Research Article https://doi.org/10.12973/ijem.9.1.271

International Journal of Educational Methodology
Volume 9, Issue 1, 271 - 281.
ISSN: 2469-9632
https://www.ijem.com/

Evaluation of the 9th-grade 2018 Physics Curriculum With Multilevel Rasch Analysis

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Received: October 12, 2022 ▪ Revised: December 7, 2022 ▪ Accepted: January 13, 2023

Abstract: This study aims to examine the 9th-grade 2018 physics curriculum according to various criteria. A cross-sectional survey model was used. The sample consists of 36 physics teachers working in various high schools in 12 regions of Turkey in the 2022-2023 academic year. The data of the study were collected via the "9th-grade 2018 physics curriculum Evaluation Form". The data collected via the evaluation form were determined with the multilevel Rasch analysis program. The results of the research revealed that the criteria determined in the evaluation of the 9th-grade physics curriculum differed in terms of strictness and generosity. In addition, the quantitative data analysis revealed that the physics teachers mostly comply with the criteria set in the program while they disapprove of some criteria. The physics teachers reported some deficiencies in the objectives, content, and educational status of the elements included in the program. In this context, it is recommended that the achievements of the 9th-grade 2018 physics curriculum be reviewed in line with the evaluations of the stakeholders related to the subject.

Keywords: *Multilevel Rasch analysis, physics curriculum, rater bias.*

To cite this article: Erdamar, F. S., & Arcagök, S. (2023). Article. *International Journal of Educational Methodology*, *9*(1), 271-281. https://doi.org/10.12973/ijem.9.1.271

Introduction

Physics is the branch of science that is concerned with nature through experiments, observations, and measurements and explains the phenomena that occur in nature Serway, (1995). Physics taught in high schools is crucial as it forms the basis of science and technology as well as helps us make sense of the environment we live in with ease. In addition, the working methods of physics and related data influence other branches of science in many ways and have broad areas of applications in this aspect Nalçacı et al. (2011). Physics is a course that exists in every detail of life and forms a basis for basic and natural sciences, especially for engineering and health sciences Ayvacı and Bebek (2018). Possessing a multi-faceted area of application and prevalence, the physics course affects our way of thinking, as well as our perspective toward nature and natural events Bayrak and Bezen (2013). Physics is a science that shows our level of knowledge about the universe, how existing information changes in the process, and the situations encountered during the presentation of an invention Bozdemir (2005). Teaching and popularizing this branch of science is only possible if physics is taught in schools. To ensure that the physics course is taught and learned inside and outside the school, certain achievements in line with a goal are required. The basic element that ensures that education is carried out in a systematic way in and out of school is the curriculum. Curriculum refers to all activities in and out of school designed to gain the objectives determined at the grade level related to a course Akpınar (2015).

In the wake of changing and developing societal needs and advances in technology, there is a need for changes in the curricula applied overtime at all education levels. Since the curricula are shaped by the change in the social, economic, political, and cultural structure of the society by nature, the curricula applied at all levels of education are expected to undergo a continuous change and development process. The current world conjuncture pins down this necessity to avoid lagging behind the understanding of contemporary science. For these reasons, the curriculum is the part that is acquired in certain periods of life under a scheme and program along with a generally conclusive document (Varış, 1996).

Various definitions have emerged for the curriculum from the past to the present. Analytically, the definitions made on the curriculum reflect what was expected from the program at that time or its application or the dynamic process. The chronology of such definitions is as follows: Caswell and Campell defined the curriculum in the 1935s as "Everything

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that students experience in school under the supervision and guidance of teachers" while Nowak et al. (1970) defined curriculum development as dealing with the total changes related to learning in the educational institution. Hauenstein (1975), on the other hand, defined the curriculum as the analysis, synthesis, and conversion of the unity between the building blocks of the program into a new form to reach predetermined goals. Büyükkaragöz (1997) defined the curriculum as “all of the activities designed to achieve the desired learning level in students” while Thompson and Gregg (1997) defined the curriculum as the first and basic mechanism applied for the educational institution to reach its determined goals and objectives. Saylor et al. (1981) defined the curriculum as “The plan to provide a learning experience to learners” while Posner (1995) defined the curriculum as “Learning outcomes that allow deciding on the instructor and the form of assessment”, Bilen (2006) as “Learning experiences that individuals face to achieve educational goals”, and Marsh and Willis (2007) as “Student experiences planned and implemented under the leadership of the school”. One may notice that curriculum development has been defined in different ways. This development and change are the same for the physics course curriculum currently taught in high schools. It is observed that chronologically and over time, the physics curriculum has been constantly updated around the world Dicle Erdamar (2019), Fernandez et al. (2008) and Fu and Clarke, (2019). Dicle Erdamar summarizes the updating of the Physics Curriculum in Turkey as follows.

When we look at the historical process of developing a curriculum for high school physics in Turkey, the first study was done in 1934, followed by studies in 1935, 1938, and 1940. It is observed that subsequently, after a long hiatus, updates were made in 1985, 1992, and 1996, albeit superficially, and after the curriculum was developed in 1998 but not put into practice, the main change took place in 2007. In the contemporary sense, curriculum elements similar to those in today’s curricula were included. The physics curriculum, which was later updated in 2011, 2013, and 2018, continues to be taught under the name of Secondary Education Physics Curriculum (SEPC) today (Göçen & Kabaran, 2013; Arıkan et al., 2017; Koç & Yayla, 2015, as cited in Dicle Erdamar, 2019).

The curriculum development process of the Ministry of National Education (2018) reveals that the expert teams consisting of physics teachers, academics, and ministerial expert personnel first reviewed the literature about the physics course, scrutinized the physics curricula implemented in different countries, and designed a program aimed at prioritizing individual development and change as well as raising well-qualified individuals. While performing curriculum development studies, practices in developed countries and the philosophical trends on which they are based are taken into account. Also, an educational philosophy underpinning the curriculum is followed in every curriculum development process. Since 2004, the Ministry of National Education has taken the Philosophy of Progressivism and Constructivism as a basis in the development process of all its curricula.

In constructivism, knowledge is discovered and adapted to new situations, that is, new learning is built upon what has been learned before Cooperstein and Kocevar-Weidinger (2004). Instead of taking in ready information, the student reaches the information through research and discovery and internalizes such information by incorporating it into pre-existing knowledge. The change in the tasks of the students has led to a change in the responsibilities of teachers playing an active role in the learning process. Brooks and Brooks (1999) point out that based on the constructivist approach, teachers have various roles such as recognizing students’ entrepreneurship and autonomy, encouraging them to question and research, and helping them discover and solve problems. The constructivist learning theory should be supported by student-centred approaches and methods to be successfully implemented in a student-centred manner. One of these methods is the active learning method. Active learning is the ability of students to actively participate and be involved in activities in the learning process Jayawardana et al. (2001). The applicability and sustainability of the curriculum depend not only on awareness of the fundamental philosophy and theory on which the new curriculum is based but also on awareness of the strategy, methods, and techniques applied in the learning-teaching process. In this sense, teachers are expected to take an active role in the evaluation and planning of the curriculum, along with their responsibilities for implementing the curriculum, to achieve the determined goals Koyuncu and Kavcar (2016).

The relevant literature encompasses some studies focusing on the updated 9th-grade Physics Curriculum in Turkey Dicle Erdamar (2019), Eke (2018), Kavcar and Erdem (2017) as well as in different countries other than Turkey Baylor et al. (2022); Fu and Clarke (2019), Menon et al. (2020), Stadermann (2022), Stadermann et al. (2019), Van De Heyde and Siebrits (2019). Taking the opinions of the teachers, the implementers of the program, about the program is crucial as such opinions disclose the faulty aspects of the curriculum and provides feedback on its applicability. This study was carried out to take the opinions of the physics teachers attending the 9th-grade physics course bearing in mind that it would contribute to the development and improvement of the high school 9th-grade physics curriculum.

The Objective of the Research

In this context, this study has been designed to evaluate the 9th-grade 2018 physics curriculum with a multilevel Rasch analysis program and the following questions are addressed:

1. What are the content validity ratios (CVR) and indexes (CVI) of the criteria of the 9th-grade 2018 physics curriculum?

2. How is the distribution of the logit and data calibration map values obtained as a result of the analysis of the 9th-grade 2018 physics curriculum with the multilevel Rasch model?

3. At what level are the analysis results of the 9th-grade 2018 physics curriculum regarding the strictness and generosity of the raters?

4. How is the distribution of the measurement report for the criteria by which the 9th-grade 2018 physics curriculum is evaluated?

Methodology

Research Model

This research is based on a cross-sectional survey model, which is defined as one of the general survey models. Studies described in the cross-sectional model are carried out with a single measurement under the structure of different types of variables Fraenkel and Wallen (2006). Since the 9th-grade 2018 physics curriculum was evaluated instantaneously and based on only one measurement, taking into account different types of criteria, the research model was used within this framework.

Sampling

The sample of the study consists of 36 high school physics teachers working in high schools in 12 different regions of Turkey in the 2022-2023 academic year. The raters (juries) assigned for the study group were determined based on two basic criteria: a) To have lectured the 9th-grade physics course in the last 5 years b) Different variables (population, social economic development, etc.) of the Turkish Statistical Institute taken as criteria in determining the physics teachers (Development Agencies, n.d.). In this context, the physics teachers of the regions determined based on Level 1 are given in Table 1.

Table 1. Physics Teachers Included in the Sample based on Level 1

Name of the Region	Level 1 Codes	Physics Teacher
1st Region	TÜRKİYE 1 [TR1]	3
2nd Region	TÜRKİYE 2 [TR2]	3
3rd Region	TÜRKİYE 3 [TR3]	3
4th Region	TÜRKİYE 4 [TR4]	3
5th Region	TÜRKİYE 5 [TR5]	3
6th Region	TÜRKİYE 6 [TR6]	3
7th Region	TÜRKİYE 7 [TR7]	3
8th Region	TÜRKİYE 8 [TR8]	3
9th Region	TÜRKİYE 9 [TR9]	3
10th Region	TÜRKİYE A [TRA]	3
11th Region	TÜRKİYE B [TRB]	3
12th Region	TÜRKİYE C [TRC]	3

1st Region: Istanbul, 2nd Region: West Marmara, 3rd Region: Aegean, 4th Region: East Marmara, 5th Region: West Anatolia, 6th Region: Mediterranean, 7th Region: Central Anatolia, 8th Region: Western Black Sea, 9th Region: Eastern Black Sea Region, 10th Region: Northeast Anatolia, 11th Region: Middle East Anatolia, 12th Region: Southeast Anatolia.

Table 1 highlights that 36 physics teachers from 12 different regions were determined as raters. The raters of the study are comprised of 36 Physics Teachers working in different regions of Turkey. The sample regions were created according to the criteria determined by the Turkish Statistical Institute based on Level 1, taking into account different variables.

Data Collection Tool

The criteria set in the evaluation form that the high school teachers, who were determined as raters in the study, are supposed to draw upon for the evaluation of the 9th-grade 2018 physics curriculum, were designed in a manner to examine the theoretical framework based on the literature review and to cover the basic dimensions of the 9th-grade Physics Curriculum (objectives, units and subjects, learning experiences, and measurement and evaluation). The evaluation form organized in this framework was finally renewed in line with the opinions of 5 instructors specialized in the field of the physics curriculum and an instructor specialized in the field of measurement and evaluation. In this context, there are 16 different criteria included in the final form of the evaluation form, whose deficiencies were corrected by field experts. The responses of the raters assigned to evaluate a total of 16 criteria consist of five-point Likert-type options. These are rated from five to one as “Strongly agree”, “Agree”, “Moderately agree”, “Disagree”, and “Strongly disagree”.

Data Analysis

The data obtained from the study were determined through the evaluation of the 9th-grade 2018 physics curriculum by 36 teachers in high school physics, depending on 16 criteria. A multilevel Rasch analysis program (Linacre, 1989) was used to evaluate the curriculum. In this context, the 9th-grade 2018 physics curriculum, the determined criteria, and the raters (juries) were organized in three different surfaces.

Findings

The data obtained from the study were analyzed using the multilevel Rasch analysis program. The findings that emerged as a result of the analysis are shown and interpreted in tables and figures.

Findings Regarding Content Validity Ratios

The first question is “What are the content validity ratios (CVR) and indexes (CVI) of the criteria of the 9th-grade 2018 physics curriculum? The data of the findings related to the first question are given in Table 2.

Table 2. Analysis Results of Content Validity Ratios of the Criteria in the 9th-grade 2018 Physics Curriculum

Dimensions	Number of Criteria	Criteria	N_G	CVR	CVI
Objective	1	The objective of the curriculum is set in line with the characteristics of the individuals the country aims to raise.	14	.94	.89
	2	The objectives of the curriculum are set in line with the expectations of the students.	15	.80	
	3	The curriculum covers units, topics, and concepts adequately.	14	.80	
	4	The curriculum is organized in line with the level of the student.	16	1.00	
Content	5	The topics in the curriculum content are compatible with the objectives.	15	.94	.90
	6	The topics in the content of the curriculum are spiral.	16	.94	
	7	The curriculum is eclectic.	15	.75	
	8	The scope of the curriculum is sufficient.	16	1.00	
Educational Status	9	The curriculum can be implemented with instructional strategies that overlap with the constructivist theory.	16	1.00	.90
	10	The curriculum can be implemented with teaching models that overlap with the constructivist approach.	16	.80	
	11	The curriculum can be implemented with teaching techniques that overlap with the constructivist approach.	16	1.00	
	12	The techniques in the curriculum are sufficient.	12	.80	
Measurement and Evaluation	13	The measurement and evaluation approach in the curriculum is process-based.	16	1.00	1.00
	14	Measurement and evaluation in the curriculum are result-oriented.	16	1.00	
	15	Measurement and evaluation in the curriculum cover both the process and the result.	16	1.00	
	16	Measurement and evaluation in the curriculum are organized with an alternative approach.	16	1.00	

Number of experts:16, Content Validity Criteria: 0.84, Content Validity Index: %92, CVR<CVI

Table 2 reveals that the 9th-grade 2018 Physics Curriculum was evaluated based on a total of 16 criteria. The content validity ratios of the criteria were calculated as .81 with the formula $CVR_{item} = (NG / N/2) - 1$ (Şencan, 2005). The content validity index (CVI) was calculated as .92 according to the formula stated by Yurdugül and Aşkar (2008). It can be said that the criteria used to evaluate the 9th-grade 2018 physics curriculum are at the targeted level, considering that these values found as a result of the analysis range between 0.75-1.00 (Veneziano & Hooper, 1997).

Findings Regarding Logit and Calibration Map

The second question is "How is the distribution of the logit and data calibration map values obtained as a result of the analysis of the 9th-grade 2018 physics curriculum with the multilevel Rasch model?". The data are shown in Figure 1.

```
+------------------------------------------------------------------------+
|Measr|+Proje|+Puanlayıcı                |-Madde                 |RATIN|
|-----+------+---------------------------+-----------------------+-----|
|   6 +      +                           +                       + (5) |
|     |      |                           |                       |     |
|     |      |                           |                       | --- |
|     |      |                           |                       |     |
|   5 +      + J13                       +                       +     |
|     |      |                           |                       |     |
|     |      |                           |                       |     |
|     |      |                           |                       |     |
|   4 +      +                           +                       +     |
|     |      | J3                        |                       |     |
|     |      |                           |                       |     |
|     |      | J33                       |                       |     |
|   3 +      +                           +                       +     |
|     |      |                           |                       |  4  |
|     |      |                           |                       |     |
|     |      |                           |                       |     |
|   2 +      +                           +                       +     |
|     |      |                           |                       |     |
|     |      | J35                       |                       |     |
|     |      | J21                       |                       |     |
|   1 +      + J1                        +                       +     |
|     |      | J20  J28                  |                       |     |
|     |      | J17  J6                   | M12  M2   M7   M8     |     |
|     |      | J26  J7                   | M1   M13  M4          | --- |
*   0 * Hed  * J22  J31                  * M15  M16  M9          *     *
|     |      |                           | M14  M5               |     |
|     |      | J16  J32                  | M10  M11  M3          |     |
|     |      | J11  J23                  | M6                    |  3  |
|  -1 +      + J10  J24  J34  J4   J8    +                       +     |
|     |      | J15  J30                  |                       |     |
|     |      | J2   J27  J9              |                       |     |
|     |      | J19  J5                   |                       | --- |
|  -2 +      + J18                       +                       +     |
|     |      | J36                       |                       |     |
|     |      |                           |                       |     |
|     |      |                           |                       |     |
|  -3 +      + J12  J29                  +                       +  2  |
|     |      | J25                       |                       |     |
|     |      |                           |                       |     |
|     |      |                           |                       |     |
|  -4 +      +                           +                       + --- |
|     |      |                           |                       |     |
|     |      |                           |                       |     |
|     |      |                           |                       |     |
|  -5 +      +                           +                       +     |
|     |      |                           |                       |     |
|     |      | J14                       |                       |     |
|     |      |                           |                       |     |
|  -6 +      +                           +                       + (1) |
|-----+------+---------------------------+-----------------------+-----|
|Measr|+Proje|+Puanlayıcı                |-Madde                 |RATIN|
+------------------------------------------------------------------------+
```

Figure 1. Data Calibration Map

Considering Figure 1, the project refers to the 9th-grade 2018 physics curriculum, the rater refers to physics teachers lecturing the 9th-grade physics and evaluating the curriculum, and the items refer to the evaluation criteria. The data calibration map reveals that the 6th item "The topics in the content of the curriculum are spiral" is emphasized as the item of strictness (criteria). On the other hand, the items of generosity are listed as the 2nd item "The objectives of the curriculum are set in line with the expectations of the students", the 7th item "The curriculum is eclectic", the 8th item "The scope of the curriculum is sufficient", and the 12th item "The techniques in the curriculum are sufficient". Also, the rater with the least tendency to strictness was the rater numbered 14 while the rater with the most tendency to strictness was the rater numbered 13.

Findings Regarding Rater Performances

The third question is "At what level are the analysis results of the 9th-grade 2018 physics curriculum regarding the strictness and generosity of the raters?". Measurement reports for the scoring performances for the 9th-grade 2018 physics curriculum are given in Table 3 along with interpretation in line with the results.

Table 3. Measurement Report on the Scoring Performance of the Raters

Rater	Total Score	Observation Average	Winsorized Mean	Model		Compatible		Incompatible	
				Measurement	S.E.	MnSq	ZStd	MnSq	ZStd
J13	70	4.38	4.37	5.08	.52	1.17	.8	1.17	.8
J3	66	4.13	4.12	3.78	.65	.75	-.3	.74	-.3
J33	65	4.06	4.06	3.33	.70	.54	-.6	.59	-.5
J35	61	3.81	3.81	1.56	.57	.76	-.3	.84	-.1
J21	60	3.75	3.75	1.26	.52	.71	2.0	.65	-.7
J1	59	3.69	3.69	1.01	.49	.81	.3	.78	-.4
J20	58	3.63	3.63	.78	.46	1.92	-.2	1.75	1.7
J28	58	3.63	3.63	.78	.46	1.09	-1.1	1.05	.2
J6	56	3.50	3.50	.39	.42	.88	-.9	.93	.0
J17	56	3.50	3.50	.39	.42	.62	-.1	.67	-.9
J7	55	3.44	3.44	.21	.41	.70	-1.2	.71	-.8
J26	55	3.44	3.44	.21	.41	.91	-.2	.95	.0
J31	54	3.38	3.38	.05	.40	.63	1.7	.62	-1.2
J22	53	3.31	3.31	-.11	.38	.90	2.9	.86	-.3
J16	51	3.19	3.19	-.40	.38	1.64	2.0	1.87	2.3
J32	51	3.19	3.19	-.40	.36	2.21	-1.1	2.15	2.8
J11	48	3.00	3.00	-.81	.36	1.76	.3	1.78	2.0
J23	48	3.00	3.00	-.81	.36	.64	.0	.63	-1.2
J10	47	2.94	2.94	-.94	.36	1.09	-1.9	1.10	.4
J34	47	2.94	2.94	-.94	.36	.99	-1.4	.99	.0
J4	46	2.88	2.88	-1.07	.36	.46	.7	.45	-2.0
J8	46	2.88	2.88	-1.07	.36	.58	.8	.59	-1.4
J24	46	2.88	2.88	-1.07	.36	1.21	-1.2	1.22	.7
J15	45	2.81	2.81	-1.20	.36	1.35	.1	1.24	.8
J30	44	2.75	2.75	-1.33	.36	.62	-2.0	.62	-1.2
J2	43	2.69	2.69	-1.46	.36	1.02	1.2	1.03	.1
J9	42	2.63	2.63	-1.58	.36	.45	.6	.45	-2.0
J27	42	2.63	2.63	-1.58	.36	.32	1.2	.32	-2.7
J19	41	2.56	2.56	-1.71	.36	1.43	-.5	1.43	1.2
J5	40	2.50	2.50	-1.84	.36	1.20	-3.3	1.20	.6
J18	38	2.38	2.38	-2.09	.36	1.43	.8	1.45	1.2
J36	37	2.31	2.31	-2.22	.36	.80	.3	.79	-.5
J12	32	2.00	2.00	-2.89	.37	.24	.2	.24	-3.3
J29	32	2.00	2.00	-2.89	.37	1.27	-.1	1.23	.7
J25	30	1.88	1.88	-3.17	.38	1.10	1.3	1.05	.2
J14	19	1.19	1.19	-5.44	.63	1.05	1.4	1.19	.5

Model, Sample: RMSE .43 Adj (True) S.D. 1.91 Separation 4.45 Strata 6.27 Reliability (not inter-rater) .95 Model, Fixed (all same) Chi-square: 539.9 d.f.: 35 significance (probability): .00

Table 3 reveals the detailed evaluations of the raters regarding the 9th-grade 2018 physics curriculum according to certain criteria. Thus, it is observed that the rater with the code "J_{13}" is the most generous participant among the raters while the rater with the code "J_{14}" is the strictest. The standard error value analyzed for the data other than the extremes for the scores determined by the raters was determined as RMSE .43. The scoring performance reliability coefficient of the raters was calculated as .95. The value for the reliability coefficient of the scoring performance of the raters indicates that the values are at a high level. In addition, the raters' scoring separation index was 1.91, and the calculated reliability coefficient was .95. In this context, considering the hypothesis "There is no significant difference between the raters in terms of strictness/generosity", this value was calculated as ($X^2_{(34)}$ = 539.9, p<.05). In this context, it can be said that the strictness and generosity levels of the raters differed significantly and that the raters exhibited consistent and overlapping rater tendency in evaluating the 9th-grade 2018 physics curriculum.

Findings Regarding Evaluation Criteria

The fourth and last question is "How is the distribution of the measurement report for the criteria by which the 9th-grade 2018 physics curriculum is evaluated?" and the findings regarding the evaluation criteria are given in Table 4.

Table 4. Analysis Results of the Evaluation Criteria Measurement Report

Criteria	Total Score	Observation Average	Winsorized Mean	Model Measurement	SE	Compatible MnSq	Compatible ZStd	Incompatible MnSq	Incompatible ZStd
Ö2	100	2.78	2.86	.61	.26	1.06	.3	1.00	.0
Ö12	101	2.81	2.89	.54	.26	1.52	2.0	1.59	2.0
Ö7	102	2.83	2.92	.48	.26	1.27	1.1.	1.33	1.2
Ö8	103	2.86	2.96	.41	.26	.57	-2.1	.54	-2.1
Ö4	104	2.89	2.99	.34	.26	1.12	.5	1.05	.2
Ö13	104	2.89	2.99	.34	.26	.83	-.7	.79	-.8
Ö1	105	2.92	3.02	.27	.26	.74	-1.1	.71	-1.2
Ö9	110	3.06	3.18	-.07	.27	.96	.0	.95	-.1
Ö15	110	3.06	3.18	-.07	.27	.51	-2.5	.68	-1.4
Ö16	110	3.06	3.18	-.07	.27	1.21	.9	1.32	1.2
Ö14	111	3.08	3.21	-.14	.27	.76	-1.0	.73	-1.1
Ö5	114	3.17	3.31	-.36	.27	1.19	.8	1.03	.1
Ö3	115	3.19	3.34	-.44	.27	.49	-2.6	.46	-2.6
Ö11	115	3.19	3.34	-.44	.27	1.01	.1	.88	-.4
Ö10	117	3.25	3.40	-.59	.28	.82	-.7	.76	-.9
Ö6	120	3.33	3.49	-.82	.28	1.83	2.8	1.89	2.8

Model, Sample: RMSE .27 Adj (True) S.D. 34, Separation 1.26 Strata 2.01, Reliability .78, Model, Fixed (all same) Chi-square: 40.6 df.: 15 significance (probability): .00

Considering Table 4, it is noteworthy that the criteria evaluated as the weakest in the curriculum are the criterion coded "$Ö_2$" "The objectives of the curriculum are set in line with the expectations of the students", the criterion coded "$Ö_{12}$" "The techniques in the curriculum are sufficient", and the criterion coded "$Ö_7$" "The curriculum is eclectic", respectively. On the other hand, the criteria evaluated as the strongest are the criterion coded "$Ö_6$" "The topics in the content of the curriculum are spiral", the criterion coded "$Ö_{10}$" "The curriculum can be implemented with teaching models that overlap with the constructivist approach", and the criterion coded "$Ö_{11}$" "The curriculum can be implemented with teaching techniques that overlap with the constructivist approach", respectively. The standard error calculated for the evaluation criteria of the 9th-grade 2018 physics curriculum was calculated as (RMSE=.27). The winsorized standard deviation analyzed within the framework of this error value was calculated as .34. This value is indicated to be a low value, which is well below 1.0 accepted as the reference value. The reliability coefficient of the 9th-grade 2018 physics curriculum was calculated as .78. These indicate that the criteria for the evaluation of the 9th-grade 2018 physics curriculum have an acceptable level of reliability. The discrimination index of the evaluation criteria in Table 4 is also included. The value for the discrimination index was calculated as 1.26. When the hypothesis "There is no significant difference in terms of the difficulties of the criteria used in determining the quality of the 9th-grade 2018 physics curriculum of high school physics teachers" was tested with chi-square ($X_2(15) = 40.6, p<.05$), it was found that the H_o hypothesis was rejected. Considering all of these data, it can be said that the criteria used for the evaluation of the 9th-grade 2018 physics curriculum can measure the features of the curriculum.

Discussion

In this paper, the 9th-grade 2018 physics curriculum was evaluated by the physics teachers lecturing the 9th-grade physics course. In this context, the 9th-grade physics curriculum, the strictness/generosity of the raters, and the three dimensions included in the "9th-grade physics curriculum evaluation form" were determined through the multilevel Rasch analysis model. The present study was designed to evaluate the criteria set to evaluate the 9th-grade physics curriculum in terms of generosity) and strictness. The findings regarding the first sub-problem revealed that the items coded [M_2], [M_7], [M_8], and [$M1_2$] contained the strictest criteria in the context of the 9th-grade physics urriculum. It can be inferred that the physics teachers do not agree with the items including "The objectives of the curriculum are set in line with the expectations of the students", "The curriculum is eclectic", "The content of the curriculum is sufficient in terms of scope", and "The activities in the curriculum are sufficient". Since the 2005-2006 academic year, curricula in Turkey have been based on a student-centred approach, taking into account the constructivist theory. This approach is aimed at ensuring that the student learns, experiences knowledge, and takes responsibility for learning Orlich et al. (1998). Bringing different learning approaches or theories to the educational environment in line with the targeted purpose Honebein and Sink (2012) is another element expected from the curriculum. The curricula that have been implemented in Turkey since the 2005-2006 academic year are aimed at integrating and blending such approaches within the scope of the curriculum, taking into account different theoretical approaches Ministry of National Education

(2005). Activity-based learning experiences have been integral parts of the curricula in Turkey since 2005 (Ayvacı & Devecioğlu, 2006). Insufficiency in this aspect of the curriculum is emphasized by the participating teachers, which is a remarkable finding and supported by previous studies. Dicle Erdamar (2019), for example, reported that the content of the curriculum is not sufficient in terms of scope and that the content for affective and psychomotor skills is not included in the curriculum. Failure to set social and emotional goals in the curriculum prevents students from meeting their needs, interests, and expectations. The social and emotional field encompasses both the personal characteristics of the learner and includes factors such as attitude, interest, love, etc. when it comes to any phenomenon Kablan (2014), Kavcar and Erdem (2017) emphasized the importance of students' participation in activities in physics courses and the application of research-based studies that can use knowledge functionally in lessons. In this context, the physics curriculum is expected to include strategies to support meaningful learning (Hansson et al., 2021). Today's curricula tend to combine two purposes. One of the purposes is the individual cognitive development process and the other is the socialization process and how the person adapts to society and social environments Caramaschi et al. (2022). Along the same lines, Kotluk and Yayla (2016) reported that the implementation of the curriculum is not up to the mark. Eke (2018) emphasized that the outcomes of 9th-grade physics do not contain content that includes students' high-level thinking skills. In this context, it can be said that the research findings of both studies show parallelism. Bugingo et al. (2022) emphasized that the physics curriculum should be transformed from being content-centered to a skill-centered structure. Physics teaching is expected to focus on the most fundamental scientific ideas and provide students with the opportunity to explore, produce, explain, evaluate, change knowledge, and participate in scientific practice National Research Council [NRC] (2007). In this context, one of the most important elements of a curriculum of high quality is to consider active learning experiences that support cooperation among learners Stadermann et al. (2019). Bao and Koenig (2019) point out that education in the 21st century will focus on three main points and one of these focuses is the skill development among learners.

Another remarkable finding was that the raters (jurists) found the criterion coded [M_6] as generous. It can be implied that the raters agreed with the criterion of "The curriculum is eclectic" and expressed it as one of the strongest aspects of the curriculum. The physics curriculum not only improves students' relationships with real life but also contributes to learning the relationships between mathematical concepts Elby (1999). The main purpose of the spiral curriculum is that subsequent learning depends on previous learning. In this context, it is of great importance for teachers to establish a relationship between in-school and out-of-school activities by taking into account the content of the curriculum (Dillon et al., 2006). In addition, it is expected that what has been learned in this approach will be repeated in detail at different times in line with the objectives in the curriculum and along with the principle of progressivity Sönmez (2015). One of the goals of the 9th-grade physics curriculum is to include repetitive acquisitions and explanations for different subjects and grade levels with a spiral point of view (Ministry of National Education, 2018). In this respect, it was emphasized by the physics teachers that the curriculum includes a spiral structure. This finding is also supported by previous studies (Dicle Erdamar, 2019; Eke, 2018; Kavcar & Erdem, 2017). Although the 9th-grade physics curriculum has been updated on different dates, the spiral approach has been consistently and structurally preserved.

In this study, when the raters with the highest level of strict and generous scoring and exhibiting bias in this context were examined, it was determined that the rater with the code [J_{14}] exhibited strict behaviour while evaluating the 9th-grade 2018 physics curriculum and that the rater coded [J_{14}] showed a tendency to behave generously in the evaluation of the curriculum.

Conclusion

The criteria used to evaluate the 9th-grade physics curriculum showed significant differences in terms of strictness and generosity. It was also revealed that physics teachers agree with most of the criteria in the curriculum while they disapprove of some of them. Also, it was concluded that the physics teachers mentioned some deficiencies in terms of the objectives, content, educational status, and measurement and evaluation as the elements of the curriculum.

Recommendations

The participants mentioned that activities included in the curriculum are limited and the content of the curriculum is insufficient. It was also reported that the curriculum does not sufficiently draw upon different approaches and methods in classroom practices. These findings demonstrate that more research should be conducted to focus and elaborate on such deficiencies in the curriculum along with the participation of different stakeholders (teachers, students, administrators, and field experts) in the curriculum development process. In addition, studies to be carried out with mixed research methods with different samples and study groups can contribute to the detailed evaluation of the findings obtained in this research, which evaluates the 9th-grade 2018 physics curriculum.

Limitations

This research is limited to 36 high school physics teachers working in high schools in 12 different regions of Turkey and the 9th-grade physics curriculum.

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