



## SEMAR Technology Readiness Level Improvement (Statistical Multimedia Based on Multi Representation and Augmented Reality)

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**Abstract:** SEMAR (Statistical Multimedia Based on Multi-representation and Augmented Reality) is a digital innovation in the form of learning multimedia that can improve numeracy literacy in statistics learning. SEMAR is a prototype developed from an integrated statistical e-module of multi-representation and augmented reality with Technology Readiness Level (TKT 3) with increased innovation from website-based media to android-based multimedia (TKT 4). The purpose of improving TKT is intended to achieve the novelty of SEMAR products in supporting independent learning of statistics in Indonesia. The TKT improvement method used is through expert validation test techniques and national-scale public tests. Both tests were carried out at seven universities in Indonesia, including Nusantara PGRI University Kediri, PGRI University Madiun, Nahdlatul Ulama University Blitar, Madura University, Khairun University Ternate, Cendrawasih University, and Indonesian Christian University Toraja. The results of the validation test show that the average SEMAR feasibility value is 90.92% with a very feasible category, and the average SEMAR user response is 77.87% with a good user response category.

**Keywords:** SEMAR; Technology Readiness Level, Validation Test, Public Test.

## Peningkatan Tingkat Kesiapan Teknologi SEMAR (Statistical Multimedia Based on Multi Representation and Augmented Reality)

**Abstrak:** SEMAR (*Statistical Multimedia Based on Multi-representation and Augmented Reality*) adalah inovasi digital berbentuk multimedia pembelajaran yang dapat meningkatkan literasi numerasi dalam pembelajaran statistika. SEMAR merupakan prototipe yang dikembangkan dari e-modul statistika terintegrasi multi-representasi dan *augmented reality* dengan Tingkat Kesiapan Teknologi (TKT 3) dengan peningkatan inovasi dari bentuk media berbasis website menjadi multimedia berbasis android (TKT 4). Tujuan peningkatan TKT dimaksudkan untuk mencapai kebaruan produk SEMAR dalam mendukung kemandirian belajar statistika di Indonesia. Metode peningkatan TKT yang digunakan adalah melalui teknik uji validasi ahli dan uji publik skala nasional. Kedua uji tersebut dilaksanakan di tujuh perguruan tinggi di Indonesia meliputi: Universitas Nusantara PGRI Kediri, Universitas PGRI Madiun, Universitas Nahdlatul Ulama Blitar, Universitas Madura, Universitas Khairun Ternate, Universitas Cendrawasih, dan Universitas Kristen Indonesia Toraja. Adapun hasil uji validitas menunjukkan bahwa rata-rata nilai kelayakan SEMAR adalah 90,92% dengan kategori sangat layak, dan rata-rata respon pengguna SEMAR sebesar 77,87% dengan kategori respon pengguna baik.

**Kata Kunci:** SEMAR; Tingkat Kesiapan Teknologi; Uji Validasi; Uji Publik.

## INTRODUCTION

The implementation of the Sustainable Development Goals (SDGs) nationally is an integral part of the implementation of the Regional SDGs. The fourth SDG related to quality education contains strategic issues about independent learning through improving science and technology-based human resources (Adhikari, & Shrestha, 2023). One of the indicators of increasing science and technology is increasing the Literacy Rate (AMH) in line with the Life Expectancy Rate (AHH) (Amalia & Mahmudah, 2020; Karim et al., 2021). Numeracy literacy is a factor that influences AMH (Suri, et al., 2016; Astuti, et al., 2017; Megantara & Budhi, 2020), but the importance of literacy does not match the data in the field which shows the low score of numeracy literacy in Indonesia. Referring to the results of PISA 2022 which showed that the average score of numeracy literacy of Indonesian students fell 13 points to 366 from the score in the previous edition (2018) which was 379. This figure is also 106 points away from the global average score (Ingram et al., 2023). The description above indicates that the problem of numeracy literacy is important to resolve related to existing strategic issues. In addition, numeracy literacy is important to support independent learning (Hilda et al., 2023; Nuryami, 2024; Tuychivich, 2024).

Regarding numeracy literacy in achieving learning independence, a study was conducted in 2023 on improving students' numeracy literacy in statistical materials using multi-representation and augmented reality-based media. Multi-representation is reviewed because the more diverse types of representation will support the improvement of numeracy literacy skills (Santia et al., 2022; 2023; 2024). Meanwhile, augmented reality shows that the implementation of science and technology innovation in learning can increase numeracy literacy competencies by 35-45% (Santia & Handayani, 2024). This is because the use of augmented reality in displaying 3D animations related to graphs and diagrams can support numeracy literacy through multi-representation (Pratiwi & Arnomo, 2022; Santia & Handayani, 2024; Sebastian & Kuswanto, 2024). However, the results of this study still require further improvement because based on FGD with 4 validators and 5 statistics lecturers, suggestions for product improvements were obtained to increase innovation from media to android-based multimedia (Santia et al., 2024). The consideration for using an android base is so that the media is easily accessible to students (Martono & Nurhayati, 2014; Apsari & Rizki, 2018; Wafa & Fahmi, 2021), while changing the media to multimedia is based on improving learning of science and technology-based statistical numeracy literacy (Nusir et al., 2012; Rogowsky et al., 2018; Marenden et al., 2021). So that innovation will be carried out in the development of a multimedia prototype SEMAR (Statistical Multimedia Based on Multi-representation and Augmented Reality) based on Android which can support independent learning of statistics.

SEMAR multimedia innovation is important to be further developed because of the benefits and advantages of innovation that we can see from the increase in users' numeracy literacy skills, as well as the commercial value generated. In addition, SEMAR multimedia supports handling strategic issues of increasing numeracy literacy based on science and technology through independent learning. The purpose of the SEMAR prototype development

innovation is to increase TKT 4 through public testing to address the problem of student numeracy literacy through independent learning of statistics. In addition, SEMAR is one of the solutions to address strategic issues of increasing numeracy literacy through science and technology. To achieve this goal, public testing was conducted at 7 (seven) universities, including Nusantara PGRI Kediri University, Nahdlatul Ulama Blitar University, PGRI Madiun University, Madura University, Khairun Ternate University, UKI Toraja, and Papua University. The target of the SEMAR prototype development is students in statistics classes or those who are working on experimental data analysis in their final assignments.

The specifications of the prototype to be developed include: 1) SEMAR is a prototype with a multimedia design that combines aspects of sound, images, and video (3 dimensions) with a size between 80 and 100 MB. The relatively small size makes it easy for users to download SEMAR; 2) SEMAR is an android-based multimedia that is practical to use; and 3) SEMAR has several application features that implement the achievement of various learning objectives. The application features in SEMAR multimedia are: 1) augmented reality application features (studio.assemblrword.com) with multi-representation of graphics and diagrams make SEMAR multimedia a medium for planting statistical concepts, 2) SPSS.23 and LiveWorksheet application features make SEMAR multimedia a medium for implementing good practices through practice questions and learning games, and 3) mind mapping application features that make SEMAR multimedia a medium for developing students' analytical thinking processes in statistical materials.

The output of the development activities carried out is the formation of an Android-based SEMAR (Statistical Multimedia Based on Multi-representation and Augmented Reality) prototype with TKT 4. While the outcome of the SEMAR prototype development is an increase in student numeracy literacy in statistics learning both in terms of pedagogy and substance, as well as the achievement of independence in learning statistics in Indonesia. The social impact seen from the development of the SEMAR prototype is the handling of strategic issues related to increasing numeracy literacy based on science and technology, which is one of the strategic issues in achieving TPB 4 related to quality education in the social pillar. While the economic impact is obtained from the commercial value of the SEMAR product, which is claimed to have high user potential, seeing its usefulness in helping students understand statistical concepts and their implementation. The development of the SEMAR prototype itself has a development impact on science, especially the implementation of TPACK (Technological Pedagogical Content Knowledge) in the field of statistics.

## **METHOD**

The technology needed to develop the SEMAR prototype technology readiness level includes augmented reality applications (studio.assemblrword.com), SPSS.23, LiveWorksheet, and Canva Pro. Meanwhile, the facilities needed related to the place and equipment needed for target 4 public testing include: 1) statistics classes at 7 (seven) different universities as public testing locations; 2) FGD implementation locations; 3) accommodation to the public testing location; 4) design development process rooms; and 4) funding to download paid

technology enhancement applications. The raw materials needed to develop SEMAR prototype innovation work include technology enhancement applications in prototype designs, survey instruments to obtain primary and secondary data, and public testing instruments. The survey and public testing instruments include: 1) numeracy literacy ability survey sheets; 2) SEMAR multimedia needs survey sheets; 3) media, language, material, and practitioner expert validation sheets; and 4) student response sheets to the use of SEMAR.

The prototype design plan to be carried out includes: 1) substitution of the studio.assemblrword.com program in the data presentation material; 2) substitution of the SPSS23 program in the inferential statistical analysis material; 3) substitution of the LiveWorksheet program in game development; 4) substitution of mind mapping in each chapter; and 5) changing the prototype base to Android. Furthermore, it is implemented with expert validation tests and implementation of learning in the test class. Then a public test is carried out, including the initial and final numeracy literacy test, N-gain analysis of numeracy literacy, response to prototype use, analysis of the commercial value of the prototype, and FGD test results.

## RESULT AND DISCUSSION

The output of the development activities carried out was the formation of an Android-based SEMAR (Statistical Multimedia Based on Multi-representation and Augmented Reality) prototype with TKT 4. The SEMAR design is depicted in the flowchart in Figure 1.

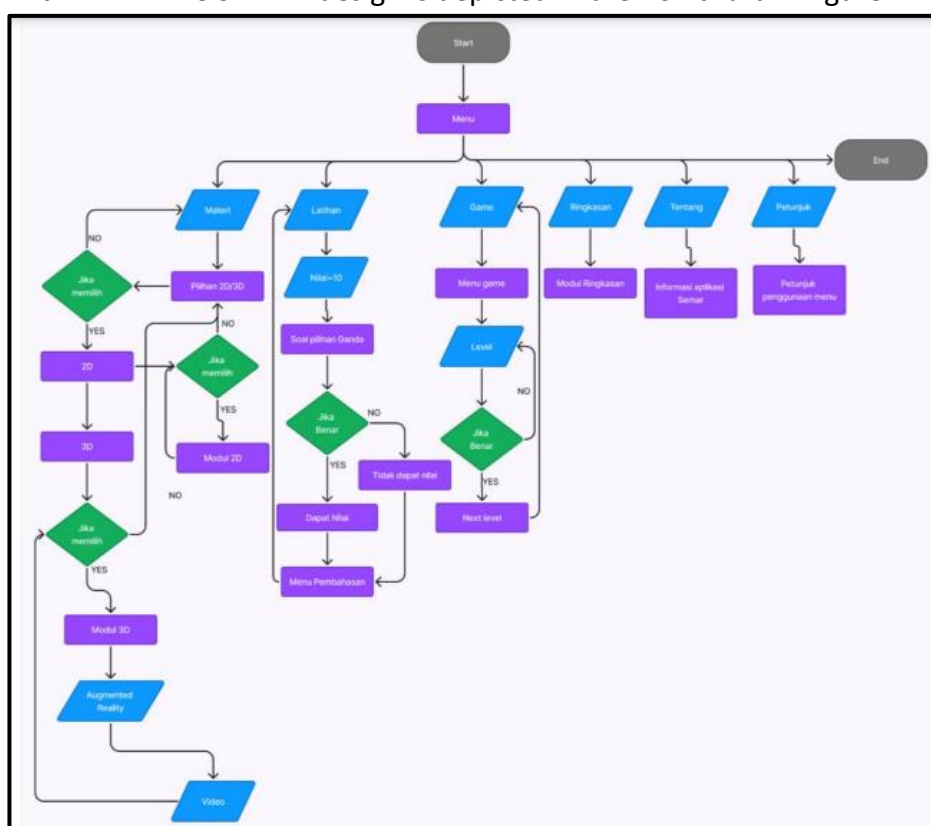


Figure 1. Flowchart of SEMAR

The design and development process of SEMAR, according to the flowchart above, is combined with statistical substance to produce a product design like Figure 2.



Figure 2. Output (SEMAR)

Figure 2 explains that SEMAR multimedia has several features, including 2D and 3D material features, summaries, exercises, and games. SEMAR is also equipped with instructions for use and explanations related to the provider of prototype external cost assistance funds by DRTPM in 2024. Meanwhile, the outcome of the SEMAR prototype development is an increase in student numeracy literacy in statistics learning both in terms of pedagogy and substance, as well as the achievement of independence in learning statistics in Indonesia. The results of the expert validation test are described in Table 1, and the results of the public user response test are described in Table 2.

Table 1. The results of the expert validation test

Assessment aspect	Percentage of NV (%)	Category
Media aspect	89,80	Very eligible
Matter aspect	91,90	Very eligible
Language aspect	91,07	Very eligible
<b>Average eligibility</b>	<b>90,92</b>	<b>Very eligible</b>

Table 2. the results of the public user response test

Assessment aspect	Percentage of RP (%)	Category
Media aspect	76,77	Good user response
Matter aspect	77,89	Good user response
Language aspect	78,96	Good user response
<b>Average user respons</b>	<b>77,87</b>	<b>Good user respons</b>

Based on Table 1, the validation results from seven experts at seven universities in Indonesia are described. The results reveal that the assessment of the media aspect reached a value of 89.80% with a very feasible category, the assessment of the material aspect reached a value of 91.90% with a very feasible category, and the assessment of the language aspect reached a value of 91.07% with a very feasible category. These results state that SEMAR can potentially be used by the wider community in statistics learning. This is because SEMAR is based on Android so that the media is easily accessible to students (Apsari & Rizki, 2018; Wafa & Fahmi, 2021, Darwin et al., 2022), Table 2 describes that the assessment of SEMAR user responses of 161 students at seven universities illustrates that user responses based on the media aspect reached a value of 76.77% with a good user response category, the assessment of the material aspect reached a value of 77.89% with a good user response category, and the assessment of the language aspect reached a value of 78.96% with a good user response category. Likewise, Table 2 describes that the assessment of SEMAR user responses of 161 students at seven universities illustrates that user responses based on the media aspect researched a value of 76.77% with a good user response category, the assessment of the material aspect reached a value of 77.89% with a good user response category, and the assessment of the language aspect reached a value of 78.96% with a good user response category. This good user response is supported by the innovation of features in SEMAR that are friendly to users (students). This is in accordance with research of Santia (2018) and Hidayah et al. (2020), which states that ICT-based learning media can increase students' learning motivation.

## CONCLUSION AND RECOMMENDATION

From the results of the public test, it can be concluded that: 1) SEMAR can improve numeracy literacy competency by 38.5%, and 2) SEMAR was declared feasible through a public test at 7 (seven) universities, namely: UNP Kediri, UNIPMA, Cenderawasih University, UNU Blitar, UNIRA, UKI Toraja, and Khairun Ternate University, with a feasibility value of 90.40%. From the results of the public test, user suggestions were obtained so that SEMAR's app size could be reduced. This research is limited to increasing the level of SEMAR technology readiness, so it is suggested that further cycle development can be carried out for wider dissemination and the process of applied research.

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