

The Rasch model in the role of assessing the characteristics of the group of students on the physics knowledge test

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Abstract. PER must be based on effective measurement techniques. One approach to addressing the need for careful measurement is Rasch analysis which facilitates the development of a measuring. In this contribution, we will present the results of the longitudinal study of applied physics knowledge tests conducted three consecutive years during different teaching conditions in Croatia at the level of the first, second and third grades of high school with the four-year Physics program. Rasch analysis has been used in parallel with CTT, which gives an insight into the characteristics of the test (both items/questions and students who took the test).

Introduction

Measurement as questionnaires and test instruments which are most important in PER, involves the processes of description and quantification. Both need to satisfy two demanding characteristics of measurement instruments: validity and reliability [1]. It is necessary to ensure that the test material, the test administration, test sessions and methods of scoring are comparable, which enables one person could be placed relative to others. For this purpose, Rasch model is appropriate method if there are two or more groups of students' which performances on one test should be compared [2].

Research questions

During COVID-19 pandemic there was a necessity to construct research which will give objective insight into teaching and learning processes which are forced to be implemented in those special eras of education, and what are the consequences of them. Also, to design the models of teaching and learning which will be implemented in the next similar condition, in the future.

According to this, the following research question arose: What are the differences in student abilities in relation to the different teaching methods applied through the entire curriculum?

Methods and findings

Longitudinal study relies on tests of knowledge that are created 2020 based on the questions from State matura [3] in Croatia from the beginning of implementation (2009/2010) until the 2018/2019 examining year. Each test (4 in total for high school) has 20 conceptual questions specifically chosen to fit physics curriculum of each of the 4 grades during high school education. Tests were conducted online via Google forms 3 times during different teaching conditions (online conditions during 2019/2020, hybrid conditions during 2020/2021 and regular conditions during 2022/2023), at the beginning of the next school year. Testing was anonymous and voluntary, and same schools were asked to participate in the research during all three testing cycles. Students of each grade, during each of the testing cycle, got one of the prepared tests, so the results could be compared. Collected data were processed by dichotomous Rasch method, using Winsteps.

According to Winsteps, for all the tests there is Cronbach alpha 0,85 or higher, tests are unidimensional (random noise with maximum of 2 items accidentally correlated) and local

independent (correlation of residuals of the items are lower than 0,6). On the Figure 1 there are results of the logits for the items and students for 3rd grade (all 3 cycles) of the high school, as an example of the obtained results.

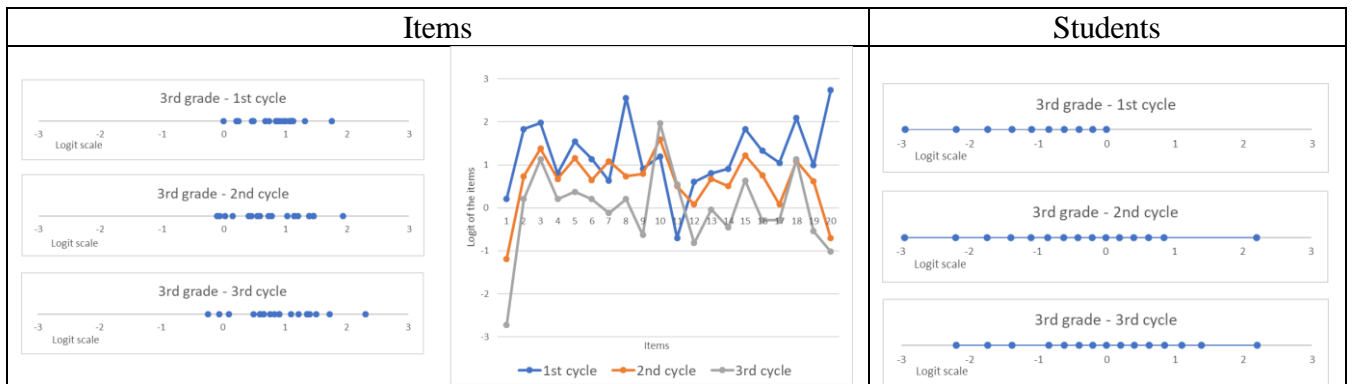


Figure 1: Logit of the items and students for the 3rd grade of high school education.

First finding was that some items (related to specific topic) have the same difficulty regardless of the testing cycle, and some items have even higher item difficulty during 1st testing cycle. Second finding was that difficulty of the items in general are lower during first testing cycle. Third finding is that ability of students is higher during 2nd and specially 3rd testing cycle (with the narrower and lower range in the 1st cycle).

Conclusion

Results show that: a) students have different abilities comparing three teaching methods that are used, b) the same lack of understanding according to specific physics topics, despite the used teaching method, c) acquired knowledge of specific topics is higher when teaching method incorporate ICT. Those results point to the proposal of teaching specific parts of curriculum using ICT. The results indicate also the possibility of improving the knowledge tests as an instrument in order to achieve better discrimination of students according to their performance parameter (ability).

References

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