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# Development of E-Test Instrument Through Vinesa in Tendency Central Materials

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**ABSTRACT**

This study aims to assess the feasibility of developing an e-test instrument for statistics courses focused on central tendency to enhance student learning outcomes. Employing a mixed-methods design within an R&D framework, this research utilized the ADDIE model. The study involved 20 students, with data collected through a validation questionnaire evaluated by experts in learning material, learning media, and language. Quantitative data analysis techniques were used to assess the feasibility of the e-test instruments. The findings indicated that the e-test instruments were valid and highly feasible, with material validation results rated as very feasible (96%), learning media validation results rated as very feasible (94%), and learning design validation results rated as very feasible (94%). Additionally, individual trials rated the feasibility at 81%, and small group trials rated the feasibility at 82%. Overall, the development of e-test instruments is deemed highly feasible for use in statistical learning. The implications of this research include enhanced student comprehension of the material and increased interaction between students and lecturers, as well as among students.



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## 1. INTRODUCTION

At the beginning of the learning process, lecturers often utilize tests to assess student performance. These tests serve as a fundamental evaluation tool, allowing educators to gauge the effectiveness of their instructional methods (Jumrah, Rukli, & Sulfasyah, 2023; Widiyawati, Nurwahidah, & Sari, 2019). Beyond evaluation, tests act as a catalyst for learning, motivating students to engage more deeply with the material (Masitoh & Aedi, 2020). They are essential for measuring the success of specific educational programs and initiatives (Fahrurrozi & Rahmawati, 2021; Sholihah, Fahrurrozi, & Gafur, 2017), and for understanding how effectively the learning process is being carried out (Manfaat & Nurhairiyah, 2021; Setiyawan & Wijayanti, 2020). Tests provide critical insights into student learning outcomes, highlighting areas of strength and identifying areas in need of improvement (Aisyah, Taena, & Ili, 2021; Birch et al., 2017; Nurfillaili, Yusuf, & Santih, 2016; Sa'diyyah, Mania, & Suharti, 2021). The results, derived from carefully constructed questions within the test instruments, encourage students to demonstrate their best abilities (Sa'diyyah et al., 2021). Additionally, tests are employed for various administrative purposes, such as new student admissions and selection processes, making them

versatile tools in the educational landscape (Litna, Mertasari, & Sudhirta, 2021; Ma'rifah, Algiovan, & Sutarsyah, 2021). Effective testing not only evaluates student knowledge but also enhances the overall educational experience by fostering a deeper understanding and encouraging continuous improvement.

With the advances in information and communication technology (ICT), traditional manual test systems are gradually being replaced by computer-based tests (Jusuf, 2019). Electronic tests, or e-tests, are a form of distance learning information system conducted via the Internet (Gamaliel & Arliyanto, 2021). The integration of information technology in final exams is crucial for obtaining accurate evaluation results and ensuring an efficient process (Adiarta & Divayana, 2019). E-tests represent an ideal modern alternative to traditional assessments for evaluating students (Alyahya & Almutairi, 2019). One of the primary advantages of e-tests is their high level of transparency, as well as the time and energy savings they offer when assessing student performance (Alyahya & Almutairi, 2019). Additionally, e-tests provide precise test evaluations, performance measurements, and immediate feedback (Alyahya & Almutairi, 2019). They are cost-effective, flexible in administering multiple tests, and allow educators to easily prepare and use most questions (Alyahya & Almutairi, 2019). In contrast, paper-based exams are less effective, requiring substantial financial resources, time, space, and human resources to administer, and are often plagued by incidents of student cheating (Kamila & Prihatiningtyas, 2022). The shift to e-tests not only enhances the efficiency and accuracy of the evaluation process but also aligns with modern educational practices.

Along with advances in information and communication technology (ICT), Manual or traditional test systems are gradually being replaced by computer-based tests (Jusuf 2019). Electronic tests, or e-tests or online tests, are a distance learning information system via the Internet (Gamaliel and Arliyanto 2021). For final exams by lecturers, the use of information technology is very important to obtain accurate evaluation results and an efficient process (Adiarta and Divayana 2019). Electronic tests are an ideal modern alternative to traditional tests for evaluating students (Alyahya and Almutairi 2019). The advantage of the e-test is that it has a high level of transparency and saves energy and time when assessing student performance (Alyahya and Almutairi 2019). E-tests provide accurate test evaluation, performance measurement, and immediate feedback (Alyahya and Almutairi 2019). Electronic tests, or e-tests, are cost-effective, have the flexibility to administer multiple tests, and most questions are easy for educators to prepare and use (Alyahya and Almutairi 2019). Paper-based exams are considered less effective because they require a lot of money, time, space, and human resources to administer, and there are still many incidents of cheating by students when administering exams (Kamila and Prihatiningtyas, 2022).

The urgency of the e-test instrument is able to facilitate the evaluation process by educators. Educators find it easier to monitor student activities because they are no longer busy managing print-based assessments (Kuncahyono, Maharani Kumalasani 2019). This is in line with research showing that computer-based tests (CBT) are a viable alternative for solving problems in implementing learning assessments (Novrianti 2014). Several important aspects that can be considered when developing CBT are practicality, cheapness, and ease of carrying out the testing process (Mastroleoa et al. 2020). Its practical value in principle is to provide convenience in every procedure carried out using ICT. The economic value in this case lies in carrying out tests that use ICT more cheaply and efficiently (Nurhikmah et al. 2021). Online tests have advantages: 1) Teachers can prepare higher quality test materials, 2) the test administration process is standardized, and 3) students can be supervised (Mastuti 2016). There are two ways to represent electronic tests: 1) Synchronous face-to-face tests are tests that can be performed face-to-face without any changes to the testing procedures, 2) Asynchronous home tests are tests that can be performed at any time using high-quality proctoring software (Poonpon 2021). Test results are integrated into the internet network, so they can be observed by teachers, students, and parents (Kuncahyono, Maharani Kumalasani 2019). By utilizing technological developments, online tests can create a system that can provide evaluations quickly and accurately, making it easier to complete the evaluation process (Kamila and Prihatiningtyas 2022). The E-Test instrument is expected

to be a breakthrough in administering exams that can reduce operational costs, time, and cheating (Kamila and Prihatiningtyas, 2022).

Based on observations, the formative assessments that have been developed by lecturers have not been implemented optimally. One of the factors causing less than optimal implementation of formative assessments is that instrument development, implementation, and analysis of formative test data take time, and the workload of lecturers is very high. Not many lecturers utilize online-based media for formative assessment. There are two interesting things about computer-based formative assessment, namely that this assessment provides direct feedback and reduces lecturer workload. Apart from that, the educational technology department at Unesa has infrastructure to support learning, including applications that have been provided by Vinesa. However, some lecturers have not made full use of the infrastructure they already have. Assessment activities are carried out using paper-based test instruments, and online assessments have not been used. Based on the problems experienced by the educational technology department, it appears that e-test instruments are one of the keys to improving learning assessment. Based on the identification of problems and several relevant studies that have been described, it is necessary to develop an e-test assessment instrument. This aims to be an innovation in the assessment process by utilizing technology-based facilities that are already available at Unesa. Apart from that, the use of e-test instruments provides benefits in terms of practical value, economy, and ease in implementing the learning process, especially assessment activities on campus.

Based on the explanation above, there is an analytical gap between the expectations to be achieved and the current reality. The hope is to develop an e-test instrument for central tendency material that can improve statistical thinking and is suitable for students majoring in educational technology. In fact, there are still very few lecturers majoring in educational technology who have developed e-test instruments, which of course affects the effectiveness of lectures in these subjects.

The novelty of this research lies in the lack of lecturers dedicated to the development of appropriate e-test instruments and the fact that not many researchers have researched e-test instruments. Apart from that, the e-test instruments developed by most lecturers in the educational technology department are not yet optimal for access via Vinesa (Unesa Virtual Learning). In this research, the feasibility and use of Unesa's e-testing tool through virtual learning have not been widely studied by lecturers in Unesa's educational technology department. To overcome these learning problems, it is necessary to develop e-test instruments because learning is taught to stimulate students' abilities not only theoretically but also practically (Krisnanto, Kurniawan, and Maftukhin 2021).

This research aims to assess the feasibility of developing an e-test instrument for central tendency material so that it can improve the accuracy of statistical results. Validity testing is carried out through stages by learning material experts, learning media experts, language experts, individual trials, and limited group tests. It is hoped that this research will provide benefits in improving students' statistical reasoning abilities and become an important lesson for introductory lecturers in improving the quality of their learning. By paying attention to the explanation and initial information that have been presented, it can be explained as follows: how to design and describe the quality of e-test instruments that are suitable for use by students majoring in educational technology.

## 2. METHODS

The written test focuses on the use of paper and pencil as tools. Apart from that, an e-test instrument was also developed, which includes questions or tools packaged in computer media so that students can answer them independently, either online via an internet network or offline without an internet network. This research uses mixed methods using an R&D design (Rahman, Suyasa, and Wahyuni 2021). This research model uses ADDIE (Analyze, Design, Development, Implementation, and Evaluation). The ADDIE development model has advantages, one of which is that each stage goes through an evaluation stage so as to minimize errors from the start (Artha and Putra, 2021; Firda and Nurhadi, 2023; Hidayat and Nizar, 2021; Pramana, Jampel, and Pudjawan 2020). The ADDIE model is

used because it is considered suitable for developing learning media (Hidayat and Nizar 2021; Melliyanti and Suniasih 2022).

The ADDIE stages are: analysis stage. Collecting various information so that product designs can be developed as planning material (Firda and Nurhadi 2023; Wirda et al. 2017). Design stage. This stage is to design test instrument products (Firda and Nurhadi 2023) namely by determining basic and core competencies and compiling a grid of questions that will be developed into a test instrument (Farahiba 2022; Firda and Nurhadi 2023). The development stage is an activity to expand questions or statements originating from the framework or grid created at the planning stage (Ahmad 2018; Farahiba 2022). This stage also includes theoretical validation by expert lecturers and the testing of test instruments (Ahmad 2018; Firda and Nurhadi 2023; Wirda et al. 2017). Implementation stage. Researchers conducted a limited trial of the instrument on several undergraduate students in educational technology to determine the level of feasibility (Firda and Nurhadi 2023; Wirda et al. 2017). Evaluation stage, namely: 1) assessing whether the steps taken previously were appropriate and produced accurate and reliable data (Farahiba 2022). 2) see the feasibility of the limited trial results. If, after evaluation, there are problems with the test instrument, revisions will be carried out, this is done in order to obtain a suitable test instrument (Firda and Nurhadi 2023).

The research was conducted in the educational technology department at Surabaya State University. Data sources are validators, lecturers, and undergraduate students in educational technology. A trial was carried out to collect data as a basis for determining the feasibility level of the e-test instrument. The trial design for developing the e-test instrument was tested on validated experts, learning practitioners, and students. The research subjects are: a) expert validation (learning material experts, learning media experts, and language experts); and b) undergraduate students majoring in educational technology. The data collection technique uses a validation questionnaire, namely validation by learning material experts, learning media experts, and language experts. This research uses qualitative and quantitative data analysis.

## 3. FINDINGS AND DISCUSSION

### *3.1 Findings*

#### 3.1.1 Analysis

Needs analysis (needs assessment) is a crucial step in identifying gaps between current conditions and ideal standards in the field (Sofia, 2017). This process helps educators and institutions pinpoint specific areas that require improvement. The results of observations and interviews reveal several significant gaps: a) Learning is less than optimal because students struggle to understand the concept of central tendency. This fundamental misunderstanding hinders their overall performance in statistics courses. b) Lecturers have not fully developed or utilized e-test instruments to evaluate central tendency material, resulting in suboptimal evaluation practices. This lack of effective assessment tools prevents accurate measurement of student understanding and learning outcomes. c) Students do not fully exploit the various e-tests available to them for studying, which limits their ability to reinforce and apply their knowledge effectively. Addressing these gaps is essential for enhancing both teaching methods and student learning experiences. Implementing comprehensive e-test instruments and encouraging their use can significantly improve student comprehension and assessment accuracy, ultimately bridging the gap between current practices and ideal educational outcomes.

#### 3.1.2 Design

Determining product specifications necessitates a thorough understanding of the results from the needs analysis to accurately develop the intended product, which in this case is the design of the e-test instrument. This design phase involves creating a simple prototype that provides an overview and blueprint for constructing the e-test instrument. The process of developing an e-test design is carried out using a computer-based application, ensuring precision and efficiency. The application employed

for this purpose is open-source and provided by Vinesa, which offers flexibility and cost-effectiveness. Furthermore, the primary application used is JotForm. JotForm is particularly suited for creating online-based e-tests with digital (electronic) displays, facilitating user-friendly and interactive assessments. The choice of JotForm enhances the ability to design versatile and customizable e-tests, meeting the varied needs of both educators and students. By leveraging these tools, the e-test design not only becomes more accessible but also aligns with contemporary digital learning environments, ensuring that the final product is both functional and innovative.

### 3.1.3 Development

After a design or product plan has been created, the e-test instrument development process will be developed. This stage of the e-test development process aims to produce a valid product. The process for developing an e-test instrument is as follows: a) preparing test instrument specifications. The test instrument specifications in question are the type of test carried out. The test is carried out to measure students' cognitive level. The form of the test is multiple choice with five answer choices, b) after preparing the test specifications, arrange the questions and answers according to field needs. The question items refer to the applicable curriculum; c) carrying out analysis of the question items and answers with the aim of making the question items and answers suitable for use in assessment, d) developing e-test products using applications. At this stage, the research team carried out product development using online applications (Kuncahyono, Maharani Kumalasani 2019). Explicitly, the e-test instrument products that have been produced can be seen as follows: The results of product development that have been completed are then tested. e) product trials, which include individual group trials with 3 students and small group trials with 6 students selected heterogeneously with high, medium, and low abilities.

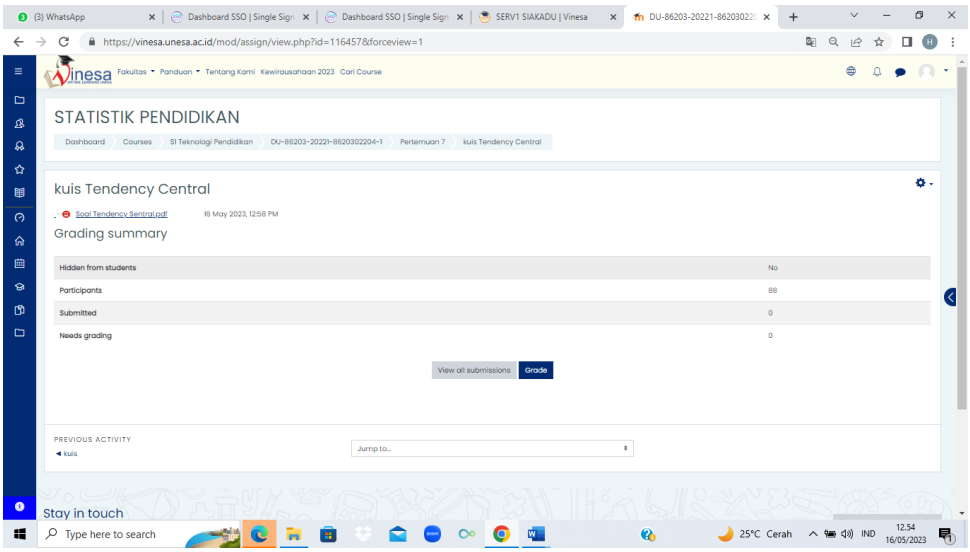


**Figure 1.** Development of electronic statistical test instruments

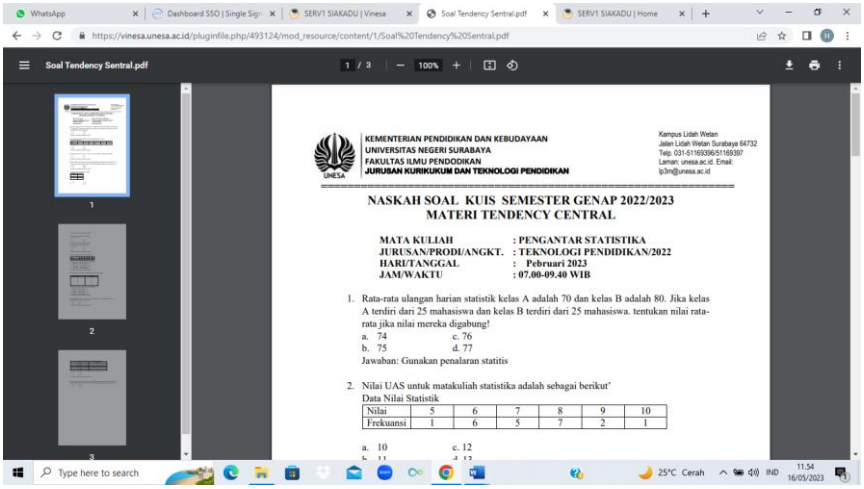


**Figure 2.** Development of electronic statistical test instruments that can be accessed by students at Vinesa

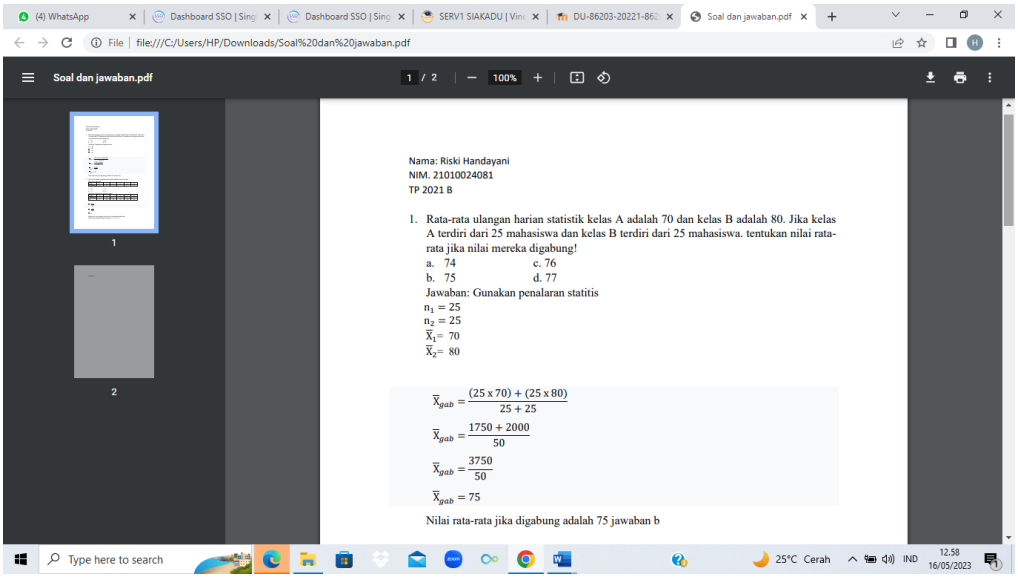


**Figure 3.** The results of working on students with statistical reasoning

### 3.1.4 Product Validation

Products that have been developed undergo a validation process before field trials are carried out. This e-test instrument development product was validated by three experts, namely: a validator, a learning material expert, a learning media expert, and a language expert. This stage was carried out to determine the validity of the product being developed, namely the e-test instrument, so that it could be tested in the field. The validation results by learning material experts are 96%, a very feasible category; the validation results from learning media experts are 96%, a very feasible category; and the validation results by language expert validators are 94%, a very feasible category.

### 3.1.5 Trials

This product trial was carried out to measure the level of student response to applying the e-test instrument to central tendency material in statistics courses in the educational technology department. Individual group trials with 3 students received a score of 81%, in the feasible category, while small group trials with 6 students selected heterogeneously with high, medium, and low abilities received a score of 82%, in the appropriate category. The e-test instrument is very interesting to use as an evaluation tool in learning. Apart from that, students seemed very enthusiastic about taking the e-test

and focused on their respective e-tests, so that any form of student cheating was almost invisible. A recapitulation of expert validation and trials can be seen in Table 1.

**Table. 1.** Product Validation Assessment Results

| Index | Validity Results | Category |
|---|---|---|
| Test learning materials | 96% | very worthy |
| Learning evaluation test | 96% | very worthy |
| Language test | 94% | very worthy |
| Individual trials | 81% | very worthy |
| Small group trial | 82% | very worthy |

### 3.1.6 Implementation

The implementation stage in this research is the stage for implementing the e-test instrument that has been developed in real-life situations in the classroom. The e-test instrument that has been developed is implemented according to learning. After it is implemented in the form of learning activities, an initial evaluation is carried out to provide feedback on the implementation of subsequent test instrument development. The main objectives in the implementation step include: 1) helping students to achieve learning goals, 2) ensuring problem-solving occurs to overcome problems previously faced by students in the learning process, 3) ensuring that at the end of learning student competence increases.

### 3.1.7 Evaluation

Evaluation is a critical process for determining whether the product being developed is successful and meets initial expectations. The evaluation stage is integrated into each of the four preceding stages: 1) expert test, 2) course lecturer test, 3) individual test, and 4) small group test. Additionally, a comprehensive evaluation is conducted at the final stage of product development to assess the overall effectiveness of the product. The revision stage follows the evaluation to analyze the results both qualitatively and quantitatively. Qualitative data is gathered from expert validation questionnaires and user trial questionnaires, which include feedback from lecturers and students. Quantitative data is derived from the test scores obtained during the trials.

The evaluation process involves several key steps: 1) product trial evaluation, 2) descriptive data analysis, 3) revision of the final product, and 4) assessment of the final product results. These steps ensure a thorough and iterative approach to product development, allowing for continuous improvement based on feedback and performance data. The evaluation of the central tendency material e-test instrument aims to achieve multiple objectives: 1) assessing student attitudes towards overall learning activities to ensure engagement and satisfaction, 2) enhancing student abilities by providing effective learning tools and resources, and 3) delivering institutional benefits through the increased competence of students, which can positively impact the institution's educational outcomes and reputation. By systematically evaluating and refining the e-test instrument, the development process aims to produce a high-quality, effective tool that meets the needs of both students and educators.

## *3.2 Discussion*

Research into the development of e-tests using Vinesa for central tendency material has been found to be highly feasible following extensive validation testing, including material validation, learning media validation, learning design validation, individual trials, and small group trials. These validation stages demonstrated that the e-test instrument is very suitable for use with central tendency material. This finding aligns with Aini's research, which concluded that a HOTS-based e-quiz was feasible after undergoing similar validation tests and field trials, particularly in mathematics subjects (Aini & Sulistyani, 2020). Additionally, Prisuna's research indicated that students' responses to online physics test media were favorable, with 40% rating it as appropriate and 60% as very feasible, making it suitable for formative physics tests (Prisuna, 2020).

Further supporting these findings, Jusuf (2019) reported positive user responses to the implementation of a website-based online test system created for independent student learning via Moodle. Similarly, Dwi Lestari's research demonstrated that science e-modules containing online tests effectively improved learning outcomes (Dwi Lestari & Putu Parmiti, 2020). Research on developing higher-order thinking skill (HOTS) e-test questions showed a validation result of 94.47%, categorizing it as very feasible for school learning activities (Wulandari et al., 2023). The E-TEFL (EEPIS Test of English as a Foreign Language) application was also found to enhance students' English language skills, demonstrating its effectiveness as an evaluation tool (Sumarsono, Kusumawati, & Nurisma, 2018).

Kuncahyono's research confirmed the validity of an e-test being developed, finding it very feasible for use as an evaluation tool, capable of minimizing cheating during assessments (Kuncahyono, Maharani, & Kumalasani, 2019). Permatasari's research on e-tests for environmental change material revealed their effectiveness in measuring class X students' problem-solving abilities (Permatasari, 2020). Research by Nurhikmah et al. (2021) concluded that computer-based tests are suitable as evaluation media for mathematics subjects. The development of a computer-based e-test for biotechnology material at SMA Negeri 1 Surabaya received an average validation score of 89.53%, deeming it very feasible for measuring student knowledge competency (Rachma, Nurmaulidia Aulia, & Ratnasari, 2015).

Research by Rachmawati and Kurniawati (2020) on mobile online-based test assessment instruments concluded that these instruments are suitable for evaluating test results in learning courses. Additionally, e-testing development can accommodate a large number of questions and assessment content (Ristov, Gusev, & Armenski, 2015). Widayanti (2021) found that an e-instrument designed to measure students' mental models of electrolyte and non-electrolyte solution materials received feasibility ratings of 89% from material experts and 83% from teachers, making it suitable for use.

There has been extensive research on online exams. For instance, Udiasih and Ghozali (2019) noted that online exams are effective for development, while Martono, Yulianjani, and Desrianti (2020) found that online examination tests improve the quality of learning. Halim et al. (2018) concluded that online diagnostic tests provide effectiveness and convenience. Rokhaniyah and Virgantara Putra (2021) reported that online tests improve student learning outcomes, and Maity et al. (2018) emphasized their effectiveness in understanding student development. The and Usagawa (2018) found online learning highly effective, and Tempelaar et al. (2012) highlighted the effectiveness of formative tests using e-learning for mathematics in Dutch research. Skopljanac-Macina, Zakarija, and Blaskovic (2021) demonstrated the feasibility of using e-learning assessment systems. Bellotti's research explained that computer testing should be both fun and challenging (Prisuna, 2020).

The advantages of electronic or online tests include immediate assessment of exams, direct question analysis, automatic question correction, and the randomization of questions and answer choices to prevent cheating (Jusuf, 2019; Kuncahyono et al., 2020; Mastuti, 2016). The ADDIE development model for central tendency material is proven to be feasible for improving reasoning abilities. The e-test instrument through Vinesa can enhance student learning outcomes across various courses. Based on these findings, the researcher suggests that lecturers adopt e-tests to foster a culture of independent learning, allowing them to access student work anytime and anywhere. Future research could develop e-test kits for other courses to further encourage students' reasoning abilities. Additionally, the quality of Vinesa's services continues to improve, benefiting the campus community.

## 4. CONCLUSION

The research on the development of e-tests for central tendency material has demonstrated their feasibility for implementation in statistics learning and their effectiveness in enhancing students' reasoning abilities. The findings imply significant benefits: lecturers can access student work anytime and anywhere, and students can gain a deeper understanding of the material while increasing interaction with peers and instructors. However, this study has several limitations. Firstly, the sample

size was relatively small, which may affect the generalizability of the results. Secondly, the study focused exclusively on central tendency material, leaving out other crucial areas of statistics that might benefit from similar e-test development. Additionally, the study did not extensively explore the long-term effects of using e-tests on student performance and engagement.

For future research, expanding the sample size and including diverse educational settings is recommended to validate the findings further. Researchers should also consider developing e-tests for a broader range of statistical topics and other disciplines to examine their efficacy across different subject matters. Incorporating more interactive and engaging features into e-tests could enhance their appeal and effectiveness, potentially leading to even greater improvements in student learning outcomes. Longitudinal studies could provide valuable insights into the sustained impact of e-tests on student learning and engagement over time. By addressing these limitations and exploring these suggestions, future research can build on the current findings and contribute to the continued advancement of educational technology.

**REFERENCES**

Adiarta, A., & Divayana, D. G. H. (2019). Pengembangan soal test digital matakuliah asesmen dan evaluasi menggunakan aplikasi Wondershare. *Jurnal Pendidikan Teknologi Dan Kejuruan, 16*(2), 287. https://doi.org/10.23887/jptk-undiksha.v16i2.19199

Ahmad, M. (2018). Development of student misconception test instrument using combination of three-tier test and certainty of response index on animal kingdom grade X high school. *Bioedu Berkala Ilmiah Pendidikan Biologi, 7*(2), 119–128.

Aini, D. F. N., & Sulistyani, N. (2020). Pengembangan instrumen penilaian e-quiz (electronic quiz) matematika berbasis HOTS (higher of order thinking skills) untuk kelas V sekolah dasar. *Widyagogik, 7*(2), 115–127.

Aisyah, S. N., Taena, L., & Ili, L. (2021). Pengembangan tes hasil belajar ekonomi kelas X SMA melalui Google Formulir. *Jurnal Online Program Studi Pendidikan Ekonomi, 6*(3), 106–114.

Alyahya, D., & Almutairi, N. (2019). The impact of electronic tests on students' performance assessment. *International Education Studies, 12*(5), 109. https://doi.org/10.5539/ies.v12n5p109

Arsanti, M. (2018). Pengembangan bahan ajar mata kuliah penulisan kreatif bermuatan nilai-nilai pendidikan karakter religius bagi mahasiswa prodi Pbsi, Fkip, Unissula. *KREDO: Jurnal Ilmiah Bahasa Dan Sastra, 1*(2), 71–90. https://doi.org/10.24176/kredo.v1i2.2107

Artha, I. M. A. W., & Putra, D. B. K. N. S. (2021). Pengembangan media audio visual dengan model analysis design development implementation evaluation pada muatan IPA kelas IV SD Negeri 2 Pejeng tahun ajaran 2020/2021. *Jurnal Edutech Undiksha, 9*(1), 149–157. https://doi.org/10.23887/jeu.v9i1.32974

Birch, C., Lichy, J., Mulholland, G., & Kachour, M. (2017). An enquiry into potential graduate entrepreneurship: Is higher education turning off the pipeline of graduate entrepreneurs? *Journal of Management Development, 36*(6), 743–760. https://doi.org/10.1108/JMD-03-2016-0036

Dwi Lestari, H., & Parmiti, D. P. P. P. (2020). Pengembangan e-modul IPA bermuatan tes online untuk meningkatkan hasil belajar. *Journal of Education Technology, 4*(1), 73–79. https://doi.org/10.23887/jet.v4i1.24095

Fahrurrozi, M., & Rahmawati, S. N. L. (2021). Pengembangan model instrumen evaluasi menggunakan aplikasi Kahoot pada pembelajaran ekonomi. *Jurnal PROFIT Kajian Pendidikan Ekonomi Dan Ilmu Ekonomi, 8*(1), 1–10. https://doi.org/10.36706/jp.v8i1.13090

Farahiba, Ayyu Subhi. 2022. "Pengembangan Instrumen Tes Literasi Peserta Didik Pada Materi Teks Anekdot." *Jurnal Dimensi Pendidikan Dan Pembelajaran (JDPP)* 10(2):146–54.

Firda, Hanum, and Didik Nurhadi. 2023. "Penerapan Model ADDIE Dalam Pengembangan Instrumen Penilaian Diri Sendidri Peserta Didik SMA Negeri Kabupaten Mojokerto." *Jurnal Hikari* 7(1):14–26.

Gamaliel, Fritz, and P. Yudi Dwi Arliyanto. 2021. "Perancangan Aplikasi Ujian Online Berbasis

Website." *Jurnal Manajamen Informatika Jayakarta* 1(4):270. doi: 10.52362/jmijayakarta.v1i4.503.
Halim, A., Mustafa, Nurulwati, Soewarno, and Novi Nanda. 2018. "Development of Two-Tier Diagnostic Test Based on E-Learning." *Journal of Physics: Conference Series* 1120(1). doi: 10.1088/1742-6596/1120/1/012030.
Hidayat, Fitria, and Muhamad Nizar. 2021. "Model ADDIE (Analysis, Design, Development, Implementation and Evaluation) Dalam Pembelajaran Pendidikan Agama Islam." *Jurnal Inovasi Pendidikan Agama Islam (JIPAI)* 1(1):28–38. doi: 10.15575/jipai.v1i1.11042.
Jumrah, Rukli, and Sulfasyah. 2023. "Pengembangan Instrumen Tes Berbasis HOTS Dengan Pendekatan Pengukuran Rasch Pada Pelajaran Matematika Topik Bangun Ruang Untuk Siswa Sekolah Dasar." *Jurnal Basicedu* 7(1):11–27.
Jusuf, Heni. 2019. "Pengembangan E-Test Sebagai Sarana Belajar Mandiri Peserta Didik Berbasis Moodle." *Progresif: Jurnal Ilmiah Komputer* 5(1):45–50.
Kamila, Saifiyatil, and Suci Prihatiningtyas. 2022. "Instrumen E-Test Sebagai Inovasi Penilaian Berbasis Website." *Exact Papers in Compilation* 4(3):603–8.
Krisnanto, Imam, Eko Setyadi Kurniawan, and Arif Maftukhin. 2021. "Pengembangan Instrumen Tes Hasil Belajar Fisika Berbasis STEM Untuk Mengukur Keterampilan Proses Sains Peserta Didik." *Jurnal Inovasi Pendidikan Sains (JIPS)* 2(2):76–81. doi: 10.37729/jips.v2i2.1375.
Kuncahyono, Maharani Kumalasani, Dian Aini. 2019. "Pengembangan Instrumen E-Test Sebagai Inovasi Penilaian Berbasis Online Di Sekolah Dasar." *JINoP (Jurnal Inovasi Pembelajaran)* 5(2):hal. 155-169.
Kuncahyono, Beti Istanti Suwandayani, and Abdurrohman Muzakki. 2020. "Aplikasi E-Test 'That Quiz' Sebagai Digitalisasi Keterampilan Pembelajaran Abad 21 Di Sekolah Indonesia Bangkok." *Lectura: Jurnal Pendidikan* 4(13–29):791–92.
Litna, K. .., N. M. .. Mertasari, and G. Sudhirta. 2021. "Pengembangan Instrumen Tes Higher Order Thinking Skills (HOTS) Matematika SMA Kelas X." *Jurnal Penelitian Dan Evaluasi Pendidikan Indonesia* 11(1):10–20.
Ma'rifah, Umi, Nyanuar Algiovan, and Cucu Sutarsyah. 2021. "An Item Analysis of English Test During Online Learning." *International Journal of Multicultural and Multireligious Understanding* 8(12):647–54.
Maity, Prabhat, Swapnil Patil, Pratiksha Pednekar, Akshata Sawant, and Prof Monali Rupnar. 2018. "Maity 2018 Online Examination System - Laher." 1956–57.
Manfaat, Budi, and Siti Nurhairiyah. 2021. "Pengembangan Instrumen Tes Untuk Mengukur Kemampuan Penalaran Statistik Mahasiswa Tadris Matematika." *Jurnal Pembelajaran Matematika* 1(1):1–19.
Martono, Aris, Arsi Yulianjani, and Dewi Immaniar Desrianti. 2020. "Online Exam System to Improve Student Learning Quality in State Vocational School 5 Tangerang City." *CCIT Journal* 13(1):65–74. doi: 10.33050/ccit.v13i1.895.
Masitoh, Lisda Fitriana, and Weni Gurita Aedi. 2020. "Pengembangan Instrumen Asesmen Higher Order Thinking Skills (HOTS) Matematika Di SMP Kelas VII." *Jurnal Cendekia : Jurnal Pendidikan Matematika* 4(2):886–97. doi: 10.31004/cendekia.v4i2.328.
Mastroleoa, Nadine R., Laura Hummb, Callon M. Williamsa, Brian D. Kilukc, Ariel Hoadleyd, and Molly Magill. 2020. "Initial Testing of a Computer-Based Simulation Training Module to Support Clinicians' Acquisition of CBT Skills for Substance Use Disorder Treatment." *Journal of Substance Abuse Treatment* 114:1–23. doi: 10.1016/j.jsat.2020.108014.Initial.
Mastuti, Endah. 2016. "Pemanfaatan Teknologi Dalam Memyusun Evaluasi Hasil Belajar : Kelebihan Dan Kelemahan ' Tes Online ' Untuk Mengukur Hasil Belajar Mahasiswa." *Peneltian Psikologi* 07(01):10–19.
Melliyanti, Ni Made Sanita, and Ni Wayan Suniasih. 2022. "Kelayakan Dan Efektivitas Media Komik Berbasis Kontekstual Pada Muatan IPA Materi Sumber Daya Alam." *Mimbar Ilmu* 27(1):124–33. doi: 10.23887/mi.v27i1.44587.

Munadi, Sudji. 2015. "Analisis Validasi Kualitas Soal Tes Hasil Belajar Pada Pelaksanaan Program Pembelajaran." *Jurnal Cakrawala Pendidikan* 1(1):145–59. doi: 10.21831/cp.v1i1.4197.

Muspardi, Yusmanila, and Evi Desmariani. 2020. "Problematika Dosen Dalam Menggunakan Instrumen Penilaian Pendidikan Keterampilan Umum Mahasiswa Berbasis Standar Nasional Tinggi (SN-Dikti)." *Jurnal Education and Development* 8(4):54–58.

Nengsi, Ayu Rahma. 2018. "Pengembangan Tes Prestasi Bentuk Pilihan Ganda Untuk Evaluasi Hasil Belajar Geografi Siswa SMA Kelas IX." *UNES Journal of Education Scienties* 2(2):118–26.

Nisrokha. 2020. "Tes Terstandarisasi." *Jurnal Madaniyah* 10(1):15–36.

Novrianti. 2014. "Pengembangan Computer Based Testing ( CBT ) Sebagai Alternatif Teknik Penilaian Hasil Belajar." *Jurnal Ilmu Tarbiah Dan Keguruan* 17(1):34–42.

Nurfillaili, Ulfa, M. Yusuf, and Anggereni Santih. 2016. "Pengembangan Instrumen Tes Hasil Belajar Kognitif Mata Pelajaran Fisika Pada Pokok Bahasan Usaha Dan Energi SMA Negeri Khusus Jeneponto Kelas XI Semester I." *Jurnal Pendidikan Fisika* 4(2):83.

Nurhasanah, Nurhasanah. 2018. "Pengembangan Tes Untuk Mengukur Kemampuan Penalaran Mahasiswa Mata Kuliah Geometri." *Pepatudzu : Media Pendidikan Dan Sosial Kemasyarakatan* 14(1):62. doi: 10.35329/fkip.v14i1.186.

Nurhikmah, Hamsu Gani, Muh. Pratama, and Hengki Wijaya. 2021. "Development of an Android-Based Computer Based Test (CBT) In Middle School." *Journal of Education Technology* 5(2):272–81. doi: 10.23887/jet.v5i2.33527.

Permatasari, Noviyanti. 2020. "The Development of Elektronic Tests (E-Test) on Environmental Change Material to Measure The Problem Solving Ability of Students In Grade X SMA." 9(1):319–24.

Poonpon, Kornwipa. 2021. "Test Takers' Perceptions of Design and Implementation of an Online Language Testing System at a Thai University during the COVID-19 Pandemic." *Pasaa* 62(December):1–28.

Pramana, Made Wisnu Adi, I. Nyoman Jampel, and Ketut Pudjawan. 2020. "Meningkatkan Hasil Belajar Biologi Melalui E-Modul Berbasis Problem Based Learning." *Jurnal Edutech Undiksha* 8(2):17. doi: 10.23887/jeu.v8i2.28921.

Prisuna, Bayu Fitra. 2020. "Media Development of Online-Based Physics Test for Senior High School." *Jurnal Penelitian Ilmu Pendidikan* 13(1):41–51.

Rachma, Nurmaulidia Aulia & Ratnasari, Evie, and Isnawati. 2015. "The Development of Electronic Test (e-Test) Based on Computer in High School 1 of Surabaya." *Berkala Ilmiah Pendidikan Biologi* 4(3):1018–22.

Rachmawati, and Anik Kurniawati. 2020. "Pengembangan Instrumen Tes Berbasis Mobile Online Pada Prodi Pendidikan Matematika." *Jurnal Pendidikan Matematika* 4(1):46–63.

Rahman, Dedi, P. Wayan Arta Suyasa, and Dessy Seri Wahyuni. 2021. "Pengembangan Media Pembelajaran E-Learning Dengan Model Pembelajaran Flipped Classroom Berbasis Edmodo Pada Mata Pelajaran Informatika." *Kumpulan Artikel Mahasiswa Pendidikan Teknik Informatika (KARMAPATI)* 10(1):13. doi: 10.23887/karmapati.v10i1.31092.

Ristov, Sasko, Marjan Gusev, and Goce Armenski. 2015. "Massive Development of E-Testing Questions." 10(4):46–53.

Rizky Ananda Setiyawan, and Palupi Sri Wijayanti. 2020. "Analisis Kualitas Instrumen Untuk Mengukur Kemampuan Pemecahan Masalah Siswa Selama Pembelajaran Daring Di Masa Pandemi." *Jurnal Lebesgue : Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika* 1(2):130–39. doi: 10.46306/lb.v1i2.26.

Rokhaniyah, Hesti, and Oddy Virgantara Putra. 2021. "Developing Web-Based Online Test System to Boost Ielts Academic Reading Score." *English Review: Journal of English Education Volume* 9(2):235–44.

Sa'diyyah, Fadhilah Nur, Sitti Mania, and Suharti. 2021. "Pengembangan Instrumen Tes Untuk Mengukur Kemampuan Berpikir Komputasi Siswa." *Jurnal Pembelajaran Matematika Inovatif*

4(1):17–26. doi: 10.22460/jpmi.v4i1.17-26.

Sholihah, Isfi, Fahrurrozi, and Hadi Abdul Gafur. 2017. "Pengembangan Modul Pembelajaran Ekonomi Berbasis Guided Inquiry Untuk Meningkatkan Hasil Belajar Siswa Kelas XI MA NW Sukamulia." 1(2):104–17.

Skopljanac-Macina, Frano, Ivona Zakarija, and Bruno Blaskovic. 2021. "Towards Automated Assessment Generation in E-Learning Systems Using Combinatorial Testing and Formal Concept Analysis." *IEEE Access* 9:52957–76. doi: 10.1109/ACCESS.2021.3070510.

Sofia, Dinda Aya. 2017. "Development of WEB Facilitated Learning By Applying Self-Regulated Learning Strategy." *Jurnal Inovasi Dan Teknologi Pembelajaran* 1:292–96.

Sri Hartini dan Fadjeri. 2015. "Kemampuan Dosen Dalam Menyusun Tes Berbasis Teori Bloom Dilihat Dari Senioritasnya Di FKIP Universitas Slamet Riyadi Surakarta Tahun Akademik 2014/2015." *Widiya Wacana* 10(1):119–26.

Sumarsono, Irwan, Eny Kusumawati, and Radina Anggun Nurisma. 2018. "The Development Of E-Tefl (Eepis Test of English As A Foreign Language) With Web And Android-Based Simulation At Politeknik Elektronika Negeri Surabaya." *Wacana Didaktika* 6(01):7–14. doi: 10.31102/wacanadidaktika.6.01.7-14.

Tempelaar, Dirk T., Boudewijn Kuperus, Hans Cuypers, Henk van der Kooij, Evert van de Vrie, and André Heck. 2012. "The Role of Digital, Formative Testing in e-Learning for Mathematics: A Case Study in the Netherlands." *RUSC Universities and Knowledge Society Journal* 9(1):284–305. doi: 10.7238/rusc.v9i1.1272.

The, Mon Mon, and Tsuyoshi Usagawa. 2018. "Effectiveness of E-Learning Experience through Online Quizzes: A Case Study of Myanmar Students." *International Journal of Emerging Technologies in Learning* 13(12):157–76. doi: 10.3991/ijet.v13i12.9114.

Udiasih, Yuli, and Imam Ghozali. 2019. "Online Test Design for Computer-Based Final Examination Preparation." *Journal of English Language and Pedagogy* 2(1):57. doi: 10.36597/jelp.v2i1.3619.

Widayanti, Y. 2021. "The Development of E-Instrument to Test Students' Mental Models on Electrolyte and Non-Electrolyte Solutions." 3(3):174–77.

Widiyawati, Yeni, Indri Nurwahidah, and Dwi Septiana Sari. 2019. "Pengembangan Instrumen Integrated Science Test Tipe Pilihan Ganda Beralasan Untuk Mengukur HOTS Peserta Didik." *Saintifika* 21(2):1–14.

Wirda, Mona Adria, Nurmala Berutu, Riki Rahmad, and Rohani. 2017. "Pengembangan Tes Standar Berbasis Teknologi Informasi DI Jurusan Pendidikan Geografi." *Jurnal Tunas Geografi* 6(2):101–15.

Wulandari, Ina, Hairida Hairida, Rahmat Rasmawan, Eny Enawati, and Rini Muharini. 2023. "Development of Problems for Higher Order Thinking Skill (HOTS) e-Test on Additive Substance Subject Material." *Hydrogen: Jurnal Kependidikan Kimia* 11(5):698. doi: 10.33394/hjkk.v11i5.8730.