symbols given on the map and calculated the distance with a compass.	
Using landforms	…….	…….	…….	…….	
Managing time	…….	…….	…….	…….	