ABDIMAS: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang
Vol.10(1) February 2025, 234-246
p-ISSN: 2721-138X e-ISSN: 2548-7159
http://jurnal.unmer.ac.id/index.php/jpkm

LPPM
UNMER
MALANG

Empowering teachers in item response theory analysis using R Studio in Manokwari

Achmad Rante Suparman[1], Murtihapsari[1], Purwati[2]

[1]Department of Chemistry Education, [2]Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Papua
Jl. Gunung Salju Amban, Manokwari, West Papua, 98314, Indonesia

ARTICLE INFO:

Received: 2024-11-13
Revised: 2024-12-20
Accepted: 2025-01-23
Published: 2025-02-28

Keywords:

Item response theory, R Studio, Teacher, Training

ABSTRACT

The training program on item response theory (IRT) analysis using R Studio for teachers in Manokwari aims to enhance their understanding of modern test theory and their ability to use R Studio as an analytical tool. Many teachers are unfamiliar with these concepts, so the training provides in-depth knowledge and practical applications to analyze test data and estimate student abilities. This interactive, practice-based training involved 30 teachers and included socialization, training, technology application, mentoring, and evaluation of R Studio in test item analysis. The results showed a significant improvement in teachers' knowledge and skills. Before the training, 90 percent of teachers were unfamiliar with R Studio, and 70 percent lacked understanding of IRT. After the training, 70 percent of teachers could use R Studio for student answer analysis, and 80 percent demonstrated a good grasp of modern test theory concepts. This improvement reflects the program's success in achieving its objectives and has the potential to enhance the quality of educational assessments in Manokwari. By utilizing IRT analysis more effectively, teachers can make better-informed decisions in the teaching and learning process, ultimately contributing to improved educational outcomes.

How to cite: Suparman, A. R., Murtihapsari., & Purwati. (2025). Empowering teachers in item response theory analysis using R Studio in Manokwari. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang, 10*(1), 234-246. https://doi.org/10.26905/abdimas.v10i1.14258

1. INTRODUCTION

Improving the quality of education in eastern Indonesia is a critical issue. One effort to achieve this goal is to improve the learning evaluation system. Item Response Theory (IRT), as a modern approach to test analysis, offers a more accurate and informative solution compared to classical methods. Item response theory (IRT), also known as latent response theory, refers to a set of mathematical models that attempt to explain the relationship between latent traits (unobservable characteristics or attributes) and their manifestations (i.e. observed outcomes, responses, or performance) (Baker & Kim, 2017; Hambleton, 2006). This theory establishes the relationship between the nature of the items on the instrument, the individuals who respond to the items, and the underlying traits being measured. IRT assumes that latent constructs (e.g. stress, knowledge, attitudes) and measurement items are arranged in an unobservable continuum.

✉ Corresponding Author: **Achmad Rante Suparman**: Tel. +62 986 211430 | E-mail: a.rante@unipa.ac.id

IRT allows for a deeper understanding of the characteristics of test items and students' abilities so that it can be used to improve the quality of assessment instruments and increase the effectiveness of learning. The IRT model predicts respondents' answers to instrument items based on their position on the continuum of latent traits and item characteristics, also known as parameters (Linden, 2018; Paek & Cole, 2020). The results of Mutluer and Çakan (2023) study stated that the IRT-based equating method has fewer errors than the classical theory equating method. These results are also supported by the results obtained by Lalot et al. (2025), who stated that the IRT approach would be significantly beneficial because it increases the accuracy and precision of the measurement instrument. One of the characteristics of IRT is the presence of an item response function, where this function characterizes its relationship. The underlying assumption is that each response to an item on the instrument provides some tendency about the level of latent traits or individual abilities. Person ability (θ) is simply the probability of agreeing to the item's correct answer (Herrmann-Abell & DeBoer, 2011; Paek & Cole, 2020). Thus, the higher the individual's ability, the higher the probability of giving the correct response.

West Papua is one of the provinces on the island of Papua with unique challenges in the field of education, such as still limited access to technology and resources in understanding IRT, thus requiring innovation in the field of evaluation. The use of R Studio in conducting evaluation assessments or test item analysis can be used as an alternative approach to utilizing IRT. R Studio, as a powerful, flexible and free open-source software, can be an effective tool for implementing IRT in the context of creating questions and assessing student test results (Suparman et al., 2024). R Studio is an accessible and fun tool that beginners can use for data analysis projects. It also has a workspace browser that tracks variables, functions, lists, and data frames used (Aiken, 1985; Nurcahyo, 2017).

With proper training, teachers in West Papua can utilize R Studio to analyze test result data, identify student weaknesses, and design better assessment instruments. Training is a crucial step in equipping teachers with the skills needed to implement IRT. Through this training, it is expected that teachers can understand the basic concepts of IRT and its advantages compared to classical methods, master the use of R Studio to conduct IRT analysis independently, apply IRT in the context of their questions by considering student characteristics and develop more valid and reliable assessment instruments to support the learning process.

Community service activities in the form of introducing and providing IRT training using R Studio to teachers in Manokwari, West Papua, are expected to increase the capacity of teachers to conduct better learning evaluations so that, in the end, it will have an impact on improving the quality of education in the West Papua region in general and Manokwari in particular. This community service activity is expected to provide a real contribution to improving the quality of education in Manokwari, West Papua; bridge the gap between theory and practice in the field of educational evaluation; and strengthen the network between universities and schools in the city of Manokwari.

The Chemistry Subject Teachers' Council (MGMP) is a community of chemistry teachers who routinely hold meetings to discuss any problems related to chemistry and its problems. MGMP plays an essential role in developing teacher professionalism and improving the quality of learning. One of the active MGMPs in West Papua Province is the Chemistry MGMP, which is centred in Manokwari Regency. The Manokwari Regency Chemistry MGPM is an organization that accommodates chemistry teachers at the SMA/SMK/MA levels in the Manokwari Regency area, West Papua. This group aims to improve the quality of chemistry learning in schools through various activities, such as training and development of teacher professionalism, development of curriculum and learning materials, creation of learning media, practical training, and preparation of scientific papers.

The total data of all teachers in West Papua, according to Table 1, and the number of chemistry teachers is around 43 people.

Table 1. Data on teachers in Manokwari Regency, West Papua

Region	SMA			SMK		
	Total	Male	Female	Total	Male	Female
Kec. Manokwari Barat	253	83	170	203	55	148
Kec. Prafi	49	19	30	40	24	16
Kec. Masni	24	10	14	21	9	12
Kec. Manokwari Selatan	24	3	21	0	0	0
Kec. Manokwari Timur	47	11	36	0	0	0
Kec. Sidey	13	4	9	19	14	5
Kec. Warmare	23	8	15	0	0	0
Kec. Manokwari Utara	0	0	0	0	0	0
Kec. Tanah Rubu	0	0	0	0	0	0
Total	433	138	295	283	102	181

Source: (Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi, 2023)

Based on the total number of high school and vocational high school teachers, there are 716 people, 43 of whom are chemistry teachers, or around 6 percent. The chemistry MGMP, which accommodates 6 percent of teachers in Manokwari Regency, routinely carries out training, both internally and by inviting speakers from outside the MGMP. This training is essential because research shows that teacher performance is influenced by the level of MGMP training (Maghfira et al., 2022).

The main problem felt by the MGMP community is in providing assessments that provide a sense of fairness for all students. So far, the assessment process still uses classical test theory, so it is not easy to distinguish with certainty the abilities of students who are capable and not yet capable. One thing that can be used to overcome the problems faced by the MGMP community is to conduct an assessment using the modern test theory known as Item Response Theory (IRT). IRT is a statistical model that offers several advantages over traditional methods in analyzing test data, including: (1) Measuring respondents' abilities more accurately than traditional methods, such as total test scores; (2) identifying test weaknesses, such as questions that are too easy or too difficult, and questions that do not differentiate between high and low ability respondents; (3) Can be used to develop better tests with a level of difficulty that matches the respondent's ability; (4) Allows comparison of the abilities of respondents who take different tests, even though the tests have different levels of difficulty (Crocker & Algina, 2008; Drasgow & Mattern, 2006; Linden, 2018; Paek & Cole, 2020).

IRT can be used for various types of tests, such as multiple-choice tests, essay tests, and performance tests (Potvin, 2023; Zenisky & Luecht, 2016). The use of IRT will be more accessible when technology is utilized in the form of applications. There are various software that can be used in calculating IRT, including winsteps, Bilog, Xcalibre, R studio and various other software. R studio is one of the leading choices for IRT analysis. Some of the advantages of R Studio include its free and open source, many IRT packages, flexibility, and the fact that it can be integrated with other tools (Baker & Kim, 2017; Webb, 2011).

The results of the questionnaire analysis based on the results of filling out the questionnaire conducted in March 2024 on members of the Chemistry MGMP in Manokwari obtained the results that 84 percent of teachers have never used R Studio, 93 percent of teachers have never used IRT, 62 percent of teachers find it challenging to analyze test data and 81 percent of teachers find it difficult to estimate student abilities. These results cause several problems to arise, including teachers having

difficulty determining the level of difficulty of test questions, difficulty determining the type of questions that are appropriate to student's abilities, and difficulty in providing appropriate feedback to students.

Based on the analysis of the situation and problems faced by the teacher community, the objectives of implementing this community service are: (1) Increasing teacher knowledge about Item Response Theory; (2) Increasing teacher knowledge and skills in using R Studio; (3) Assisting teachers in analyzing test data and estimating student abilities; (4) Improving the quality of learning in schools.

2. METHODS

The Community Service Implementation Method includes five main stages: socialization, training, technology application, mentoring and evaluation, and program sustainability. This activity uses R studio because it has an intuitive and easy-to-use graphical interface, provides various features that support the data analysis process, is available for free, and is open source, so anyone can use it without having to pay a license fee, flexibility and its ability to handle big data which is very important in IRT analysis.

Socialization

The socialization stage is divided into three parts of implementation, including coordination with the West Papua Provincial Education Office, Manokwari sub-district, to obtain permission and support in implementing the community service program; holding an initial meeting with the MGMP community in Manokwari, West Papua to explain the objectives, benefits, and methods of implementing community service in the form of training; disseminating information about the community service program through social media and other publications, so that the main target is not only part of the MGMP community, but also teachers or other practitioners who are interested in IRT and R studio.

Training

The stages of training implementation are divided into three parts of the implementation, including the presenter creates a training module on IRT analysis using R studio that is easy for training participants to understand; training teachers on how to use RStudio, which has previously been directed to install; both from how to enter data, copy code in R Studio and introduce reading and meaning of the output results obtained through R Studio; and provide opportunities for teachers to practice using IRT in real situations. The data used is the actual data owned by chemistry teachers obtained so far from the results of each semester's evaluation.

Application of technology

The stages of technology implementation are divided into two parts: the first is providing teachers with access to IRT online learning resources. These online learning resources are modules that have previously been created by the presenters that all training participants can access and assist teachers in developing IRT tests. The development of the test in question is to help see and read the results of IRT on R studio and provide suggestions on which tests are good and which should be improved.

Mentoring and evaluation

The stages of mentoring and evaluation are divided into two parts of implementation, including mentoring teachers in implementing IRT using R Studio assessment and evaluating program implementation by conducting tests and quizzes to measure teachers' knowledge and skills about IRT and interviews with teachers about their experiences using IRT.

Sustainability of the program

The stages of program sustainability are divided into two parts of implementation, including forming an online learning community for teachers to share experiences and knowledge about IRT and R studio and working with local governments to promote the use of IRT in schools.

In general, the method of implementing community service is in accordance with Figure 1, and the R Studio display used is in accordance with Figure 2.

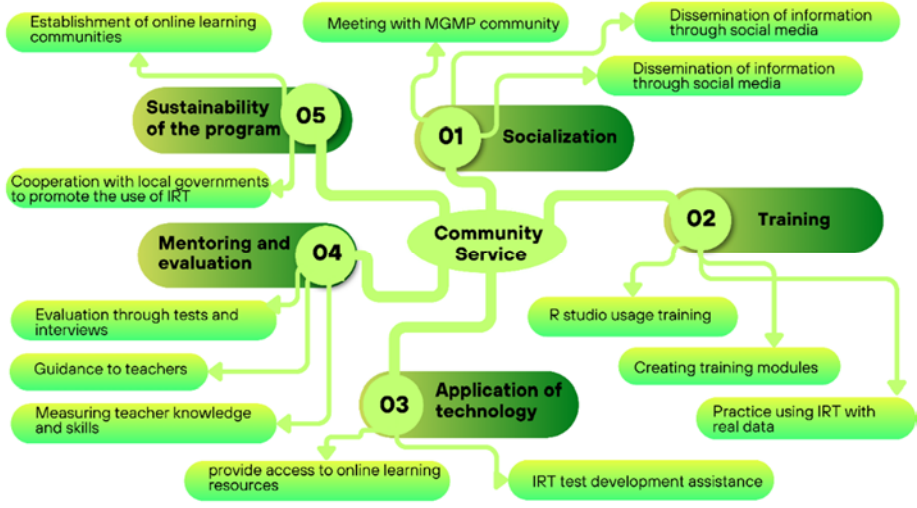


Figure 1. Framework for community service implementation methods

Figure 1 is a series of methods that present the five main stages of community service and small parts of each central part that are carried out from the beginning to the end of the activity.

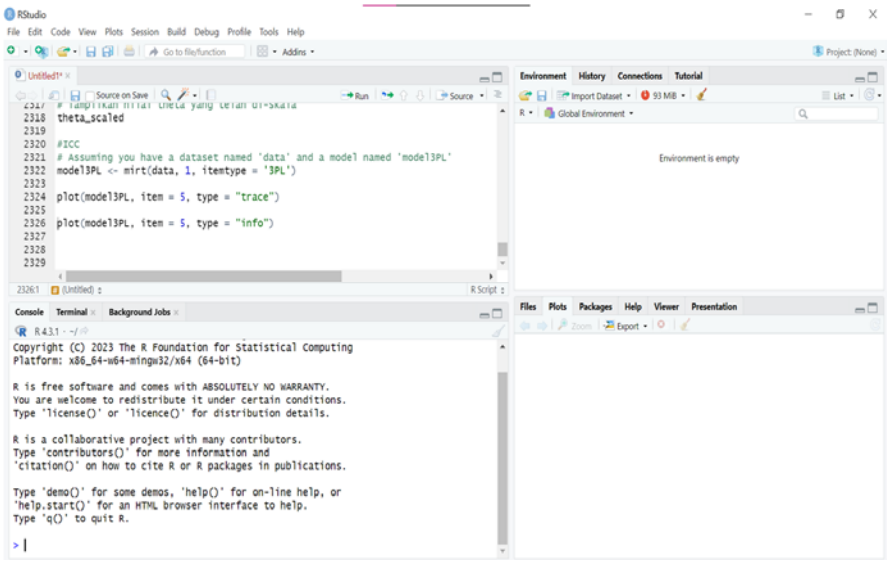


Figure 2. R Studio view

Figure 2 is the initial display of R Studio used in the community service process. This section is the main display for entering syntax, reading data, and showing the analysis results using R Studio.

3. RESULTS AND DISCUSSION

Results

This community service activity introduced the Item Response Theory (IRT), commonly known as modern test theory. In addition to introducing modern test theory, training was also carried out on assessing and determining question characteristics based on modern test theory using R Studio. The partner team consists of teachers in Manokwari, West Papua.

The first step taken by the community service team was to conduct socialization and coordination with partners about the implementation of the community service. The community service team spoke directly with partners about the series of schedules that would be implemented during the community service activity process. The socialization stage was introduced by introducing modern response theory in general with the aim of training participants to avoid being surprised by modern response theory and R Studio. In addition, this stage also agreed on the time for implementing the contemporary test theory training community service with partners. The partners welcomed the activities carried out and tried to get many teachers involved in this community service activity.

Figure 3. Socialization and coordination activities for community service implementation

Figure 3 shows the coordination carried out by the team before carrying out the community service to obtain the appropriate time so as not to disrupt the learning process at a school. The community service team consists of three lecturers with different fields of science, namely Educational Research and Evaluation, chemistry, and mathematics, and involves several students.

The next step taken by the team is to record the teachers' knowledge of modern test theory and the use of R Studio. This data collection is essential so that the training implementation process will be more focused and as input for the community service team to prepare the proper steps in the training carried out. This data collection is carried out by asking several teachers directly through short interviews and also through questionnaires distributed to teachers. This data collection was carried out for several days directly to the school or by filling out a Google form that the community service team had prepared.

Before the training, an initial assessment was conducted to evaluate teachers' knowledge and technology usage. This assessment focused on three aspects: daily laptop usage, understanding of modern response theory, and familiarity with R Studio. The results of this assessment are summarized in Table 2.

Table 2. Summary of teachers' initial knowledge and technology usage

Criteria	N	Percentage (%)
Daily Laptop Usage		
Uses laptop daily	24	80
Does not use laptop daily	6	20
Initial Understanding of Modern Response Theory		
Did not know about item response theory	21	70
Just heard about it from the questionnaire	9	30
Initial Understanding of Using R Studio		
Never used R Studio	27	90
Knows but has never used R Studio	3	10

Table 2 summarizes the initial knowledge and technology usage of teachers before participating in the training program. The data indicates that 80 percent (24 teachers) regularly use laptops in their daily activities, while 20 percent (6 teachers) do not use laptops frequently. This suggests that most teachers are accustomed to using digital tools in their work.

Regarding their initial understanding of modern response theory, the results reveal that 70 percent (21 teachers) were unfamiliar with item response theory before the training. Meanwhile, 30 percent (9 teachers) had at least heard about it through the questionnaire but lacked a deeper understanding. This highlights the need for targeted training in this area.

In terms of familiarity with R Studio, 90 percent (27 teachers) had never used the software before, while only 10 percent (3 teachers) knew about it but had never actively used it. This indicates a significant gap in experience with statistical analysis tools, emphasizing the importance of hands-on training in R Studio. Overall, Table 2 findings highlight teachers' varying technological proficiency and knowledge levels, which served as the basis for designing the training program.

The results of the initial capability analysis are used as an essential reference for the teams to prepare for the next steps. The community service team held a follow-up meeting to prepare the form of community service that will be carried out with partners. It was decided to carry out the first stage of community service activities, with the main focus being the introduction of modern test theory while providing an initial introduction to R Studio.

Figure 7. Presentation of introductory material on modern theory by the community service team
Figure 8. The atmosphere of the training process using R Studio for modern test theory

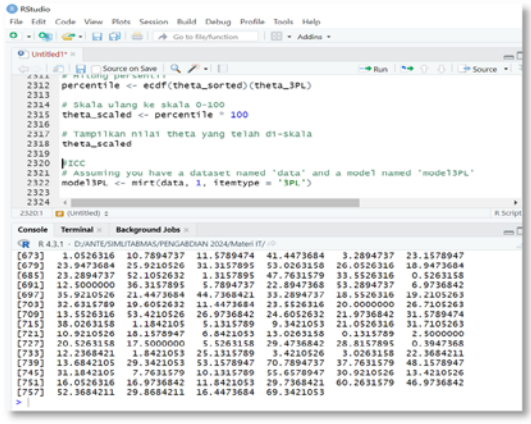
Thirty teachers attended this community service activity, and the person in charge of the community service partner officially opened the activity. The introduction and training of modern test theory were packaged in a relaxed atmosphere and really adjusted to the initial data that had been obtained during the socialization so that the training was carried out in a relaxed atmosphere so that training participants could receive the material presented. This can be seen in Figures 7 and 8.

Figures 7 and 8 show the stages of the community service program implementation. This community service introduces the main foundations of item response theory and then the basics of using R Studio. The introduction to R Studio starts with installing the program, entering data, creating syntax, and reading the analysis results.

During the implementation, several challenges were encountered. One of the main challenges was the varying levels of familiarity with statistical concepts and software among teachers. Some teachers had difficulty understanding the basics of IRT statistics, while others faced difficulties operating R Studio due to a lack of experience with programming-based tools. Exceptional guidance is given to teachers who are still struggling with simplified steps.

Another challenge related to internet connectivity affected the smoothness of online resources and software installation. To address this, offline modules and pre-installed software packages were prepared before the training began, ensuring all participants could fully engage with the material. In addition, peer collaboration was encouraged, allowing teachers with stronger technical skills to assist their colleagues. Despite these challenges, the program was successfully implemented, and teachers demonstrated significant improvements in their understanding and ability to use R Studio for test analysis.

The products obtained from the results of this community service are teachers' abilities in understanding item response theory and using R Studio. Teacher abilities can be seen from the results of the teacher's analysis of getting scores in the form of theta and Item Probability Functions using R Studio. Theta and Item Probability Functions obtained by teachers using R Studio can be seen from the screenshots of the training participants shown in Figures 9 and 10.



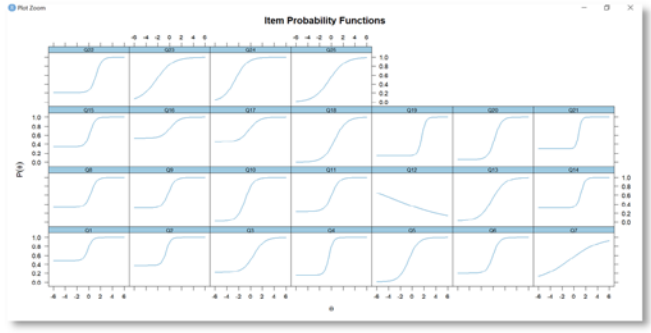


Figure 9. Theta results obtained by training participants using R Studio
Figure 10. Item Probability Functions Results obtained by training participants using R Studio

Figure 9 shows teacher performance results in getting theta scores, which will then be used as a reference for teachers to assess their students' abilities. Figure 10 shows the teacher's abilities and the

Item Probability Functions. Item Probability Functions describe the relationship between test participants' skills and their probability of answering an item correctly. This function is used to understand how a question's characteristics affect test participants' responses. In addition, the results of Figure 10 can be used as a reference to see good and bad questions. The results of this community service activity were measured by the results of the questionnaire filled out by the teacher after the community service activity was completed. The results of this questionnaire are presented in Table 3.

Table 3. Summary of teachers' knowledge and use of technology after training

Criteria(s)	N	Percentage (%)
Ability to use R Studio		
Able to use R studio after training	21	70
Not able to use R Studio after training	9	30
Application of Modern Test Theory		
Able to apply modern test theory after training	18	60
Not yet able to apply modern test theory	12	40
Daily use of modern test theory and R Studio		
Will apply modern test theory and R Studio in daily work	27	90
Will not apply modern test theory and R Studio in daily work	3	10
Efficiency of test creation and analysis		
Stated that test creation and analysis became more efficient	21	70
Hesitant about efficiency improvement	9	30
Preparation for assessing using modern test theory		
Will prepare themselves for the assessment using modern test theory	24	80
Not yet ready for the evaluation using modern test theory	6	20
Benefits of training in improving test data management skills		
Stated that the training was beneficial	30	100
Did not find significant benefits from the training	0	0

Table 3 summarizes the knowledge and application of modern test theory and R Studio among teachers after completing the training. The results indicate that 70 percent (21 teachers) could use R Studio, significantly improving their initial knowledge. Regarding modern test theory, 60 percent (18 teachers) successfully applied the concepts learned, while the remaining 40 percent required further practice. Furthermore, 90 percent (27 teachers) expressed their intention to integrate modern test theory and R Studio into their daily teaching activities, demonstrating the practical relevance of the training. Regarding efficiency, 70 percent (21 teachers) found that test creation and analysis became more efficient using the new methods, though 30 percent remained uncertain. When asked about their readiness to assess using modern test theory, 80 percent (24 teachers) confirmed their preparedness, showing confidence in implementing the new knowledge. Lastly, all the participants (100 percent) stated that the training improved test data management skills, indicating a generally positive reception of the program.

Discussion

The results of this community service show that the main objective of this service has been achieved, where there is an increase in understanding and interest of teachers in Manokwari towards Item Response Theory (IRT) and the use of R Studio. Some of the benefits for community service partners include teachers who take part in this training now have better skills in analyzing exam data in a modern way and are able to distinguish between good and bad questions so that they can improve the quality of assessment in their schools. Before the training, most teachers were unfamiliar with IRT and R Studio concepts. However, after taking part in the training, there was a significant increase in their understanding of both. This can be seen from the results of the post-training questionnaire, which showed that most teachers felt more confident in using R Studio and applying the IRT concept in assessment practices.

One factor contributing to the success of this training was the training design, which was tailored to the needs and initial knowledge level of the participants. The training materials were delivered in easy-to-understand language and combined with concrete examples. In addition, the use of R Studio as a data analysis tool also provided participants with direct experience in applying the IRT concept.

The results of this community service also showed that teachers were highly motivated to apply IRT in their assessment practices. Most participants stated that they would use IRT to develop better assessment instruments and obtain more accurate information about student abilities. This shows that this training has succeeded in raising awareness of the importance of using quality assessment instruments.

This activity contributes to advancing science and technology (IPTEK) and innovation for society. Using R Studio as a data analysis tool in schools in Manokwari is an innovation that increases the efficiency and accuracy of educational assessment. Teachers can develop more reliable and objective evaluation tools by integrating modern statistical analysis methods into daily practice, leading to improved educational decision-making. Although the training has increased teachers' understanding and interest in IRT, several challenges must be considered. Some participants still need help understanding more complex statistical concepts. In addition, the limited training time may limit the depth of participants' understanding. To overcome these challenges, the following steps can be taken: ongoing training by holding regular follow-up training to strengthen participants' knowledge and overcome difficulties faced by teachers; development of training materials by developing more interactive and problem-based training materials to increase teacher involvement; need technical support in the form of providing ongoing technical support to participants after the training to help them overcome problems that arise when implementing IRT in practice; and closer collaboration with schools to integrate IRT into the curriculum and daily assessment practices. The results of this community service have significant implications for improving the quality of education in Manokwari. Through IRT, teachers can develop more valid and reliable assessment instruments to provide more accurate feedback to students and parents. In addition, the use of IRT can also help teachers make more appropriate instructional decisions based on data.

In addition to the challenges mentioned above, the implementation of IRT in the field faces several other obstacles. One of them is limited resources, both human and technology. Not all schools have the same access to statistical software such as R Studio, nor do they have teachers who are sufficiently competent to develop IRT-based assessment instruments. Therefore, efforts are needed to provide further training and more intensive technical support for teachers in remote areas.

To ensure the long-term success of IRT implementation, active involvement from various stakeholders is needed. In addition to teachers, principals, and school supervisors, the role of the

education office, universities, and the community is also vital. The education office can issue policies that support the use of IRT in educational assessment, while universities can act as centers for human resource development and research in the field of educational measurement.

The results of this study have important implications for the formulation of education policies at the regional and national levels. Policies that support the development of teacher capacity in educational measurement and the provision of adequate technological infrastructure need to be a priority. In addition, periodic evaluations of the effectiveness of IRT implementation and appropriate policy adjustments need to be carried out.

The acceptance and implementation of IRT in Manokwari must be connected to the influence of local culture. The strong culture of cooperation and collectivism in West Papuan society can be a driving force in the implementation of IRT. Teachers tend to be more open to collaborating and sharing knowledge with their colleagues (Christianti et al., 2022; Cooper et al., 2017; Gultom et al., 2020). However, this culture can also be an obstacle if there is resistance to change. Some teachers may feel more comfortable with traditional assessment methods that they have known for a long time (Çelen, 2019; Geelan, 2020; Morales López & Tuzón Marco, 2020; Pokorný, 2023). Therefore, it is essential to involve leaders in the process of socializing and implementing IRT in order to gain broader support.

4. CONCLUSION AND RECOMMENDATIONS

This community service program aims to improve teachers' knowledge of Item Response Theory, improve teachers' knowledge and skills in using R Studio, assist teachers in analyzing test data and estimating students' abilities, and improve the quality of learning in schools. This community service program has succeeded in achieving its stated objectives. This training has improved teachers' knowledge and skills in understanding modern test theory and using R Studio as an analysis tool. The evaluation results showed that after the training, there was a significant increase in teachers' abilities, where 70 percent of them could use R Studio, and 80 percent showed a good understanding of the basic concepts of modern test theory. The success of this program demonstrates the importance of ongoing training to ensure continuous improvement in the quality of education and positively impact the quality of assessment and learning in schools in Manokwari.

It is recommended that more in-depth advanced training on data analysis using R Studio be conducted and online modules that teachers can access independently to deepen their understanding of modern response theory and data analysis using R Studio be provided. This training can cover advanced topics such as assessment analysis for essay questions. Closer collaboration between universities and schools in Manokwari is needed to support implementing modern test theory in educational practice. It is also recommended that the provincial and district/city education offices support schools and teachers in implementing assessments using modern test theory.

ACKNOWLEDGEMENTS

Thank you to the Directorate of Research, Technology, and Community Service or *Direktorat Riset, Teknologi, dan Pengabdian Kepada Masyarakat* (DRTPM) of the Ministry of Education, Culture, Research and Technology for the community service grant for the community-based empowerment scheme within the scope of Community Partnership Empowerment or *Pemberdayaan Kemitraan Masyarakat* (PKM) for the 2024 budget year.

REFERENCES

Aiken, L. R. (1985). Three coefficients for analyzing the reliability and validity of ratings. *Educational and psychological measurement*, *45*(1), 131-142. https://doi.org/10.1177/0013164485451012

Baker, F. B., & Kim, S. H. (2017). *The basics of item response theory using R*. Springer International Publishing. https://doi.org/10.1007/978-3-319-54205-8

Çelen, B. (2019). Motivations for teaching English: A review of journal articles on L2 teacher motivation. In G. Y. Ekşi, L. Guerra, D. Werbińska, & Y. Bayyurt (Eds.), *Research trends in English language teacher education and English language teaching* (pp. 241–258). University of Évora.

Christianti, M., Retnowati, T. H., Wening, S., Hasan, A., & Ratnawati, H. (2022). Early literacy assessment among kindergarten teachers in Indonesia: A phenomenological study. *European Journal of Educational Research, 11*(4), 2401–2411. https://doi.org/10.12973/eu-jer.11.4.2401

Cooper, A., Klinger, D. A., & McAdie, P. (2017). What do teachers need? An exploration of evidence-informed practice for classroom assessment in Ontario. *Educational Research, 59*(2), 190–208. https://doi.org/10.1080/00131881.2017.1310392

Crocker, L., & Algina, J. (2008). *Introduction to classical and modern test theory*. Cengage Learning.

Drasgow, F., & Mattern, K. (2006). New tests and new items: Opportunities and issues. In D. Bartram & R. K. Hambleton (Eds.), *Computer-Based Testing and the Internet* (pp. 59–76). John Wiley & Sons Ltd.

Geelan, D. (2020). Physical science teacher skills in a conceptual explanation. *Education Sciences, 10*(1). https://doi.org/10.3390/educsci10010023

Gultom, S., Hutauruk, A. F., & Ginting, A. M. (2020). Teaching skills of teacher in increasing student learning interest. *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences*, *3*(3), 1564-1569. https://doi.org/10.33258/birci.v3i3.1086

Hambleton, R. K. (2006). Psychometric models, test designs and item types for the next generation of educational and psychological tests. In D. Bartram & R. K. Hambleton (Eds.), *Computer-Based Testing and the Internet* (pp. 77–90). John Wiley & Sons Ltd.

Herrmann-Abell, C. F., & DeBoer, G. E. (2011). Using distractor-driven standards-based multiple-choice assessments and Rasch modeling to investigate hierarchies of chemistry misconceptions and detect structural problems with individual items. *Chemistry Education Research and Practice, 12*(2), 184–192. https://doi.org/10.1039/c1rp90023d

Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. (2023). *Data guru nasional - Dapodikdasmen*. Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. Retrieved from: https://dapo.kemdikbud.go.id/guru

Lalot, F., Räikkönen, J., & Ahvenharju, S. (2025). An item response theory approach to measurement in environmental psychology: A practical example with environmental risk perception. *Journal of Environmental Psychology*, *101*, 102520. https://doi.org/10.1016/j.jenvp.2025.102520

Linden, W. J. van der. (2018). *Handbook of item response theory volume three applications* (J. Gill, W. J. van der Linden, S. Heeringa, & T. Snijders, Eds.). CRC Press.

Maghfira, I., Mustar, S., Ifnaldi, I., & Faishol, R. (2022). Pelatihan Musyawarah Guru Mata Pelajaran (MGMP) dan insentif terhadap kinerja guru. *Ar-Risalah Media Keislaman Pendidikan dan Hukum Islam*, *20*(1), 18-50. https://doi.org/10.69552/ar-risalah.v20i1.1327

Morales López, A. I., & Tuzón Marco, P. (2022). Misconceptions, knowledge, and attitudes towards the phenomenon of radioactivity. *Science & Education*, *31*(2), 405-426. https://doi.org/10.1007/s11191-021-00251-w

Mutluer, C., & Çakan, M. (2023). Comparison of test equating methods based on classical test theory and item response theory. *Journal of Uludag University Faculty of Education, 36*(3), 866–906. https://doi.org/10.19171/uefad.1325587

Nurcahyo, F. A. (2017). Aplikasi IRT dalam analisis aitem tes kognitif. *Buletin Psikologi*, *24*(2), 64-75. https://doi.org/10.22146/buletinpsikologi.25218

Paek, I., & Cole, K. (2020). *Using R for item response theory model applications* (First). Routledge.

Pokorný, M. (2023). Experience with online learning of mathematics in primary education. *International Journal of Emerging Technologies in Learning (IJET), 18*(02), 203–213. https://doi.org/10.3991/ijet.v18i02.35401

Potvin, P. (2023). Response of science learners to contradicting information: A review of research. *Studies in Science Education, 59*(1), 67–108. https://doi.org/10.1080/03057267.2021.2004006

Suparman, A. R., Rohaeti, E., & Wening, S. (2024). Development of computer-based chemical five-tier diagnostic test instruments: A generalized partial credit model. *Journal on Efficiency and Responsibility in Education and Science*, *17*(1), 92-106. https://doi.org/10.7160/eriesj.2024.170108

Webb, N. L. (2011). Identifying content for student achievement tests. In S. M. Downing & T. M. Haladyna (Eds.), *Handbook of test development* (pp. 155–180). Lawrence Erlbaum Associates.

Zenisky, A. L., & Luecht, R. M. (2016). The future of computer-based testing: Some new paradigms. In C. S. Wells & M. F. Bond (Eds.), *Educational measurement from foundations to future* (pp. 221–238). The Guilford Press.