

Statistical Literacy Learning Design Using Concept Maps To Facilitate Statistical Literacy Abilities

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Abstract

Statistical literacy is an important skill that must be possessed by students, especially in the field of mathematics education, to understand and analyze data effectively. This study aims to develop a statistical literacy learning design by utilizing concept maps that meet the criteria of validity, practicality, and effectiveness. The research design used in this study is Educational Design Research (EDR). The subjects of this study involved Mathematics Education students of UIN Alauddin Makassar. The research instruments used include validation sheets, guidebooks, student worksheets, test instruments, learning modules, response questionnaires, learning design implementation sheets, and student activity observation sheets. Data analysis was carried out based on three main aspects, namely validity, practicality, and effectiveness. Hypothesis testing was carried out using the Independent sample t-test to compare student learning outcomes between the experimental class using statistical literacy learning design with concept maps and the control class using conventional learning. The results of the analysis show that this learning design is valid after going through a validation process by experts, practical based on positive responses from lecturers and students, and effective in improving student learning outcomes. The results of the hypothesis test using the Independent sample t-test showed that there was a



significant difference between the experimental class and the control class, with an average value of student learning outcomes in the experimental class of 81.04, exceeding the KKM of 75, and classical completeness reaching 83.33%. Thus, the developed statistical literacy learning design has proven effective in improving students' understanding and skills in statistical literacy.

Keywords: Learning Design, Statistical Literacy, Concept Maps

INTRODUCTION

Education in the 21st century demands a paradigm shift in learning methods, where students are not only required to understand basic knowledge, but also develop critical and creative thinking skills, as well as the ability to solve problems that are in line with the needs of the times.(Nur et al., 2024). Therefore, students need learning that can support the thinking process, reasoning process, and development of critical attitudes.(Syamsuddin et al., 2022). Mathematics and mathematics learning are the main components in the education curriculum that have a crucial role in developing cognitive abilities and important skills that are in accordance with the needs of the times. This makes mathematics learning one of the mandatory learning that must be followed by students from various levels.(Sabar et al., 2023;Amin et al., 2024). Mathematics learning is not only limited to mastering formulas and operational procedures, but also provides them with logical, analytical thinking skills and problem-solving abilities needed in everyday life as well as in the professional world.(Suhaeni et al., 2023). As the world becomes increasingly filled with data and information, mathematical literacy becomes a very important element in preparing students to face these challenges.

Mathematical literacy itself refers to an individual's ability to interpret, analyze, and utilize mathematical concepts in various life contexts. (Purwanti et al., 2021;Fauziah et al., 2022). This ability is not limited to mastery of theory, but includes the skills to use mathematics in making decisions based on data obtained from the surrounding environment. One of the main elements in mathematical literacy is the content of uncertainty and data.(Junika et al., 2020). This content focuses on students' ability to understand and manage data, as well as to recognize and account for the uncertainty that often exists in data-based decision making. This is where statistical literacy becomes an integral part of mathematical literacy, because statistics provides the framework needed to collect, process, and analyze data and understand the uncertainty contained in the data. As expressed byPujiati et al. (2023)that mastery of statistical concepts is of course greatly influenced by mathematical abilities.



Statistical literacy, as a branch of mathematical literacy, refers to the ability to understand statistical concepts, analyze data, and interpret the results of statistical analysis in an appropriate context (Maryati & Priatna, 2018; Andriatna et al., 2021; Herlina et al., 2024). This involves an understanding of various statistical techniques, such as those that include the ability to process, organize data, create and display tables, and be able to present data to draw conclusions. (Setiawan, 2019; Indawati et al., 2024). In a world increasingly filled with data, statistical literacy skills are very important, because students who have good statistical literacy can understand information presented in statistical form, whether in research reports, surveys, graphs, or in various life situations that require them to make data-based decisions. Statistical literacy also allows students to develop critical skills in assessing the quality of data and the conclusions generated from the analysis, so that they can make more appropriate and informed decisions. (Andriatna et al., 2021).

However, in reality, statistical literacy skills in Indonesia are still very low and still need to be improved (Habibie & Hidayat, 2022). This is an implication of the low overall mathematical literacy ability, considering that statistical literacy is an integral part of mathematical literacy. Based on the results of the Program for International Student Assessment (PISA) 2015, 2018, and 2022 tests, Indonesia's mathematical literacy score is still far below the international average. In 2015, Indonesia's mathematics score was 386, then decreased to 379 in 2018, and further decreased to 366 in 2022, which shows that students' ability to understand mathematical and statistical concepts as a whole is still limited (OECD, 2019; OECD, 2023). These results indicate a significant decline over the past three years. (Amin et al., 2025). The relatively low PISA score achievement from year to year raises the suspicion that statistical literacy skills developed at school level are inadequate. (Setiawan, 2021).

Furthermore, many students experience difficulties in solving statistical problems related to the real world context, such as interpreting survey data, understanding graphs, or making decisions based on data involving uncertainty. As in research by Hafiz & Nur Atiqoh (2023) shows that the statistical literacy ability scores of students are still in the low category. Other research by The Last Supper (2021) which revealed that students still have difficulty in analyzing data and reading data in the form of diagrams, tables and graphs. In addition, research by The Last Supper (2021) shows that students still have low ability in understanding and communicating data. One of the main challenges is to help students understand abstract and theoretical concepts, so that they can be transformed into practical and relevant understanding to various situations in everyday life. (Baharuddin et al., 2025). In addition to research, data on statistical literacy skills can also be



obtained from the National Assessment (AN) report card in high schools which was first implemented in Indonesia in the 2020-2021 academic year. The results show that achievement in the data and uncertainty domain (statistics) has an average of 49.77%, which indicates that students' statistical literacy skills are still relatively low.(Fitri et al., 2023). This underscores the need for more effective learning approaches, particularly those that can improve overall mathematical and statistical literacy in Indonesia. Given the importance of statistical literacy in making accurate data-based decisions, efforts to improve the quality of education in this area are becoming increasingly urgent.

Realizing this, various efforts are needed to improve statistical literacy skills.students. One effort that can be done is to design a more effective statistical literacy learning design, with an approach that can facilitate students' understanding of statistical concepts that seem abstract and complicated. Statistical literacy learning design based on concept maps is one promising solution in this context. A concept map is a graph structure that contains nodes that are connected to each other with labeled and directed arcs that refer to the form of knowledge representation between two related concepts.(Chiou, 2008;Cañas & Novak, 2014). Concept maps represent visualized relationships between thematically related units of information.(Krieglstein et al., 2022). Another characteristic of concept maps is that the concepts are represented hierarchically with the most inclusive and general concepts at the top of the map and the more specific and less general concepts arranged hierarchically below them.(Novak & Cañas, 2006). Concept maps provide an opportunity for students to think about the relationships between the terms they are learning, organize their thinking and visualize the relationships between key concepts systematically, and reflect on their understanding.(Vanides et al., 2005).

This concept map-based statistical literacy learning design is designed to develop understandingstudents to statistics with a more structured and visual approach. Concept maps provide graphical representations that make it easier for students to organize knowledge and clarify how one concept relates to another.(Novak & Cañas, 2007;Novak & Cañas, 2008). In statistical literacy learning, concept maps are not only used to describe the relationship between statistical concepts, but also to help students see and understand how data is collected, processed, and interpreted. By using concept maps, students can visualize the statistical analysis process more simply, which in turn will improve their understanding of the concepts taught.

Several previous studies have examined the use of concept maps in statistics learning, which has shown positive results in increasing understandingstudents. Research bySolehah et al. (2024)shows that the use of concept maps can make a significant contribution to improving



students' understanding of educational statistics material. Other research by Rohana et al. (2009) revealed that the use of concept maps can help students improve their understanding of statistical concepts. However, previous studies have not specifically examined the application of concept maps in statistical literacy learning designs. This gap is the main focus of this study, namely how statistical literacy learning designs based on concept maps can facilitate students' statistical literacy skills.

The urgency of this research is further strengthened by the results of observations conducted in the Mathematics Education Study Program of UIN Alauddin Makassar, where until now no specific concept map-based statistical literacy learning design has been found. This shows that there is still a gap in the application of effective learning approaches to improve understanding of students to statistical concepts. By designing and developing statistical literacy learning designs based on concept maps, this study aims to provide solutions that can help improve students' statistical literacy skills effectively.

METHOD

This study uses Educational Design Research (EDR) research design, initiated by Plomp & Nieveen (2013), with the aim of designing and developing statistical literacy learning designs based on concept maps. This study refers to Plomp's development model which consists of three main stages: Preliminary Research, Prototyping Phase, and Assessment Phase. In the initial stage, an analysis is carried out to identify problems faced by students in learning statistics, as well as determining the needs of learning design. The prototyping stage involves the development of learning designs that include guidebooks, learning modules, student worksheets (LKM), and test instruments. The resulting design is then tested on semester III students of the Mathematics Education Study Program at UIN Alauddin Makassar. The assessment stage is carried out to evaluate the validity, practicality, and effectiveness of the learning design using questionnaires, observations, and learning outcome tests. Data analysis in this study involves three aspects, namely validity, practicality, and effectiveness, as well as hypothesis testing to assess the impact of the design on student learning outcomes. In this study, the hypothesis test used is the Independent Sample t-test to test the differences between the experimental group and the control group in terms of the effectiveness of the concept map-based statistical literacy learning design. The hypothesis tested is whether there is a significant difference in student learning outcomes between the group using the concept map-based learning design and the group without the concept map-based learning design.



RESEARCH RESULTS AND DISCUSSION

Research result

The research results are described systematically by referring to the Plomp development procedure. The results obtained in each development phase in relation to the design development process are described as follows.

1. Preliminary Research Stage

Preliminary research(preliminary research) is the first stage in the Plomp (2013) model by conducting a preliminary study to determine the needs of lecturers in designing learning as one of the basic considerations in designing statistical literacy learning designs by utilizing concept maps. In this initial stage, a number of preliminary studies were conducted, such as needs analysis, and content analysis of development, review and literature review, and development of a theoretical framework or conceptual framework for developing interventions.

a. Needs and Content Analysis

Needs analysis was conducted to identify the problems underlying the research and the reasons for the importance of implementing statistical literacy learning design by utilizing concept maps. Some of the problems found include the low statistical literacy skills of students, as shown by various studies and the results of the PISA survey which reflect the decline in mathematical literacy scores in Indonesia. Students also have difficulty in solving statistical problems, especially in understanding concepts, presenting data in the form of graphs or diagrams, and implementing problem-solving strategies. In addition, statistics is often considered a difficult and uninteresting subject, so students are less motivated to study it. The teaching method which is still conventional is also an obstacle, because it does not actively involve students in the learning process. Therefore, a more effective approach is needed to improve the understanding of statistical concepts, one of which is by utilizing concept maps. To meet these needs, a more interactive learning design needs to be developed so that students can understand statistical concepts better. The use of concept maps is expected to help students connect various statistical concepts systematically.

b. Content Analysis

Content analysis was conducted to examine the contents of the proposal and examine the proposed learning design. In this study, there are several main components that are the focus, namely the design of statistical literacy learning by utilizing concept maps, a conceptual framework that integrates statistical literacy through concept maps, and a theoretical basis that includes behavioristic, cognitive, constructivist, and humanistic approaches as the basis for



learning design. In addition, the learning model developed includes a series of steps ranging from problem identification to evaluation and reflection. This study uses a research development method based on research design (Design Research) to develop and test the effectiveness of the proposed learning design.

c. Results of conceptual framework development

The results of the development of the conceptual framework in this study are to create a design as a guide for lecturers in designing statistical literacy learning by utilizing concept maps. There are five work procedures for statistical literacy learning design as follows:

1) Formulate learning outcomes.

The first step in designing statistical literacy learning is to formulate learning outcomes. This process is important to ensure that every aspect of the learning design is focused on the desired outcomes and can be measured effectively. The learning outcomes referred to here are the learning outcomes of the course or often called Course Learning Outcomes. Each step towards the final goal can be measured and evaluated systematically.

2) Mapping and Organizing Learning Materials

Mapping and organizing learning materials is an effort to determine and group learning materials into main topics, sub-topics, and main materials according to the learning achievements and indicators that have been determined.

3) Designing Learning Activities

In improving statistical literacy at the college level, learning using concept maps is designed to be fully implemented with the Synchronous Learning approach. This learning approach allows lecturers and students to interact directly in real-time, either through face-to-face or using online learning platforms.

4) Formulate learning steps.

The stages of learning statistical literacy using concept maps are as follows:

Table 1. Stages of Statistical Literacy Learning

Learning Stages	Lecturer Activities	Student Activities
Introduction and Problem Exploration	1. The lecturer begins the lesson by giving a brief introduction regarding the main topic and learning objectives.	1. Students listen to the lecturer's explanation regarding the problem presented. 2. Students focus on understanding the given



Learning Stages	Lecturer Activities	Student Activities
	- The lecturer then presents a real problem that is relevant to the topic to be studied. The problem is presented in the form of a narrative description that contains various complex aspects and challenges that need to be solved, without providing solutions or concept maps. - The lecturer encourages students to understand the context and scope of the problem, asking them to pay attention to key elements of the problem.	problem, identifying key elements of the explanation, and taking notes to aid their thinking process later.
Collaborative Strategy	- The lecturer divides students into work groups and explains the roles and tasks of each member in the group. - The lecturer provides directions on how each group should work together to solve the problem, including how to organize tasks such as compiling concept maps and further investigations. - The lecturer provides guidance on sources of information that can be used by groups in their investigation process.	- Students form groups according to the lecturer's instructions and divide the roles and responsibilities of each member. - The group begins to discuss together how they will approach the problem and what they need to learn more about. - Each group develops strategies to complete tasks such as creating concept maps and planning initial investigations.
Concept Map Investigation and Development	The lecturer directs students to begin the investigation process, providing advice and guidance on information sources and approaches that can be used.	Students in groups begin to conduct in-depth investigations based on the given problem, looking for relevant information and data.



Learning Stages	Lecturer Activities	Student Activities
	2. The lecturer monitors discussions between groups, provides feedback, and helps overcome obstacles encountered in the investigation process.	2. Each group creates an initial concept map based on the results of their investigation, identifying relationships between key elements of the problem and potential solutions. 3. Groups actively discuss to develop their understanding of the problem and create a structured concept map.
Solution Development	1. The lecturer gives direction to students to develop solutions based on the investigations they have conducted and the concept maps they have prepared. 2. Lecturers guide students in developing more concrete solutions and provide feedback to improve or deepen the proposed solutions.	1. Each group develops a solution to the problem they are facing by referring to the concept map they have created. The solution must be connected to the elements of the problem that have been identified. 2. The group discusses in depth to develop a comprehensive solution and considers various aspects of the problem and the implications of the proposed solution. 3. The resulting solutions are outlined in a more detailed concept map and supplemented with supporting arguments.
Presentation and Feedback	1. The lecturer facilitates a presentation session, where each group presents the concept maps and solutions they have developed.	1. Each group presents the results of their work, including concept maps and proposed solutions, to other groups and the lecturer.

Learning Stages	Lecturer Activities	Student Activities
	- The lecturer provides guidance on aspects that students must explain in the presentation, such as the relationship between problem elements and solutions. - The lecturer facilitates discussions and question and answer sessions between groups, providing input and constructive criticism.	- Students from other groups provide input, questions, or criticism of the solutions presented by the group that is presenting. - Each group records the feedback provided to be used in revising and refining the solution.
Solution Revision and Concept Map Refinement	- The lecturer provides final feedback to help students refine their concept maps and solutions, highlighting areas that still need development. - The lecturer facilitates a reflection and discussion session on how to improve the solution based on the feedback received.	- Each group revises their concept maps and solutions based on input provided by the lecturer and classmates. - The group refines the proposed solution by correcting elements that are not appropriate or adding information needed to strengthen their argument. - The final concept map and final solution are prepared to be reported as the final group output.
Solution Evaluation and Implementation	- The lecturer conducts a final assessment of the concept maps and solutions produced by each group. The assessment includes creativity, clarity of solution, and understanding of the problem. - The lecturer also provides opportunities for groups to implement their solutions through	- Students complete their final report which includes a final concept map and a refined solution. - The groups present their final reports and undergo a final evaluation from the lecturer regarding the implementation of the solutions they developed.

Learning Stages	Lecturer Activities	Student Activities
	simulations or applications to other case studies.	3. Students conduct individual and group reflections on the learning process they have gone through.

5) Designing assessment strategies.

Designing an assessment strategy is a crucial step in learning design, because assessment not only serves to evaluate student learning outcomes but also to guide and improve the learning process itself.

2. Prototype Stage

Prototyping phase(prototype stage) is the second stage in the Plomp (2013) model by designing interventions and micro cycles. The interventions in question are not only limited to the form of intervention such as educational programs, learning and teaching strategies, learning materials, products or learning systems but also to everything that supports the success of the intervention such as facilities, policies, norms, rules, and so on. The interventions in this study are (1) A guidebook for statistical literacy learning design using concept maps; (2) Learning Modules; (3) Student Worksheets (LKM); (4) Research instruments consisting of validity instruments, practicality instruments, and effectiveness instruments.

3. Assessment Stage

At the assessment stage in this study is a micro cycle which is an iterative and dynamic development cycle, where the intervention repeatedly undergoes a trial process, formative evaluation, and conceptual revision (redesign) to achieve performance optimization and effectiveness. This microcycle produces data that is rich in information about the quality and effectiveness of learning design. Through the validation process by experts, assessment of design procedures, and a series of trials, quantitative and qualitative data are obtained that can be used to iteratively improve learning design. The results of this evaluation not only show the feasibility of the product, but also provide valuable input for further product development. Before the evaluation was carried out, the research instrument had gone through a validation process by two experts in their fields.

a. Validity Analysis

The research instrument developed has gone through a validation process by 2 experts in



their fields, namely Prof. Hamzah Upu, M. Ed. and Dr. Muhammad Darwis M., M.Pd. These two experts provided a critical assessment of the feasibility and relevance of the instrument. In general, the results of the validation analysis of all instruments can be seen in table 2 as follows.

Table 2. Instrument Validation Results

Type of Instrument	Overall Average	Validity Criteria
1. Design Guide Book Assessment Sheet	3.6	Very Valid
2. Design Implementation Assessment Sheet Prepared by Research Subjects	3.56	Very Valid
3. Expert Response Questionnaire Assessment Sheet	3.52	Very Valid
4. Lecturer Response Questionnaire Assessment Sheet	3.57	Very Valid
5. Statistical Literacy Problem Solving Skills Assessment Sheet	3.64	Very Valid
6. Student Response Questionnaire Assessment Sheet	3.72	Very Valid

Table 2 shows that the average validity value of each statistical literacy design instrument using concept maps is in the very valid category so that referring to the validity criteria, it is at least in the valid category, so the statistical literacy design using concept maps meets the validity criteria.

b. Practicality Analysis

The analysis of the practicality of the design is based on the results of the analysis of the design implementation, and the results of the lecturer response questionnaire analysis. Based on the results of the analysis of the implementation of the statistical literacy learning design, the quantitative analysis shows that the average observation of the two observers is 1.84 and is in the interval 2 with the category of fully implemented. This indicates that the implementation of statistical literacy learning by utilizing concept maps is fully implemented. This finding is supported by data showing the number of agreements between the two observers reached 96, while uncertainty (disagreement) was 9. Thus, the percentage of agreement reached 91.43%, which confirms that both observers have consistent views on the implementation of the components of statistical literacy learning. $1,5 \leq M \leq$ Thus, it can be concluded that the implementation of



statistical literacy learning by utilizing concept maps in the experimental class was generally carried out well. Furthermore, the results of data analysis showed that in the experimental class, the lecturer's response to all aspects of the learning design was in the range of 85-100%, namely 91.46%, indicating a very positive acceptance. This shows that the overall learning design is considered very positive by the lecturer. Evaluation of the practicality criteria shows that the learning design by utilizing concept maps as a whole achieves an adequate degree of implementation in the learning context.

c. Effectiveness Analysis

Evaluation of the effectiveness of statistical literacy design is based on the fulfillment of three main components, namely: 1) student responses, 2) student activities, and 3) learning outcome tests. The following will present the results of the effectiveness test of statistical literacy learning design by utilizing concept maps in the experimental class that has been implemented. The results of student responses can be seen in table 3 as follows:

Table 3. Results of Analysis of Experimental Class Student Responses

Aspects responded to		Response Percentage				Category
		-	%	+	%	
1	Syntax	112	33.94	218	66.06	Good
2	Learning Module	8	3.33	232	96.67	Very good
3	LKM	26	10.83	214	89.17	Very good
Overall Aspects		146	18.02	664	81.98	Very good

Analysis of student response data in the experimental class showed that the average overall aspects of statistical literacy learning design (Syntax, Learning Modules, and LKM) were in the range of 81-100% with a score of 81.98% indicating very good acceptance. This shows that the overall learning design is considered very good and interesting by students. Furthermore, Student activity observation data acts as a supporting indicator in measuring the effectiveness of statistical literacy learning design. Student activities include activities that are systematically observed during five meetings in the experimental class. Based on the results of the analysis, it is known that the percentage of student activity in learning that applies statistical literacy learning design is 82.4%. So based on the category of student activity, the percentage of 82.4% is in the interval of 70% - 85% which means it is in the active category. Overall, several activities show a high level



of participation, such as students making assessments in problem solving and making conclusions from the learning carried out.

The results of the pretest and posttest scores of students in the experimental class can be seen as follows:

Table 4. Analysis of Pretest and Posttest Results of Experimental Class

Interval	Pretest		Posttest		Category
	Frequency	Percentage	Frequency	Percentage	
91 – 100	0	0	3	10	Very high
75 – 90	0	0	22	73.33	Tall
60 – 74	5	16.67	5	16.67	Currently
40 – 59	25	83.33	0	0	Low
0 – 39	0	0	0	0	Very Low
		Pretest Average		49.13	Low
		Posttest Average		81.04	Tall

Based on the descriptive statistical analysis in table 4 on the learning outcomes of 30 students, it can be seen that most students were able to achieve the minimum completion value set after participating in learning with statistical literacy design by utilizing concept maps. Based on the test results before treatment, it can be seen that 83.33% were in the low category and 16.67% of students were in the medium category. However, after being given treatment, there was a significant increase. As many as 10% of students managed to reach the very high category, 73.33% were in the high category, 16.67% were in the medium category and no students were in the low category. The average posttest score also increased to 81.04 which exceeded the KKM value of 75. Based on the learning outcome value after implementing the statistical literacy learning design by utilizing concept maps, the classical completion percentage was 83.33% with an average posttest of 81.04 which was in the high category. Thus, the statistical literacy learning design by utilizing concept maps has a significant positive impact on student learning outcomes.

As a comparison, the results were analyzed in the control class. The results of the pretest and posttest scores of students in the control class can be seen in table 5 as follows:



Table 5. Analysis of the results of the pretest and posttest of the control class

Interval	Pretest		Posttest		Category
	Frequency	Percentage	Frequency	Percentage	
91 – 100	0	0	0	0	Very high
75 – 90	0	0	10	29.41	Tall
60 – 74	0	0	23	67.65	Currently
40 – 59	16	47.06	1	2.94	Low
0 – 39	18	52.94	0	0	Very Low
		Pretest Average		32.06	Very Low
		Posttest Average		69.34	Currently

Based on the descriptive statistical analysis of the pretest learning outcomes of 34 students in the control class, it can be seen that 18 students or 52.94% are in the very low category and 16 students or 47.06% are in the low category. While the posttest results show that only 10 students or 29.41% managed to achieve the KKM. While there are 23 or 67.65% of students in the medium category or did not achieve the KKM.

To determine the comparison between the experimental and control classes, an analysis was conducted using the t-test. The results of the analysis are as follows:

Table 6. Hypothesis Testing

Independent Samples Test						
Gain Score (%)		Leneve Test For Equality Of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
	Equal Variances Assumed	37,661	,080	2.38	62	,020
	Equal Variances Not Assumed			2.27	34,986	,029

Based on the table6 Independent Sample t Test for N-Gain score, it is known that the Pvalue (2-tailed) is 0.020 < 0.05. Thus it can be concluded that there is a significant difference in effectiveness between the experimental and control classes. In other words, the treatment given to the experimental class has been proven to have a significant impact on the results of statistical



literacy learning. Thus, the implementation of statistical literacy learning design by utilizing the developed concept map meets the effective criteria.

DISCUSSION

The research and development that has been carried out has succeeded in producing a product in the form of a statistical literacy learning design by utilizing concept maps. Based on the results of the study, this learning design has met the criteria of validity, practicality and effectiveness. The validity criteria have been strengthened through a validation process involving two expert validators. The validation results are an important basis for making improvements and refinements to the learning design, especially related to the supporting devices and instruments used. The criteria for practicality of implementation are obtained through the analysis of the results of observations of the design of the implementation of statistical literacy learning by utilizing concept maps. In addition, practicality is also obtained through responses and input from lecturers who have implemented this design in classroom learning practices. The effectiveness criteria are evaluated through several indicators, namely student responses to the learning design, observations of student activities during the learning process, and analysis of student learning test results. By fulfilling these three criteria, the statistical literacy learning design by utilizing concept maps is expected to be an alternative effective and innovative learning model in improving the quality of mathematics learning.

The initial stage in developing statistical literacy learning design by utilizing concept maps begins with a needs analysis that covers several aspects, including needs analysis and development context, namely understanding student needs and the context of the learning environment where the intervention will be implemented, reviewing relevant literature to develop theoretical foundations and identify research gaps, formulating a framework for thinking that underlies the development of interventions. Several previous studies also explain that students are at a low level in every indicator of statistical literacy skills.(Fadillah & Munandar, 2021;Prihastari et al., 2022). There are still many students who still have statistical literacy skills in the low category.(Maryati & Priatna, 2018;(Hafiyusholeh, 2015). Meanwhile, according toThe Greatest Showman (2020),Maryati (2017),The Last Supper (2021)explains that one of the things that causes low statistical literacy skills is the difficulty of students in solving statistical problems. The most common difficulty experienced by students is at the stage of creating mathematical modeling and applying strategies to solve problems.(Nugraha & Basuki, 2021).

Furthermore, based on the observation results, it can be seen that students are less careful



when reading data so that the final results obtained in solving problems are not accurate. Meanwhile, based on the results of interviews conducted with students of the Mathematics Education Study Program, Faculty of Tarbiyah and Teacher Training, UIN Alauddin Makassar, and lecturers who teach statistics courses in semester III, explained that students face obstacles in solving statistics problems, have difficulty in presenting data through diagrams and graphs. This is because students misinterpret the answers, have low initial mathematical abilities, as a result they misunderstand how to collect, describe, and interpret data. If we examine the content of the material given in statistics courses, there are quite a few students who have the view that statistics is difficult and unpleasant. The assumption that statistics is difficult makes students not want to study it, even avoid it.

Departing from the problems and relevant literature studies, this research focuses on developing statistical literacy designs by utilizing concept maps. The implementation of statistical literacy learning design by utilizing concept maps has been carried out in the Mathematics Education Study Program, Faculty of Tarbiyah and Teacher Training, UIN Alauddin Makassar. This study involves the implementation of learning design that has gone through systematic development stages, including the preparation of initial drafts, validation by experts, revisions based on validator input, and field trials to ensure the practicality and effectiveness of the design. The research instruments used have also gone through the validation and revision process.

The results of the implementation data analysis show that the statistical literacy learning design using concept maps was implemented well. The design implementation indicator reached an average of 1.85, indicating that all components of the learning design were implemented. This finding shows that the statistical literacy learning design using concept maps can be implemented optimally in the Mathematics Education Study Program, Faculty of Tarbiyah and Teacher Training, UIN Alauddin Makassar. This study provides evidence that learning design has the potential to improve the quality of mathematics learning. High implementation shows that this design is relevant and easy to adapt by lecturers, especially in the Mathematics Education Study Program. In addition, the response from lecturers reached 91.46 which is included in the very positive category.

Evaluation of student responses to the implementation of the learning design showed very good results. Data analysis showed that the average percentage of student responses reached 81.98%, indicating a very good level of acceptance of this learning design. In addition, observations of student activities during the learning process showed a percentage of achievement of 82.4%. This percentage meets the active criteria. The results of this observation indicate that the



statistical literacy design by utilizing concept maps has succeeded in increasing students' active participation in the learning process. Furthermore, qualitative analysis shows that every aspect of the observed activity meets the effective criteria. Students looked enthusiastic and motivated during the learning process. In addition, learning tools (Learning Modules and LKM) were able to increase student learning activities both cognitively and physically so that they had an impact on increasing students' understanding and motivation to learn. Overall, the results of this evaluation indicate that this learning design is effective in improving the quality of mathematics learning, especially in statistics material. This design is not only able to create a conducive learning environment, but also able to increase students' active involvement, understanding of the material, and motivation to learn.

The implementation of this learning design also shows a positive impact on student learning outcomes. Data analysis shows that the average student learning outcomes reached 81.04 which exceeded the KKM of 75. And this achievement also shows classical completion reaching 83.33% which exceeds the classical completion requirement of 70%. These results indicate the effectiveness of statistical literacy learning design by utilizing concept maps can help students achieve the expected competencies. Overall, student learning outcomes provide support for the effectiveness of learning design in improving statistical literacy learning achievement. Overall, research on statistical literacy learning design by utilizing concept maps has very important implications in improving the quality of learning and education development. By implementing this research, lecturers can become more professional, students can learn more effectively and the education system can continue to develop and improve.

CONCLUSION

The conclusion of this study shows that the statistical literacy learning design by utilizing concept maps has met the criteria of validity, practicality, and effectiveness. Based on the results of the validity analysis, the developed learning design was declared valid after being validated by two expert experts, with minor revisions based on their input. In terms of practicality, this design has proven to be practical to use in learning, as seen from the positive response of the lecturer and the implementation of the design which has achieved the criteria of being implemented in full. In terms of effectiveness, the hypothesis test using the Independent sample t-test shows that this design is effective, with student learning outcomes exceeding the KKM and completeness classical which reached 83.33%, as well as active student activities and very good responses.



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