## Analysis of Laboratory Videos of Science Teacher Candidates with Many-Facet Rasch Measurement Model

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| Article Info | Abstract |
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| | Aim of the present study is to analyze science teacher candidates' laboratory videos by using Many-facet Rasch model. Survey method was used in the study. The study was conducted in 2017-2018 academic year spring semester. Rasch model's surfaces are respectively: 9 juries, 13 science activities and 19 criteria. FACETS program was used for data analysis. Findings reveal that laboratory video, which was coded as SA8, was found to be the most successful and SA1 coded video was found the most unsuccessful with respect to criteria. The simplest articles which science teacher candidates were subjected are "introducing yourself", "using proper costume", "appropriate time" and the articles for which the science teacher candidates are constrained mostly "sound-supporting effect", "writing effect", "warning for security precautions". Jury numbered 3 or coded as J3 is "the most lenient" and scorer numbered 2 is "the severest" when juries are sequenced from the most lenient. Moreover, it could be said that, some of the jury members were extremely severe or lenient against some science activities according to bias analysis. |

## Introduction

Laboratory is one of the main part of and plays a central role science education (Hofstein & Lunetta, 1982; Hofstein & Mamlok-Naaman, 2007). The science laboratories have been considered as the most convenient place to teach science. Since students perform experiments to learn science in science laboratories, teaching can be more effective with respect to other learning environments such as classrooms. Laboratory activities in science education provide opportunities to develop scientific concepts, improve interest and motivation, and acquire problem solving and scientific practical skills, scientific habits of mind and understanding of nature of science (Bopegedera, 2011; Deiner et al., 2012; Roth, 2013; Walker & Sampson, 2013).

In order to make possible the provided opportunities through laboratory teaching for the science students, science teachers need to have specific field knowledge and pedagogical field knowledge (Boesdorfer & Lorsbach, 2014). First, science teachers need to have deep understanding on a specific science concept especially for the abstract ones. Then, they need to decide or design for the convenient laboratory activity with the consideration of their science laboratory opportunities, student profile, and their understanding. Later, they need to implement the laboratory activity as possible as they designed and be ready for the unexpected situations. Finally, they need to make assessment for each laboratory activity in order to be sure that their students get well from the opportunities of science laboratory. After all these efforts, the perfect achievement is not guaranteed as much as expected since science students need to be active participants of the laboratory activities. In other words, science laboratory activities can easily become science cookbook activities which mean doing somewhat scientific activity without making any sense (Herron, 2009).

Since early 1800s, the science education researchers performed too much effort through searching to bring better science education understanding and prevent science laboratories to become science kitchens (Pickering, 1993). When the literature reviewed on teaching science through laboratories, it was seen that researches on science teaching laboratories mostly focused on teaching science issues (Donnelly, 1998). The researches were conducted to increase understanding of the issues which are hard to understand since including the abstract concepts or occur at micro level rather than observed through naked eye (Pickering, 1993). In addition, the effects of science teaching in laboratories searched in terms of achievements, attitudes, and skill developments (Hasson & Yarden, 2012). However, only the limited number of researches focused on role of teachers and teacher education in science teaching in laboratories (Bond-Robinson & Rodriques, 2006; Greene, 2000; Roth et al., 2009). Determining the opinions of teachers and prospective teachers provide important benefits for science

educators in order to improve the performance of science education process. So, it was aimed to determine opinions of science teacher candidates on laboratory videos related to science laboratory activities.

Technology or laboratory approach was embedded in the instruction, students learn better and their attitudes increase (Oymak & Ogan-Bekiroglu, 2017). "Video is generally thought to be a valuable medium for exploring teaching and learning because it captures much of the richness of the classroom setting" (Sherin, Linsenmeier, & van Es, 2009, p. 214). Laboratory videos may be evaluated with the help of Many-facet Rasch measurement model. As evaluating the measurement tools, two theories are commonly used: Classical Test Theory and Item Response Theory. Even though there are similarities between these theories it can be said that Item Response Theory has some advantages (Hambleton & Swaminathan, 1985). According to the Classical Test Theory, measurement is a matter of a certain amount of error, observing the knowledge and skills to be measured and converting the results of the observations into numbers and symbols. In Classical Test Theory an examinee's observed score can be expressed as; $X = T + E$. In the equation, X is observed score, T is true score and E is error score (Crocker & Algina, 1986). With the help of models depend on Item Response Theory a linear relationship can be obtained, loss data can be overcome, accuracy of measurement can be estimated and results that do not meet standard values can be evaluated (Elhan & Atakurt, 2005; Aziz & Masodi, 2010).

Rasch model is one parameter logistic as well as static model within Item Response Theory (IRT). With the help of Rasch model each person with a certain amount of a given latent trait specifies the probability of a response. For Rasch model which is the simplest model based on Item Response Theory, the natural logarithm of the odds ratio is modeled by the difference between person's trait score and item's difficulty. The standard Rasch model with persons and items: $\log (P_{ni} / (1 - P_{ni})) = B_n - D_i$. $P_{ni}$ is the probability that person n will succeed on item I; person n has ability $B_n$ and $D_i$ is the difficulty of item (Linacre, 2014; Embretson & Reise, 2000). Severity or leniency of the juries was added to Rasch model for Many-Facet Rasch Measurement (Linacre, 1993). The simple general form of Many-facet Rasch model can be expressed as follows:

$$\log \frac{Pnijk}{Pnijk-1} = B_n\text{-}D_i\text{-}C_j\text{-}F_k$$

In the formula,
$P_{nijk}$ is the probability of examinee *n* being awarded on item *i* by judge *j* a rating of *k*
$P_{nijk-1}$ is the probability of examinee *n* being awarded on item *i* by judge *j* a rating of *k-1*
$B_n$ is the ability of examinee *n*
$D_i$ is the difficulty of item *I*
$C_j$ is the severity of judge *j*
$F_k$ is the extra difficulty overcome in being observed at the level of category *k*, relative to category *k-1* (Linacre, 1989).

Rasch model which is one parameter logistic model depends on Item Response Theory and explained in "Some Probabilistic Models for Intelligence and Attainment Tests" book by George Rasch (Rasch, 1960). Rasch model and Many-facet Rasch model approach has been used in a steadily increasing number of applications in the fields of language testing (Bonk & Ockey, 2003; Eckes, 2005), educational and psychological measurement (Yılmaz & Sözer, 2018; Köse, Sözbir & Kalender, 2017; Ismail, Roslan, Adnan, 2017; Çetin & İlhan, 2017; Chang & Engelhard, 2016; Ahmad, Ali & Zainudin, 2011; Semerci, 2011a, Semerci, 2011b; Kaya Uyanık, Güler, Taşdelen Teker & Demir, 2017), health sciences (Park, Kim, Cha, Minn, Kim & Kim, 2018).

### Aims of the study

The aim of the study is to make "Analysis of laboratory videos related to science activities with Many-Facet Rasch measurement model". In parallel with this purpose;

1. Analysis of science activities performance,
2. Criterion hardness analysis,
3. Analysis concerning severity/leniency of the juries and
4. Jury bias analysis were performed.

## Method

In the study survey method was used. The observed data were analyzed by Many-Facet Rasch model. The facets or surfaces used laboratory videos of science teacher candidates; judge severity/ leniency and the relevancy of the used items: 9 juries, 13 science activities and 19 items or criteria. Jury was coded as J1, J2, … , J9; 13 science activities were coded as SA1, SA2, … , SA19 and criteria were coded as abbreviation.

### Study group

The study was conducted in 2017-2018 academic year spring semester. 9 science teacher candidates were included in the peer assessment process. Linacre (1993) stated that in the Rasch measurement model, there is no assumption that the results of the data obtained from the sample are generalized to the universe. That's why "study group" concept was used in the study. Teacher candidates prepared science activities under first author supervision. These science activities were coded as: SA1: Nutrient content, SA2: Force measurement, SA3: Friction, SA4: Friction and mass, SA5: Melting and freezing, SA6: From gas to liquid or vice versa, SA7: Boiling water, SA8: Pure substances, SA9: Boiling temperature of water, SA10: From ice to liquid or vice versa, SA11: Naphthalene dissolution, SA12: Water temperatures change, SA13: Expansion and contraction.

### Research data

Assessment or criteria form (Kara & Bakirci, 2017) was examined and 19 items were arranged in 5-pointed Likert type between "not appropriate" corresponding to 1 and "completely appropriate" corresponding to 5. Criteria were indicated in Table 1. Expert opinion was obtained from one expert of measurement and evaluation and three experts of science education department. After experts approved the form in terms of usability and clarity of statements, it was used for the study. Cronbach's $\alpha$ coefficient for reliability was calculated as .89. The quantitative data obtained in the study were analyzed with Many-facet Rasch model. FACETS 3.71.4 program was used to analyze data (Linacre, 2014).

## Findings

When taking into consideration the analysis of laboratory videos or science activities of the science teacher candidates with many-facet Rasch measurement model the surfaces used in study (laboratory videos, severity/leniency of the juries and criteria) and the general information concerning these surfaces are given in Figure 1. The measure on the left side of Figure 1 is the logit measurement located between (-) and (+) and same for three surfaces.



Figure 1. Laboratory videos, judges and criteria summary report (calibration map)

The general information concerning these surfaces are given in calibration map in Figure 1. According to Figure 1, J3, J4 and J6 scored above the intermediate level on the other hand J9, J1, J7, J8 and J2 scored science activities below the intermediate level. SA8 is the most sufficient activity with respect to criteria. Logit values and more detailed information about calibration map were indicated in Table 1.

Table 1. Logit values for jury, science activities and criteria

| Jury | Logit | Science Activity | Logit | Criteria | Logit |
|------|-------|------------------|-------|----------|-------|
| J3 | .51 | SA8: Pure substances | 5.21 | Introducing yourself | 2.98 |
| J4 | .45 | SA11:Naphthalene dissolution | 2.59 | Proper costume | .95 |
| J6 | .25 | SA13: Expansion and contraction | 2.30 | Appropriate time | .30 |
| J5 | .02 | SA12: Water temperatures change | 2.07 | Clear inference | .26 |
| J9 | -.07 | SA7: Boiling water | 2.04 | Image quality | .19 |
| J1 | -.14 | SA10: From ice to liquid or vice versa | 2.04 | Security precautions | .14 |
| J7 | -.28 | SA6: From gas to liquid or vice versa | 2.01 | Using experimental processes | .07 |
| J8 | -.35 | SA4: Friction and mass | 1.83 | Describing experimental process | .07 |
| J2 | -.39 | SA9: Boiling temperature of water | 1.53 | Meaning of result | .01 |
| | | SA5: Melting and freezing | 1.34 | Introductory information | -.08 |
| | | SA3: Friction | 1.32 | Viewing angle | -.12 |
| | | SA2: Force measurement | 1.20 | Instruction sequence | -.18 |
| | | SA1: Nutrient content | .52 | Material selection | -.20 |
| | | | | Clear voice | -.21 |
| | | | | Sound quality | -.39 |
| | | | | Gesture | -.61 |
| | | | | Warning for security precautions | -.88 |
| | | | | Writing effect | -1.01 |
| | | | | Sound-Supporting effect | -1.30 |

According to Table 1 it can be said that laboratory video numbered as SA8 (logit= 5.21) is successful at higher level, laboratory video numbered as SA1 (logit= .52) is successful at the lowest level. The most lenient jury is number J3 (logit= .51) and the severest member of jury is number J2 (logit= -.39). It was observed that the most difficult criteria is "Sound-supporting effect (logit= -1.30)" as well as "writing effect (logit=-1.01)" amongst the evaluation criterions of laboratory videos. It could be said that, these criterions were met at lower level in reference to other criterions. The easiest criterion is "introduction yourself (logit= 2.98)" and "using proper costume (logit= .95)".

**Science activities performance analysis**

A detailed measurement report including laboratory videos related to science activities of the science teacher candidates are shown in Table 2 which indicates that RMSE or Root Mean Square Standard Error was found .31 and the number is lowered than critical value standard deviation was found 1.06. Reliability was calculated as .92. This reliability value shows at which reliability the laboratory videos were evaluated. This coefficient .92 shows that science teacher candidates are graded in a high reliability.

Table 2. Science activities measurement

| Science Activities | Nu | Measure | Model S.E | Infit | ZStd | Outfit | ZStd | Total Score | Obsvd Average |
|--------------------|-----|---------|-----------|-------|------|--------|------|-------------|---------------|
| SA8 | 8 | 5.21 | 1.00 | .98 | .3 | .38 | .0 | 759 | 4.99 |
| SA11 | 11 | 2.59 | .24 | .80 | -.4 | .86 | -.1 | 745 | 4.90 |
| SA13 | 13 | 2.30 | .20 | 1.41 | 1.1 | 1.76 | 1.5 | 739 | 4.86 |
| SA12 | 12 | 2.07 | .17 | 1.05 | .2 | 2.11 | 2.2 | 732 | 4.82 |
| SA7 | 7 | 2.04 | .17 | 1.27 | .9 | .67 | -.8 | 731 | 4.81 |
| SA10 | 10 | 2.04 | .17 | 1.13 | .4 | .78 | -.4 | 731 | 4.81 |
| SA6 | 6 | 2.01 | .16 | 1.57 | 1.7 | .96 | .0 | 730 | 4.80 |
| SA4 | 4 | 1.83 | .14 | 1.08 | .3 | .86 | -.2 | 717 | 4.75 |
| SA9 | 9 | 1.53 | .11 | 1.23 | 1.0 | 1.01 | .1 | 703 | 4.63 |
| SA5 | 5 | 1.34 | .10 | 1.26 | 1.3 | .74 | -.8 | 684 | 4.53 |
| SA3 | 3 | 1.32 | .10 | 1.29 | 1.5 | 1.37 | 1.2 | 685 | 4.51 |
| SA2 | 2 | 1.20 | .09 | 1.11 | .7 | .96 | .0 | 702 | 4.42 |
| SA1 | 1 | .52 | .07 | .69 | -3.1 | .69 | -1.8 | 635 | 3.71 |
| RMSE (Model): .92 $x^2$=309.6 df: 12 p= .00 | | | | | | | | | |

Null hypothesis was rejected when "there is a measurable distinction amongst the laboratory videos of science teacher candidates" hypothesis that belongs to fixed effect with separation index 3.39 and reliability coefficient .92 was tested with chi-square test ($x^2$=309.6, df: 12, p= .00). This conclusion shows that there are significant distinctions between the laboratory videos of science teacher candidates in terms of statistical. The qualification sequence of performance tasks is as follows: SA8, SA11, SA13, SA12, SA7, SA10, SA6, SA4, SA9, SA5, SA3, SA2 and SA1.

## Criteria Difficulties Analysis

Criteria measurement report are given for the criteria used evaluation of science activities in Table 3. Separation index was found 2.93 and reliability coefficient was found .90. Null hypothesis was rejected when "there is significant distinctions between difficulties of articles used in evaluation of science activities" hypothesis was tested with chi square (x2= 258.6, df: 18, p= .00). According to these results, there is a significant distinctions between articles used in evaluation of science activities statistically. According to Table 3 the simplest articles which science teacher candidates were subjected are "introducing yourself", "using proper costume", "appropriate time" and the articles for which the science teacher candidates are constrained mostly "sound-supporting effect", "writing effect", "warning for security precautions".

Table 3. Criteria measurement report

| Criteria | Meas. | S.E | Infit | ZStd | Outfit | ZStd | Total.score | Obs. Aver. |
|---|---|---|---|---|---|---|---|---|
| Introducing yourself | 2.98 | 1.00 | .98 | .4 | .53 | .4 | 529 | 4.99 |
| Proper costume | .95 | .34 | 1.40 | 1.9 | 3.08 | 1.9 | 517 | 4.92 |
| Appropriate time | .30 | .22 | .54 | -.7 | .51 | 1.05 | 503 | 4.84 |
| Clear inference | .26 | .21 | .48 | -.6 | .57 | 1.04 | 507 | 4.83 |
| Image quality | .19 | .20 | .98 | .7 | 1.39 | .91 | 510 | 4.81 |
| Security precautions | .14 | .19 | 1.39 | .3 | 1.07 | 1.03 | 504 | 4.80 |
| Using experimental processes | .07 | .18 | .48 | -.9 | .51 | 1.05 | 502 | 4.78 |
| Describing experimental process | .07 | .18 | .61 | -.9 | .49 | 1.06 | 502 | 4.78 |
| Meaning of result | .01 | .18 | .66 | -.1 | .82 | .95 | 500 | 4.76 |
| Introductory information | -.08 | .17 | .99 | -.6 | .65 | 1.07 | 497 | 4.73 |
| Viewing angle | -.12 | .16 | .83 | -.2 | .81 | 1.05 | 500 | 4.72 |
| Instruction sequence | -.18 | .15 | .62 | -.9 | .56 | 1.02 | 493 | 4.70 |
| Material selection | -.20 | .15 | 1.38 | .0 | .96 | 1.17 | 492 | 4.69 |
| Clear voice | -.21 | .15 | 1.20 | .2 | 1.07 | .94 | 496 | 4.68 |
| Sound quality | -.39 | .13 | .76 | -.3 | .79 | .94 | 487 | 4.59 |
| Gesture | -.61 | .12 | 1.00 | -.1 | .87 | .94 | 469 | 4.47 |
| Warning for security precautions | -.88 | .10 | 1.04 | .7 | 1.26 | 1.21 | 447 | 4.26 |
| Writing effect | -1.01 | .10 | 1.40 | 1.4 | 1.53 | .93 | 435 | 4.14 |
| Sound-Supporting effect | -1.30 | .09 | 1.54 | 2.0 | 1.69 | .67 | 403 | 3.80 |
| Seperation: 2.93 Reliability: .90 $x^2$= 258.6, df: 18, p= .00 | | | | | | | | |

## Analysis of Jury

Severity/leniency comparison of jury is given in Table 4. Jury separation index is 2.74 and reliability coefficient is .88 in Table 4. Null hypothesis was rejected when "there is distinction between severity/leniency of jury" hypothesis was tested with chi-square test (x2=73.2, df=8, p= .00). According to these results, there is a significant distinction between severity/leniency points of the five evaluators statistically. It could be said that the scorer numbered 3 or coded as J3 is "the most lenient" and scorer numbered 2 is "the severest" when juries are sequenced from the most lenient towards the severest in Table3. Juries may be sequenced from the severest to the most lenient as J2, J8, J7, J1, J9, J5, J6, J4 and J3.

Table 4. Jury measurement report

| Jury | Nu | Measure | Model S.E | Infit | ZStd | Outfit | ZStd | Total Score | Obsvd Average |
|------|-----|---------|-----------|-------|------|--------|------|-------------|---------------|
| J3 | 3 | .51 | .14 | 1.06 | .3 | .84 | .0 | 1193 | 4.83 |
| J4 | 4 | .45 | .13 | .87 | -.5 | .36 | -1.3 | 1190 | 4.92 |
| J6 | 6 | .25 | .12 | 1.85 | 3.2 | 1.81 | 1.4 | 1177 | 4.90 |
| J5 | 5 | .02 | .10 | .90 | -.4 | 1.43 | .9 | 1158 | 4.88 |
| J9 | 9 | -.07 | .17 | .52 | -1.8 | .41 | -1.2 | 99 | 4.86 |
| J1 | 1 | -.14 | .09 | .98 | .0 | .52 | -1.2 | 1136 | 4.85 |
| J7 | 7 | -.28 | .09 | 1.27 | 1.6 | 1.05 | .2 | 1120 | 4.83 |
| J8 | 8 | -.35 | .08 | .87 | -.8 | 1.13 | .4 | 1113 | 4.81 |
| J2 | 2 | -.39 | .08 | 1.08 | .5 | 1.00 | .1 | 1107 | 4.80 |

Seperation: 2.74 Reliability: .88 $x^2$=73.2, df=8, p= .00

## Jury Bias Analysis

Bias/interaction graphic can concrete the situation and absolute measure of jury and science activities can be examined. The bias analysis of the jury is given in Table 5.

Table 5. Bias/interaction report

| Obs. Score | Exp. Score | Obs. Count | Obs-Exp Avarage | Ju | measr | SA | Act. Measure |
|------------|------------|------------|------------------|-----|-------|------|--------------|
| 75 | 91.89 | 19 | -.89 | J5 | .02 | SA12 | 2.07 |
| 66 | 84.92 | 19 | -1.00 | J1 | -.14 | SA5 | 1.34 |
| 62 | 81.24 | 19 | -1.01 | J8 | -.35 | SA3 | 1.32 |
| 66 | 82.84 | 19 | -.89 | J1 | -.14 | SA2 | 1.20 |
| 84 | 91.10 | 19 | -.37 | J2 | -.39 | SA13 | 2.30 |
| 87 | 92.46 | 19 | -.29 | J6 | .25 | SA6 | 2.01 |
| 87 | 92.27 | 19 | -.28 | J2 | -.39 | SA11 | 2.59 |
| 70 | 81.37 | 19 | -.60 | J4 | .45 | SA1 | .52 |
| 87 | 91.78 | 19 | -.25 | J5 | .02 | SA7 | 2.04 |
| 51 | 63.47 | 19 | -.66 | J7 | -.28 | SA1 | .52 |
| 90 | 93.11 | 19 | -.16 | J3 | .51 | SA6 | 2.01 |
| 94 | 94.83 | 19 | -.04 | J8 | -.35 | SA8 | 5.21 |
| 95 | 93.67 | 19 | .07 | J6 | .25 | SA11 | 2.59 |
| 95 | 93.54 | 19 | .08 | J4 | .45 | SA13 | 2.30 |
| 95 | 93.22 | 19 | .09 | J3 | .51 | SA12 | 2.07 |
| 95 | 93.17 | 19 | .10 | J3 | .51 | SA7 | 2.04 |
| 95 | 93.11 | 19 | .10 | J4 | .45 | SA12 | 2.07 |
| 95 | 93.05 | 19 | .10 | J4 | .45 | SA7 | 2.04 |
| 95 | 93.05 | 19 | .10 | J4 | . 45 | SA10 | 2.04 |
| 95 | 92.96 | 19 | .11 | J1 | -.14 | SA11 | 2.59 |
| 95 | 92.52 | 19 | .13 | J4 | .45 | SA4 | 1.83 |
| 95 | 92.39 | 19 | .14 | J8 | -.35 | SA11 | 2.59 |
| 95 | 92.15 | 19 | .15 | J1 | -.14 | SA13 | 2.30 |
| 95 | 91.30 | 19 | .19 | J8 | -.35 | SA13 | 2.30 |
| 95 | 91.20 | 19 | .20 | J1 | -.14 | SA12 | 2.07 |
| 95 | 91.06 | 19 | .21 | J1 | -.14 | SA7 | 2.04 |
| 95 | 91.06 | 19 | .21 | J1 | -.14 | SA10 | 2.04 |
| 95 | 90.92 | 19 | .21 | J1 | -.14 | SA6 | 2.01 |
| 94 | 90.44 | 19 | .19 | J7 | -.28 | SA12 | 2.07 |
| 95 | 90.79 | 19 | .22 | J3 | .51 | SA5 | 1.34 |
| 95 | 90.11 | 19 | .26 | J7 | -.28 | SA6 | 2.01 |
| 90 | 84.93 | 18 | .28 | J1 | -.14 | SA4 | 1.83 |
| 95 | 89.99 | 19 | .26 | J8 | -.35 | SA12 | 2.07 |
| 95 | 88.80 | 19 | .27 | J8 | -.35 | SA7 | 2.04 |
| 95 | 89.31 | 19 | .30 | J2 | -.39 | SA6 | 2.01 |
| 93 | 87.16 | 19 | .31 | J1 | -.14 | SA9 | 1.53 |
| 87 | 72.13 | 19 | .78 | J5 | .02 | SA1 | .52 |
| 87.7 | 87.7 | 18.9 | .00 | | | Mean (Count: 106) | |
| 10.2 | 9.05 | 1.2 | .28 | | | S. D. (Pouplation) | |
| 10.2 | 9.09 | 1.2 | .28 | | | S. D. (Sample) | |

Fixed (all=0) chi-square: 254.3 d.f. : 106 significance (probability): .00

It could be said that, some of the jury members were extremely severe or lenient against some science activities according to bias analysis. For instances it was observed that, J8 made an extremely severe scoring by giving 62 point for science activities although jury was expected to give nearly 82 point in the evaluation related to science teacher candidates' science activity (SA3). A similar case is for J1 that J1 gave S5 66 point instead expecting to give about 85. On the other hand lenient scoring was also observed. J5 gave SA1 87 point instead expecting to give 72. 13. For more detailed information about jury bias, Table 5 may be examined. In Figure 2 bias/interaction graphic is given.
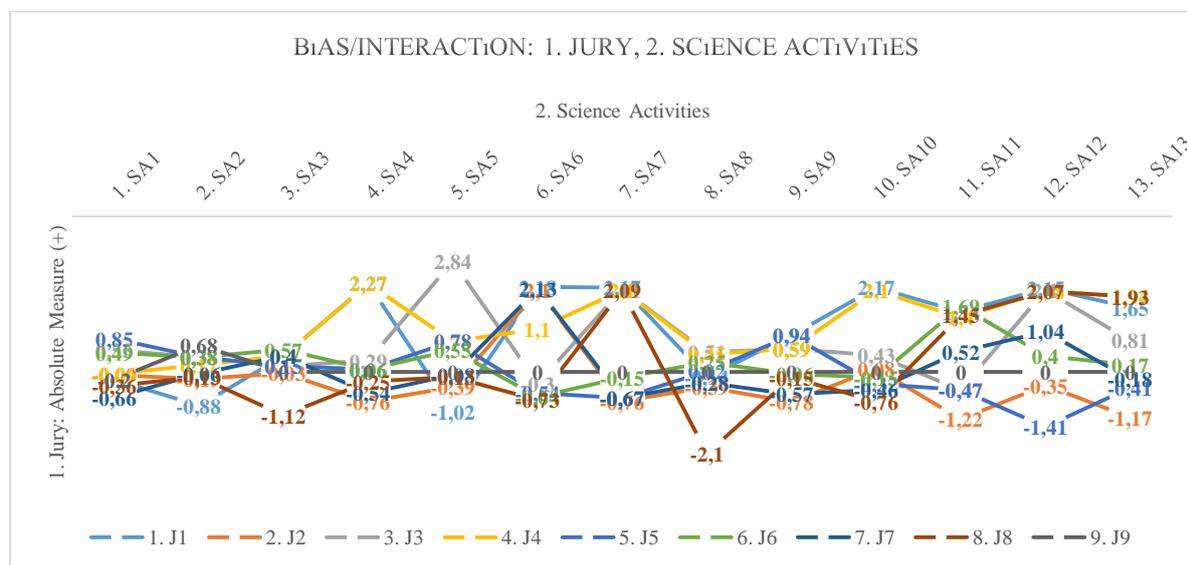


Figure 2. Bias/interaction graphic

## Conclusion and Recommendations

The Rasch model has two main advantages. First one is specific objectivity and second one is that its stability although it may be used for small samples (Fischer 1997; Fischer 2005; Linacre 1994; Linacre, 2006). In this study, the analysis was performed for videos of science teacher candidates related to laboratory activities with many-facet Rasch measurement model. The surfaces of model were jury, laboratory videos and criteria. Reliability coefficient of Rasch analysis is similar to Cronbach alpha or KR-20 (Linacre, 1997). Measurement report of Many-Facet Rasch measurement model indicate reliability coefficient. In this study, reliability coefficients were calculated 0.92 for science activities performance analysis, 0.88 for jury analysis and 0.90 for criteria difficulties.

The laboratory video which was coded as SA8, was found to be the most successful and SA1 coded video was found most unsuccessful with respect to criteria. Jury numbered 3 or coded as J3 is "the most lenient" and scorer numbered 2 is "the severest" when juries are sequenced from the most lenient. It could be said that, some of the jury members were extremely severe or lenient against some science activities according to bias analysis. In the literature differences in rating process between raters or juries can be determined.

The videos prepared by science teacher candidates related to science experiments were subjected to performance analysis. The results of the analysis reveal that the videos of laboratory activities prepared by the science teacher candidates differ in terms of the evaluation criteria. In the reflection of the videos prepared by science teacher candidates on the performance analysis results, teacher candidates' ability to prepare different videos, their knowledge, attitude and interest, pedagogical competencies have been effective (Christ et al., 2014). In addition, the evaluation criteria used were effective to a certain extent. Although, the criteria used in the assessment were determined at the beginning of the study and shared with prospective teachers, prospective teachers showed different performance in fulfilling the expectations (Christ et al., 2012). There is also the effect of the scores of the juries independently of each other in the performance difference. The fact that juries gave points or variable scores when giving points to videos gave rise to a result that could be seen as bias (Van Es et al., 2014).

The criteria used in the evaluation of the videos prepared by science teacher candidates about science experiments were subjected to difficulty analysis. Analysis results indicate that there are differences between the

criteria used in the evaluation. In the videos of the science laboratory prepared by teacher candidates, it is understood that they can fulfill the narrator criteria such as "introducing themselves and" using "proper costume". On the other hand, it has been revealed that the teacher candidates have difficulty in technical subjects such as using "sound-supporting effect and "writing effect". In addition, it is revealed that science teacher candidates have difficulty in covering the security issue such as laboratory safety in prepared videos. In this context, it was revealed that that science teacher candidates were not challenged in the narrator and activity process criteria when preparing videos, but they had difficulty in technical specifications and laboratory safety criteria. Even though teacher candidates have successfully completed computer course techniques including video editing techniques and laboratory safety techniques including video editing techniques, they have difficulty in gathering the competencies they acquired in different courses in order to prepare an instructional material. In the video analysis studies that focus on decision making justification (Rich et al ., 2008), reflective thinking, teaching skills (Nagro et al., 2017) and science achievements (Taylor et al., 2017) , teacher candidates are expected to they were forced to demonstrate the knowledge, skills and abilities they were expected to acquire. It is also effective that that teacher candidates work in a way to produce a product as well as having the knowledge and skills expected to show a comfortable or compelling attitude about fulfilling their expectations (Masats & Dooly, 2011).

The jury bias analysis was performed on the data obtained from the evaluation of teacher candidates' videos about science experiments. The results of the analysis indicate that there are bias among the juries that are in the evaluation. In fact, the juries that will conduct a video evaluation at the beginning of the study were briefed about the scope, importance and how to make the evaluation. However, because juries are independent of each other and they reflect the impressions they get from the evaluation videos in the direction of their knowledge, skills and abilities, they have different evaluation scores and jury biases (Semerci et al ., 2013). In addition, the juries were determined among the pre-service teachers. In other words, judges have made peer evaluation. Although it is assumed that juries will be evaluated in line with the research objectives and based on the evaluation criteria, criticism or over-criticism can be made in peer review (Şahin et al ., 2016) .

Şahin et al. (2016) analyzed peer assessment through Many-facet Rasch measurement model. The research was conducted with 91 graduate undergraduate students and with the lecturer. Semerci et al. (2013) aimed to make analysis of seminar presentation performances of postgraduate students. The study group included seven students and five juries observed their seminars. Some of the jury members were extremely severe or lenient against some post graduate students according to bias analysis. Study of European Council (2009) stated that Rasch measurement model doesn't reveal biases but it indicates the references of biases and to which jury does biases belong to. The biases which appeared may have various reasons such as professional experience, personality traits, attitudes, demographic characteristics workload, and assessment purpose.

The simplest articles which science teacher candidates were subjected are "introducing yourself", "using proper costume", "appropriate time" and the articles for which the science teacher candidates are constrained mostly "sound-supporting effect", "writing effect", "warning for security precautions". The results of the study were discussed with science teacher candidates and they were informed how they can develop their skills. It may be recommended that similar studies can be conducted with different measurement tools and raters. By this way researchers may analyze case objectively and define the educational materials.

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