Development and validation of a table tennis serve skill assessment instrument for junior high school students: A psychometric approach

Muhammad Aliffajaruddin Alfani[1*A,B,D,F], Mashuri Eko Winarno[1,E,F], Siti Nurrochmah[1,C,E,F]

[1] Sport Education, Faculty of Sport Science, Universitas Negeri Malang, Indonesia, Jl. Semarang No 5, Malang City, East Jawa Province, 65145, Indonesia

***Corresponding author:** Muhammad Aliffajaruddin Alfani; Jl. Semarang No 5, Malang City, East Jawa Province, 65145, Indonesia; email: aliffajar1403@gmail.com

Received: 2025-03-10
Accepted: 2025-04-30
Published: 2025-05-19

A – Research concept and design
B – Collection and/or assembly of data
C – Data analysis and interpretation
D – Writing the article
E – Critical revision of the article
F – Final approval of article

ABSTRACT

Background: The highest assessment weight in physical education lessons lies in psychomotor skills. In order to find out how far the competencies possessed by students, a clear and comprehensive assessment tool or instrument is needed.

Objectives: The research aims to develop a test instrument for forehand and backhand service skills in table tennis small ball games.

Methods: The development of this instrument uses a research and development scheme, with predetermined steps (1) determining objectives, (2) analyzing literature, (3) developing specifications, (4) administering, (5) conducting tests, (6) analyzing data validity, reliability, and objectivity. The cluster sampling procedure was conducted on students aged 13-15 who met the inclusion criteria, involving junior high school students (n=80), consisting of 41 female students and 39 male students. Data were analyzed using IBM SPSS Statistics version 11.0. The basis for decision-making is the Pearson correlation test. The analysis technique in the reliability test uses a test and retest external estimation approach.

Results: The forehand serve variable has a calculated r-value of 0.456> r-table 0.312, and the backhand serve variable obtained a calculated R-value of 0.352> r-table 0.312, so the table tennis skill instrument on that variable was declared valid. At the same time, the reliability test shows a value above 0.70; the instrument that has been prepared can be declared reliable.

Conclusions: The assessment instrument for forehand and backhand serve skills in table tennis games for junior high school students has met the validity and reliability criteria. This shows that the instrument is suitable for teachers as an objective and consistent measuring tool in evaluating basic table tennis skills in students. Recommendations for future studies are encouraged to expand the sample size and integrate digital features to enhance the scalability and objectivity of the assessment.

Keywords: reliability, table tennis, validity.

How to cite this article: Alfani, M. A., Winarno, E. M., & Nurrochmah, S. (2025). Development and validation of a table tennis serve skill assessment instrument for junior high school students: A psychometric approach. *Physical Education and Sports: Studies and Research*, *4*(2), 95-102. https://doi.org/10.56003/pessr.v4i1.525

INTRODUCTION

Physical education (PE) helps students develop motor, cognitive, and social skills. One of the materials taught is the game of table tennis. This game not only trains technical skills but also trains concentration, improves the development of eye-hand coordination, and balance functions (González-Devesa, Sanchez-Lastra, Pintos-Barreiro, & Ayán-Pérez, 2024; Novikova & Burlaka, 2023). In learning table tennis, the development of students' skills needs to be evaluated. Ideally, every PE teacher needs to design instruments based on the psychomotor, cognitive, and affective skills being assessed. Moreover, it is important to understand the development and use of valid and reliable assessment instruments (Sailer et al., 2021).

Unfortunately, observations in the field show various problems in applying evaluation in physical education learning, especially in table tennis material. Many teachers still use conventional assessment methods that are subjective because they do not have clear standards for assessing students' skills, such as observation without using rubrics or structured assessment indicators. In addition, the lack of understanding of the validity and reliability of assessment instruments causes inconsistent evaluation results and inaccurate assessments that hinder the objective mapping of students' abilities. Matthew (2024) states that a valid instrument can provide an accurate picture of learner achievement and help teachers provide comprehensive feedback to improve learning and optimal learner skill development.

There has been much research on the evaluation and development of assessment instruments in table tennis games (Faber, Koopmann, Büsch, & Schorer, 2021; Utama, Tomoliyus, Sridadi, Widodo, & Ariani, 2023). However, of the few studies found, no validated and reliable assessment instrument has been developed explicitly for evaluating junior high school students' forehand and backhand serve skills in educational settings. Most existing studies focus on athletic performance. Meanwhile, assessment instruments in education are indispensable for teachers in identifying whether students have realized the lesson objectives (Oppi & Eisenschmidt, 2022; Van Geel, Keuning, & Safar, 2022). Polenghi (2024) states that the results of assessment instruments provide insight into the effectiveness of teaching methods and curriculum design. Therefore, this study fills a significant research gap by providing a psychometrically tested instrument tailored for school-based physical education.

Based on the information obtained and answering the previously described gaps, this research aims to develop a table tennis game skill assessment instrument by limiting the focus to junior high school students. The instrument developed will adjust the dominant movements of students as well as the selection of specific assessment criteria, with implementation procedures and language that is easy to understand and clear. In addition, this research will place special emphasis on the validity and reliability of the instrument. This research aims to provide reliable references and tools for teachers to evaluate and provide comprehensive assessments related to physical education.

METHODS

Study Design and Participants

The research stages were adopted from Miller, Linn, & Gronlund (2009) to facilitate understanding and prove the validity and reliability of the test instrument to be developed. The research flowchart can be seen in Figure 1.

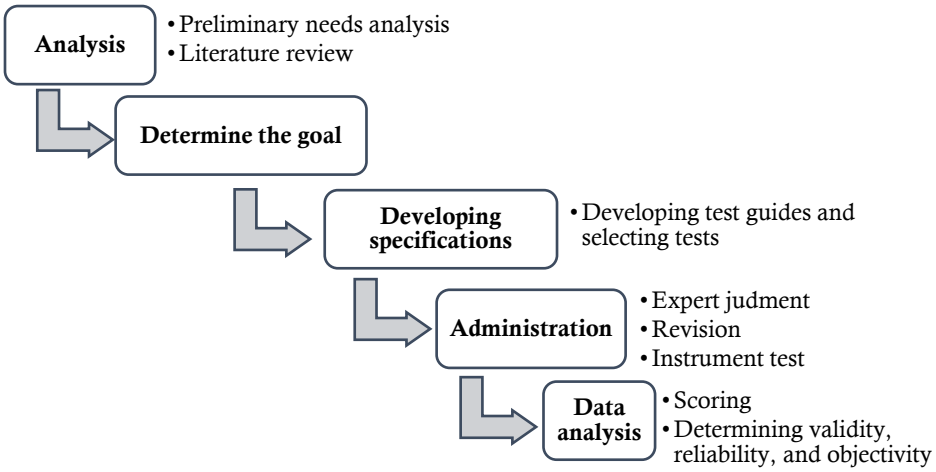

Figure 1. Research Flowchart

The initial step of the researcher is conducting an initial needs analysis by conducting observations and distributing questionnaires to four physical education teachers at the junior high level in Malang City and Regency, based on the information obtained and strengthened by searching for previous research. The second stage for researchers is to determine the purpose of preparing the instrument: to develop a table tennis forehand and backhand skill assessment instrument in the form of process and product assessments. The third stage is developing specifications by designing and compiling grids, indicators, and test instrument items. In the fourth stage, the results of the design and arrangement of the test instruments were consulted with expert judgment. In order to obtain content validity, two experts in the field of learning evaluation were involved. Input from experts was considered to assemble the instrument items, and the instrument trial was continued.

The last stage of the data obtained is used to construct empirical validity by correlating the criterion score with the test score through the product-moment correlation coefficient. At the same time, it is necessary to prove reliability using a test-retest external estimation approach. Objectivity is proven by correlating the results of the two observers. The correlation coefficient value of proving reliability and objectivity will be compared with the Kirkendall effect reference (Kirkendall, Gruber, & Johnson, 1960). The subjects in this study were phase D students with a total of 80 students, consisting of 40 Surya Buana Junior High School students, 20 Nurul Huda Islamic Junior High School students, and 20 Nurul Huda MTS students. The cluster sampling procedure was conducted on students aged 13-15 who met the inclusion criteria. The inclusion criteria were based on a consent form signed by the students; if the students did not sign the form, they would be excluded. At the same time, the types of data used are quantitative and qualitative, qualitative data obtained from expert input and needs analysis, and quantitative data obtained from proving validity, reliability, and objectivity.

Ethical approval statement

The study received approval from the ethical committee at the Universitas Negeri Malang with the assigned approval number 27.07.6/UN32.14.2.8/LT/2024

Research Instruments

The instruments used in data collection in this research and development are observation, interviews, questionnaires, non-test instruments, and test instruments.

The type of observation carried out by researchers is non-participant observation, where researchers do not participate in the activities observed; furthermore, unstructured interviews are conducted. Non-test instruments in the form of questionnaires were addressed to physical education teachers in junior high schools. Moreover, the test instrument is the result of the design made by the researcher.

Data Analysis

Data were analyzed using IBM SPSS Statistics version 11.0. The basis for decision making is that if the Pearson correlation test value (r count)> r table, it is declared to be related; otherwise, if the Pearson correlation test (r count) < r table, it is declared not related. The analysis technique in the reliability test uses a test and retest external estimation approach with value categories of 0.00-0.59 (Unacceptable), 0.60-0.79 (Average), 0.80-0.89 (High), 0.90-1.00 (Excellent). The value category of the technique analysis technique on the objectivity test is as follows: 0.00-0.69 (Unacceptable), 0.70-0.84 (Average), 0.85-0.94 (High), 0.95-1.00 (Excellent).

RESULTS

The results of content validity are obtained through an expert assessment process, carried out using the FGD (forum group discussion) method, with an average value of 81.3% (valid / can be used without revision) based on the results of the FGD three indicators are used to assess the ability of table tennis serve motion of junior high school students. Discussion points include content suitability, accountability, and transparency. The results can be seen in Figure 2.

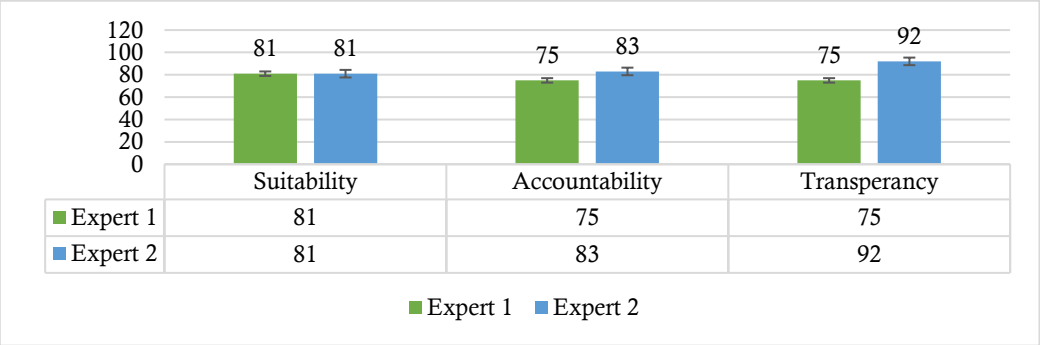

Figure 2. Results of Expert Assessment

Based on Figure 2, the following FGD results were analyzed for each component: 1) Appropriateness, with an eligibility score of 81% (valid); 2) Accountability, with a score of 79% (valid); 3) Transparency, with an eligibility score of 81% (valid).

Table 1. Instrument Reliability Test Result Data

No	Instrument	N	∑x	∑y	r	Desc
1	Forehand Serve	40	280	290	0,78	Reliable
2	Backhand Serve	40	259	250	0,79	Reliable

Based on Table 1, the instrument's reliability level using the retest method has been shown. The first experiment (x) and the second experiment (y) were conducted on 40 students limited to the junior high school level in Malang Raya, with an age range of 13-15 years, and the results show numbers above the threshold of 0.70 so that the instrument that has been developed can be declared reliable.

Table 2. Instrument Validity Test Result Data

No	Instrument	(N) df	Sig	r-table	R-count	Desc
1	Forehand Serve	38	0,05	0,312	0,456	Valid
2	Backhand Serve	38	0,05	0,312	0,352	Valid

Based on the results of proving empirical validity, Table 2. Using the Pearson Product-Moment correlation approach with a significance level of 0.05, the forehand serve variable has a calculated R-value of 0.456> r-table 0.312, so the table tennis skill instrument on that variable is declared valid. The backhand serve variable obtained a calculated R-value of 0.352> r-table 0.312, so the table tennis skill instrument on that variable was declared valid.

DISCUSSION

Teachers are indifferent to assessment and consider it to have no more importance than administration. This is exacerbated by a large workload that makes it difficult for teachers to compile and test assessment instruments in depth. As a result, most teachers still use conventional assessments without using instruments that have been tested for validity (Andarage, Fernando, Lokuarachchi, Athuluwage, & Wijewickrama, 2023). Moreover, the large number of class groups is a challenge for teachers in assessing and evaluating. Therefore, the instrument developed is here to answer these problems. This instrument can be implemented by PE teachers when carrying out formative assessments, or teachers can easily observe and assess. At the same time, students practice basic table tennis techniques. The minimum number of indicators and simple language selection will also help him make observations and assessments. Whereas the purpose of the instrument is as a tool in measuring student learning achievement, it is also important to help educators examine the extent to which students can achieve curriculum goals (Pratama & Dewi, 2023). Not only understanding the material taught, but also developing the expected competencies and skills.

The study of the development of process and outcome skill assessment instruments in table tennis learning forehand and backhand service material is expected to provide exceptional convenience for educators in physical education subjects. An instrument tested for validity will be able to measure what should be measured, while a reliable instrument guarantees a consistency of measurement results in various conditions. Moreover, the results of measurement and evaluation become the basis for making decisions about teaching strategies and methods and provide helpful feedback for students' academic progress (Faiz, Putra, & Nugraha, 2022; Walters, Maclaughlin, & Deakin, 2023). Thus, using instruments that meet both criteria will improve the quality of assessment.

The correlation coefficient shows a minimum threshold based on the results of proving the empirical validity of the forehand and backhand tests. This is related to the ability of students to respond to external stimuli, where the feeder throws the ball and students are required to respond to the stimulus quickly and accurately. The stimulus in question is the ball's speed, the bounce's height, and the ball's rotation. Research from Kurniawan & Rangkuti (2020) revealed that having good hand-eye coordination also leads to reasonable accuracy in table tennis games. Alternatively, the inverse paradigm of children with poor eye-hand coordination can be seen in their ability to perform stroke techniques in table tennis (Suryati, Triansyah, Hidasari, & Haetami, 2020).

The selection of topics is based on several benefits that will be useful for students' future development. This means that the essence of table tennis lessons is not merely about the sport itself, but holistic development, such as physical, mental, social, and emotional skills (He, 2024). An investigation showed that regular table tennis can help cardiovascular fitness (Zaferanieh et al., 2021). Other findings reveal table tennis as a fun and accessible activity to help improve children's health and limit sedentary behavior (Pradas, Ara, Toro, & Courel-Ibáñez, 2021).

Limitations of the study

This study has several limitations that need to be considered. First, the sample used was limited to junior high school students in the Greater Malang area with an age range of 13-15 years, so generalization of the results to a broader population, such as other age levels or different regions, needs to be done carefully. Second, although the validity and reliability of the instrument have been empirically proven, the testing was still conducted in a conventional learning environment without the support of digital technology. This limits the utilization of the instrument in the growing digital-based learning context. Third, students' affective and cognitive aspects have not been the focus of this instrument development, even though they are also important components in the overall assessment of physical education. Therefore, further research is recommended to expand the sample coverage, integrate digital features in the assessment, and develop instruments that include affective and cognitive dimensions to obtain a more comprehensive picture of student abilities.

CONCLUSIONS

Based on the test results and research findings, it can be concluded that the assessment instrument for forehand and backhand serve skills in table tennis games for junior high school students has met the validity and reliability criteria. This shows that the instrument is suitable for teachers as an objective and consistent measuring tool in evaluating basic table tennis skills in students. Further research with a larger number of subjects and optimization of digitization-based features needs to be carried out to provide a more representative picture of the diversity of student abilities, facilitate the administration process, and improve the efficiency of the assessment.

ACKNOWLEDGMENTS

The research team would like to thank the Universitas Negeri Malang and Active Movement Indonesia for providing funding so that this research can be completed.

DATA AVAILABILITY

All data supporting the findings of this study are included in the article and its supplementary materials. Additional datasets are available from the corresponding author upon a reasonable request.

FUNDING

This research was funded by the State University of Malang.

CONFLICT OF INTEREST

The author hereby declares that this research is free from conflicts of interest with any party.

REFERENCES

Andarage, I. S. N., Fernando, D., Lokuarachchi, B. A., Athuluwage, M. G., & Wijewickrama, P. (2023). Early Childhood Action Monitoring and Analytics System (ECAMS). *2023 IEEE 28th Pacific Rim International Symposium on Dependable Computing (PRDC)*, 346–351. IEEE. https://doi.org/10.1109/PRDC59308.2023.00056

Faber, I. R., Koopmann, T., Büsch, D., & Schorer, J. (2021). Developing a Tool to Assess Approach Combining Professional and Scientific Literature and Coaches' Perspectives Technical Skills in Talented Youth Table Tennis Players—a Multi-Method. *Sports Medicine - Open*, *7*(1), 42. https://doi.org/10.1186/s40798-021-00327-5

Faiz, A., Putra, nugraha permana, & Nugraha, F. (2022). Memahami Makna Tes, Pengukuran (Measurement), Penilaian (Assessment), dan Evaluasi (Evaluation) dalam Pendidikan. *Jurnal Education and Development*, *10*(03). https://doi.org/10.37081/ed.v10i3.3861

González-Devesa, D., Sanchez-Lastra, M. A., Pintos-Barreiro, M., & Ayán-Pérez, C. (2024). Benefits of Table Tennis for Children and Adolescents: A Narrative Review. *Children*, *11*(8), 963. https://doi.org/10.3390/children11080963

He, S. (2024). The Application of Deep Learning-Based Technique Detection Model in Table Tennis Teaching and Learning. *Systems and Soft Computing*, *6*, 200116. https://doi.org/10.1016/j.sasc.2024.200116

Kirkendall, don r, Gruber, joseph j, & Jhonson, robert e. (1960). *Measurement and Evaluation for Physical Educators*. United States of America: Brown Company Publishers.

Kurniawan, R., & Rangkuti, Y. A. (2020). Hubungan Koordinasi Mata-Tangan dengan Ketepatan Pukulan Forehand Tenis Meja Mahasiswa PKO FIK UNIMED. *Journal Physical Health Recreation*, *01*(01). https://doi.org/10.55081/jphr.v1i1.247

Matthew, I. A. (2024). Teacher Performance Appraisal in Educational System: Issues and Way Out. *Education, Language and Sociology Research*, *5*(4), p9. https://doi.org/10.22158/elsr.v5n4p9

Miller, M. D., Linn, R. L., & Gronlund, N. E. (2009). *Measurement and Assessment in Teaching* (10th ed.). United States of America: Person Education.

Novikova, I. V., & Burlaka, I. V. (2023). Table Tennis as a Means of Physical Education of Students in Secondary Schools. *Scientific Journal of National Pedagogical Dragomanov University. Series 15. Scientific and Pedagogical Problems of Physical Culture (Physical Culture and Sports)*, (3(161)), 128–130. https://doi.org/10.31392/NPU-nc.series15.2023.03(161).29

Oppi, P., & Eisenschmidt, E. (2022). Developing a Professional Learning Community Through Teacher Leadership: A Case in One Estonian School. *Teaching and Teacher Education: Leadership and Professional Development*, *1*, 100011. https://doi.org/10.1016/j.tatelp.2022.100011

Polenghi, S. (2024). Histories of Educational Technologies. Introducing the Cultural and Social Dimensions of Pedagogical Objects. *Paedagogica Historica*, *60*(1), 1–

17. https://doi.org/10.1080/00309230.2023.2298337

Pradas, F., Ara, I., Toro, V., & Courel-Ibáñez, J. (2021). Benefits of Regular Table Tennis Practice in Body Composition and Physical Fitness Compared to Physically Active Children Aged 10–11 Years. *International Journal of Environmental Research and Public Health*, *18*(6), 2854. https://doi.org/10.3390/ijerph18062854

Pratama, Y. A., & Dewi, L. (2023). *Pengembangan Kokurikuler: Menumbuhkan Potensi, Meraih Merdeka Belajar* (01 ed.). Bandung: Indonesia Emas Group.

Sailer, M., Stadler, M., Schultz-Pernice, F., Franke, U., Schöffmann, C., Paniotova, V., Husagic, L., & Fischer, F. (2021). Technology-Related Teaching Skills and Attitudes: Validation of a Scenario-Based Self-Assessment Instrument for Teachers. *Computers in Human Behavior*, *115*, 106625. https://doi.org/10.1016/j.chb.2020.106625

Suryati, Triansyah, A., Hidasari, fitriana puspa, & Haetami, M. (2020). Hubungan Kemampuan Koordinasi Mata-Tangan dan Kelincahan Terhadap Kemampuan Pukulan Backhand Tenis Meja. *Jurnal Pendidikan Dan Pembelajaran*, *09*(11). https://doi.org/10.26418/jppk.v9i11.43389

Utama, B., Tomoliyus, T., Sridadi, S., Widodo, H., & Ariani, N. (2023). Validity and Reliability of Table Tennis Performance Measuring Eye-Hand Coordination. *International Journal of Human Movement and Sports Sciences*, *11*(1), 176–183. https://doi.org/10.13189/saj.2023.110121

Van Geel, M., Keuning, T., & Safar, I. (2022). How Teachers Develop Skills for Implementing Differentiated Instruction: Helpful and Hindering Factors. *Teaching and Teacher Education: Leadership and Professional Development*, *1*, 100007. https://doi.org/10.1016/j.tatelp.2022.100007

Walters, W., Maclaughlin, V., & Deakin, A. (2023). Perspectives and Reflections on Assessment in Physical Education: A Narrative Inquiry of a Pre-service, in-Service and Physical Education Teacher Educator. *Curriculum Studies in Health and Physical Education*, *14*(01). https://doi.org/10.1080/25742981.2022.2053334

Zaferanieh, A., Haghighi, A. H., Kakhak, S. A. H., Maleki, A., Cè, E., & Esposito, F. (2021). Effect of Ballistic and Power Training on Performance Adaptations of Elite Table Tennis Players. *Sport Sciences for Health*, *17*(1), 181–190. https://doi.org/10.1007/s11332-020-00671-1