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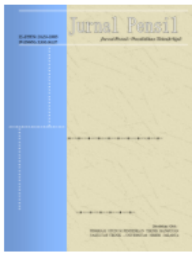

# ROUTE ANALYSIS LEARNING MODULE BASED ON GOOGLE EARTH ROAD CLASSIFICATION FOR GEOMATICS COURSE

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**Abstract**

Due to limited learning resources and low student grades in the Geomatics course, it is very important to carry out this research to improve the quality of special learning activities in the Geomatics course. This research aims to develop a route analysis learning module based on Google Earth Road Classification. This research uses the Thiagarajan Research and Development (R&D) model, known as 4D design. The data collection technique uses a questionnaire to reveal the validity of the product based on material experts, media experts, and user responses. The result of this research is a product development using a 4D R&D model with stages (1) defining, which refers to needs based on competency in Geomatics subjects, especially in operating the Google Earth application; (2) design, which includes four learning activities on A4 paper size and 12pt Arial font; (3) development, which was completed with validation results from material experts totaling 122 scores with an average of 4.07 (suitable); from media experts, 201 scores with an average of 4.28 (very appropriate); as well as the development stage. user feasibility results of 3666 scores with an average of 4.52 (very feasible); (4) the dissemination stage, which is carried out by distributing learning modules to lecturers in geomatics courses and uploading the products developed to Google Drive to be used as learning media. The implications of this research will provide changes to learning activities, and the existence of learning modules is expected to improve student learning outcomes.

**Keywords:** Route Analysis, Google Earth, Learning Module

## Introduction

The rapid development of science and technology requires every human being to have a tenacious and disciplined attitude toward increasing resources (Afifah, 2020). Information technology in education is advancing alongside Indonesia's development in science and industry. Technological developments always go hand in hand with developments in the world of education (Indra et al., 2021). Infrastructure and educational facilities play a critical role in helping educational goals be achieved. Educational facilities are all kinds of equipment used by teachers to facilitate the delivery of lesson material. Meanwhile, educational infrastructure is all kinds of equipment and objects used by teachers (and students) to facilitate the implementation of education (Rohiyatun, 2019). In an educational setting, such as in schools and colleges, this might be helpful to support the execution of the offline and online learning process. Each university aims to provide the best possible graduates for each student. Therefore, to produce quality alumni, we are required to be able to develop the potential of students to be more competent so that they are more innovative, creative, and professional (Nda, 2020). Therefore, the government and universities must play a part in encouraging students to become good and quality graduates to accomplish these educational goals.

Learning media is a means of conveying information or teaching material that can stimulate the learning process (Amalia, 2020). Learning media are needed to increase the effectiveness of learning achievement (N. Dewi et al., 2018). Learning media are all the instruments, processes, strategies, and environments utilized to disseminate knowledge (Hartoyo, 2009). Learning media is a teaching aid (Mahardika et al., 2021). In other words, learning media is a productive way for students and teachers to connect or communicate during the teaching process at a postsecondary institution. According to Utomo et al. (2022), learning media are necessary to link classroom instruction with the real world. The use of media in teaching should be a part that receives attention from educators as facilitators in every learning activity (Nurfadhillah et al., 2021). The existence of media can make learning more interesting and fun (Firmadani, 2020). As technology advances, learning media utilization is becoming more sophisticated (Febrianto et al., 2021). Numerous forms of visual learning media are used during teaching, particularly in postsecondary institutions. Information technology is one of the areas in which the media is used. Using information technology to aid the transmission of educational content is meant to be a component of learning media (Adam & Syastra, 2015). Google Earth software is a multimodal media that can be applied to learning (Burhanuddin, 2022). Google Earth is a geographic information application in the form of a virtual globe (Ashari, 2023). Google Earth is an application in the form of an image of the earth's surface or certain objects with scales, images, lines, and symbols through a projection system (Sukron & Turmudi, 2019). Google Earth displays satellite images of the earth's surface with varying resolutions, allowing users to obtain various information visually, such as houses, roads, rivers, and so on (Nur et al., 2021). Google Earth technology covers the entire world map with satellite imagery. Type in the name of the place or location you want, and you will see an image of the area quickly and more efficiently than using a globe (Dayu et al., 2022). The Google Earth application is often used as a learning medium to present learning concepts to construct the practice course. It is hoped that the use of the Google Earth application will increase the use of better learning tools, thereby increasing students' understanding of the subject matter, which will have an impact on improving learning outcomes (Putra et al., 2019).

Google Earth provides advantages, including: imagery can be accessed and used anytime and anywhere, and using Google Earth imagery really saves usage costs (Phonna & Abdi, 2023). The use of Google Earth-based learning media in learning has advantages. First, increase students' interest and motivation in participating in learning. Second, students gain new experiences, especially in using Google Earth as a learning medium, and improve their' spatial thinking skills (Santoso et al., 2022). Another advantage of using Google Earth is its ability to be used for visual analysis, such as regarding current patterns and sediment patterns in waters that are very clearly visible from the air (Suwandana, 2019). Some of the advantages of the Google Earth application

that can be utilized in Geomatics learning include displaying information in the form of places or cities, forming a contour to find out the difference in the height of the place, measuring distances, making maps, knowing the depth of an ocean and analysing routes or elongated profile. The Geomatics course discusses mapping survey skills detailed in each study with an understanding of processing procedures and the appearance of spatial data properly and correctly (Raharjo & Armi, 2021).

Route analysis is one form of Google Earth application that can be used as learning media in Geomatics courses. The application of Google Earth software has a positive impact on students because Google Earth software is more practical to analyse a road classification job. This software can decrease the constrain of distance, time, and condition, including data on a route's height, distance, and slope. It is also applicable because it can be accessed anytime and anywhere with an internet connection. The learning process, currently performed by lecturers or teachers, is integrated with the online application as a source for learning. For the 2021/2022 school year, several tertiary institutions are still implementing online learning due to the post-pandemic era, the Geomatics course, and the Department of Civil Engineering Education and Planning, Faculty of Engineering, Universitas Negeri Yogyakarta. However, the students still lack Geomatics expertise. The limited learning media is becoming the main factor failing to promote autonomous learning. Based on the learning scores for Geomatics II in A class of 2019, out of 25 students, 32% obtained B+ score, 24% had C, and the rest was E, as presented in Figure 1.

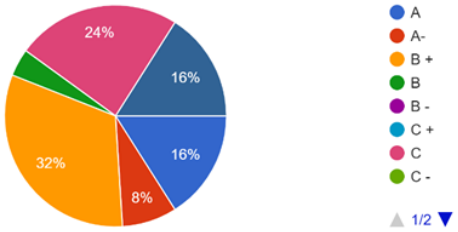


Figure 1. Diagram of Geomatic Students' Scores

The department has developed some modular learning media, but a learning module on route analysis using the Google Earth application does not exist yet. Modules are important teaching materials for learning activities (Ramadhani & Fitria, 2021). A learning module is the smallest learning program unit that can be studied by students individually or taught by students to themselves (Sumarna et al., 2019). The module is formulated as a complete unit consisting of a series of learning activities arranged to assist students in achieving learning objectives that have been formulated specifically and operationally (Elvarita et al., 2020). Learning modules are teaching materials that have independent learning characteristics (Andriani & Lestari, 2021). Modules are arranged in a systematic and interesting manner that covers all learning content and materials, teaching methods, and evaluation (Alimin & Effendi, 2020). Modules are teaching materials written with a purpose so that students can learn independently, without or with teacher guidance (Negara et al., 2019). Modules are independent learning materials that can help students master their learning objectives with programs that are prepared and designed in such a way as independent learning materials to help students achieve their goals (Hananingsih & Imran, 2020). This module is crucial as a standalone learning tool, allowing students to study at their own pace (D. K. Dewi et al., 2017). Module development will be beneficial for students and teachers to have effective, interactive learning process (Syamsudin et al., 2020). The use of learning modules can help students with learning activities, thereby influencing the students' desired learning outcomes (Nizaar et al., 2020). This research has advantages over another research. This research does not only summarize the material into a module but also combines the material with the software used. The software in question is Google Earth.

Developing a route analysis learning module with Google Earth based on road classification is expected to be a sufficient, effective, and innovative teaching material for the students. This

research aims to develop a Google Earth software application module for the Geomatics courses at the Department of Civil Engineering Education Planning, Universitas Negeri Yogyakarta. This study may serve as an alternative solution to the problems of limited learning media (Marsudi et al., 2020). The developed product of the route analysis module using is also expected to enhance students' learning motivation and promote their autonomous learning.

## Research Methodology

This study used the R&D (Research and Development) research methodology, which, as its name suggests, is a process for creating new goods and evaluating their viability. R&D aims to find, develop, and validate a product. This process can take years in increments because it is used to produce or enhance new products. The outcomes can be hardware or software, including learning aids like flashcards, modules, and textbooks. It is envisaged that R&D research will boost educational production by creating results that have undergone rigorous testing for efficacy. The 4D model by S. Thiagarajan (1974) was used to develop this research. The 4D development model consists of define, design, develop and disseminate (Santosi & Sumarjo, 2021). Compared to other development models, the 4D development of each procedure is explained in detail. It contains what researchers will do when developing a product, such as teaching materials, books, or other teaching materials. An illustration of the research process can be seen in Figure 2.

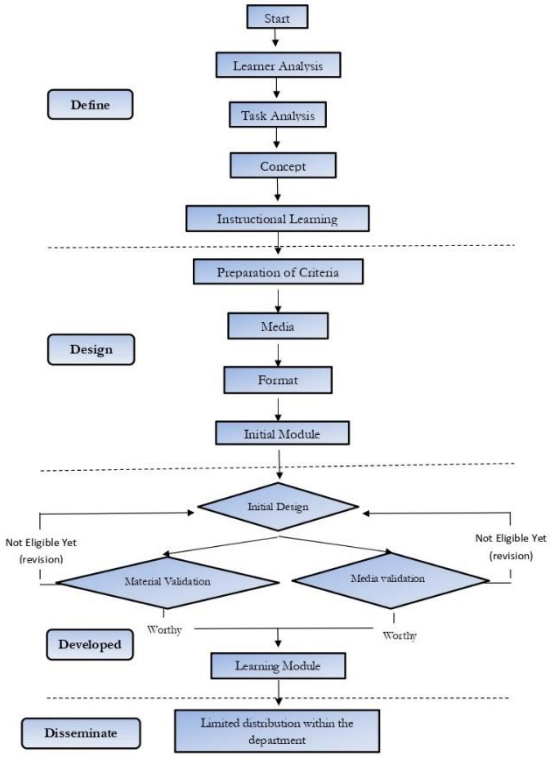


Figure 2. Learning Module Development Stages

The Define stage is the initial stage carried out by identifying problems and gathering various information on the competencies of the Geomatics course. This stage consists of learner analysis, lask Analysis, concept analysis, and analysis of instructional objectives. The second stage of design is designing a product. The following are some of the learning module design processes applied, namely (1) arranging the media concept, (2) finding various sources of suitable material and grouping them, (3) arranging learning material, and (4) creating a learning layout. The develop stage includes validator evaluation so that learning media products can be implemented at this stage. It requires validation to examine the product design, which was done by expert assessment. The assessment in each field provides suggestions for improving the design of the materials to be

produced. Therefore, product design testing on real objects is called development testing. It is used to obtain feedback data from the users' responses to improve the product. After making improvements, it was tested again to make it more effective. The dissemination stage of this study involves 3 steps so the product could be disseminated, including (1) validation testing; (2) final packaging; and (3) diffusion and adaptation. The purpose of disseminating this product is to show the scope of the learning process for the Geomatics course at the Department of Civil Engineering Education and Planning, Universitas Negeri Yogyakarta. However, the research is limited to focus on the validation testing stage, which was discussed in this paper, and the subjects were limited to students taking Geomatics courses and the lecturers teaching the courses.

The subjects for this study were students in semesters 4 and 6 of the 2020/2021 students in the Civil Engineering Education and Planning Study Program, Faculty of Engineering, Universitas Negeri Yogyakarta, who were taking the subject Geomatics course and the material experts and media experts of Route Analysis based on Road Classification in the Google Earth Application. This study's focus is gathering a specific information-learning tool built on Google Earth. The questionnaires were distributed to evaluate the feasibility of the developed learning modules. To confirm the developed instructional materials' feasibility, the expert in material and media aspects were involved in reviewing and examining the developed products.

## Research Results and Discussion

As explained above, this research was done through the 4D development method, including the define and design as the results of the initial product development. It was followed by the development stage involving the material and media experts' validation process and the user's responses (students). The final stage of the 4D development method was the dissemination, which will be carried out at the Department of Civil Engineering Education and Planning, Universitas Negeri Yogyakarta.

### Define

Several learning media have been developed in the Department of Civil Engineering Education and Planning, Universitas Negeri Yogyakarta, especially in the Geomatics course, but the learning process is still constrained. In learning, lecturers or teaching staff still focused on the internet as a learning source. Many materials are felt to have not been fully conveyed so students still found it difficult to master the competencies in the Geomatics course. The limited learning media in conveying material failed to promote students' autonomous learning. Four main concepts must be comprehended by students as learning activities, as follows: (1) route analysis based on road classification, (2) Google Earth application, (3) spatial data processing, and (4) route analysis based on Google Earth Road classification in Geomatics course.

In this study, instructional objectives were determined as learning objectives in learning media and referred to the competencies of the Geomatics course. Based on the competence of explaining and practicing Geographic Information System (GIS), in this case, the operation of the Google Earth application, this study determines the learning objectives in learning media. It Is expected that students can make Route Analysis using the Google Earth application in a proper and structured procedure after studying this module.

### Design

This study chose the module as the developed learning medium to overcome the basic problems experienced by students and lecturers in the learning process. Compared to learning videos and interactive media that require devices, such as smartphones or computers, the use of modules will be more accessible to students. Meanwhile, from a financial point of view, modules are more cost-effective than other learning media because the manufacturing process only requires a low budget. The cost might be for the hardcopy, or printed versions if necessary.


Figure 3. Front Cover Design


Figure 4. Design of the Back Cover

This learning module was designed using a paper format based on the ISO series A standard, i.e., A4 paper format with dimensions of 21.0 cm x 29.7 cm. The selected font style is Arial, with a size of 12 pt and a spacing of 1.5 pt.

Development

The validation results from the material expert on the developed products showed that the media of the route analysis was "feasible". The material validation emphasised five assessment aspects with 30 statement items in the questionnaire. Based on Sukmantari et al. (2022), the score categories in the material expert questionnaire are 5 "Very Feasible", 4 "Feasible", 3 "Quite Feasible", 2 "Infeasible," and 1 "Very Infeasible". Below is a graphical data comparison of the number of scores based on the results of the material validation.

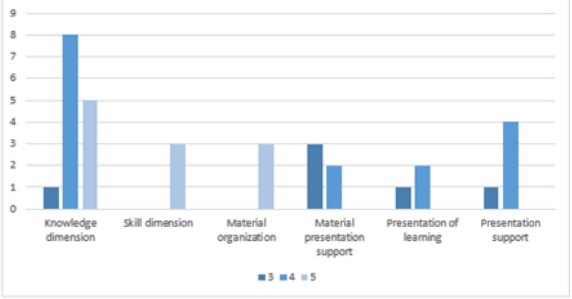


Figure 5. Validation Results of Material Experts

The material expert's assessment data was analysed and obtained the following overall average.

Table 1. Data Analysis from Material Experts

| Score Conversion | Score | Categories |
|---|---|---|
| 126 < X | | Very Feasible |
| 102 < X ≤ 126 | **122** | **Feasible** |
| 78 < X≤102 | | Quite Feasible |
| 54 < X ≤ 78 | | Infeasible |
| X ≤ 54 | | Very Infeasible |

The material expert's assessment scored 122 and an average of 4.57, so by referring to Table 1, the developed learning module can be categorised as "Feasible". Several suggestions and inputs from the material expert were used as references to revise the product. The validation results were feasible, scoring 3, 4, and 5 for each aspect. The assessment items that obtained a score of 3 were subject to revision in future research. The comments given by material experts are the following: (1) the cover should be in line with the title (characterizes the title); (2) The module title should be in a larger font; (3) The identity of the module maker and agency must be clear; (4) The concept map should be made into a chart for each learning activity to make it clearer; (5) The cover of each learning activity should be changed in base color; (6) the theory and sources should be added to each learning activity; (7) the image that matches the material should be added; and (8) the formative tests should be based on the learning objectives.

Validation Results of the Media Experts

The validation results from the media expert on the developed products also indicated that the media of the route analysis was "very feasible" as presented below. The questionnaire for the media expert was also contained in 30 statements and analysed based on Sukmantari et al. (2022) categorisation.

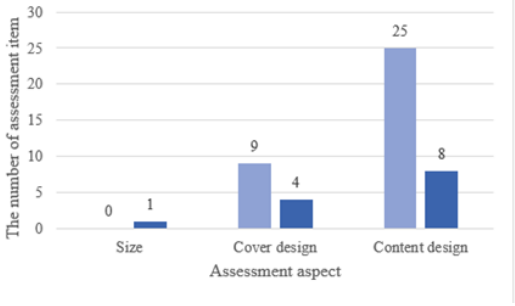


Figure 6. Results of Media Expert Validation

The media expert's assessment data were analysed and the following overall results were obtained.

Table 2. Data Analysis from Media Experts

| Score Conversion | Score | Categories |
|---|---|---|
| 197.4 < X | **201** | **Very Feasible** |
| 159.97 < X ≤ 197.4 | | Feasible |
| 122.22 < X≤159.97 | | Quite Feasible |
| 84.66 < X ≤ 122.22 | | Infeasible |
| X ≤ 84.66 | | Very Infeasible |

The material expert's assessment scored 199 and an average of 4.28, so by referring to Table 1, the developed learning module can be categorised as "Very Feasible. In the media expert validation, the subject for correction of the developed learning module was in the aspects of the cover design, i.e. (1) the picture on the cover should be taken from a good perspective; and (2) the sharpness of the cover image should be improved. Each indicator gets an assessment score of 3 (quite feasible). It means that the author's cover aspect is still not optimal and will be improved in further research. The media experts also mentioned that, in other aspects, the developed route analysis learning module was good and feasible to use. To fully express the objectives and information of the module, it is intended that all evaluative results—particularly those about components of the cover design and module content—will be accommodated throughout the development of future modules.

Results of User Responses

The user feasibility test phase was conducted on 30 students of the 2020/2021 academic year in the Department of Civil Engineering and Planning, Universitas Negeri Yogyakarta, who joined the Geomatics course. The feasibility test assessment from the user's point of view was divided into 2 aspects, namely, the material and the media feasibility aspect. There were 13 statement indicators for the material aspect and 12 statements for the media aspect. In the material aspect, several indicators included: (1) the media purposes; (2) the clarity of material; (3) Ease of understanding; (4) usability; (5) learning interest; (6) attractiveness; and (7) curiosity promotion. Meanwhile, in the media aspect, the indicators covered: (1) ease of use; (2) sentence clarity; (3) the illustrations; (4) creativity and innovation. The score categories contained in the questionnaire are 5 "Very Feasible", 4 "Feasible", 3 "Quite Feasible", 2 "Infeasible" and 1 "Very Infeasible".

The material aspect feasibility results were gained based on the users' response with a score of 1894 out of 2100. Meanwhile, the media aspect feasibility results obtained a score of 1772 from the maximum score of 1950. In this way, the average score of the user feasibility test results was obtained with the value of 4.52 on 5.00 scale. Furthermore, the lowest score obtained in the user feasibility test was 3 and there were 38 indicators in the material aspect, with a score of 3 from 30 users. Regarding the media aspect, 34 indicator items scored 3 out of 30 users. The data from user responses were analysed based on the calculation of the Mean Ideal (Xi) and Standard Deviation (Sbi) with the overall average as follows.

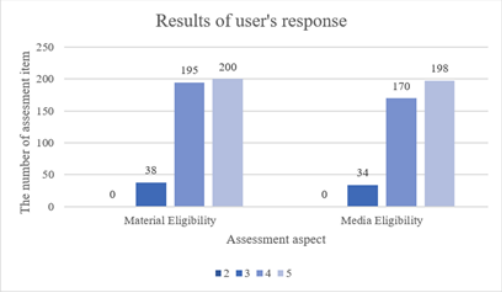


Figure 7. Validation Results Based on Students' Responses

The assessment of users' responses is analysed to obtain the overall average for categorisation according in table 3.

Table 3. Analysis of User Feasibility

| Score Conversion | Score | Categories |
|---|---|---|
| 3402 < X | **3666** | **Very Feasible** |
| 2754 < X ≤ 3402 | | Feasible |
| 2106< X≤ 2106 | | Quite Feasible |
| 1458< X ≤ 2106 | | Infeasible |

| Score Conversion | Score | Categories |
|---|---|---|
| X ≤ 1458 | | Very Infeasible |

Based on Table 3, the assessment based on the users' responses obtained a score of 3666 and an average of 4.52, or it can be categorised as "Very Feasible". During the feasibility based on the user's point of view, several corrections to some indicator items scored 3. Those become the focus of improvements in preparing further research.


Figure 8. Learning Media Poster

Disseminate

The module was printed in hard copy only for the validation process by material and media experts. The dissemination of the learning module was packaged in PDF format or softcopy form as well as in the form of a QR code module poster for Geomatics course. It can be easily accessed since it has been uploaded to Google Drive with the following address: http://bit.ly/ModulAnalisisRutewithGoogleEarth.

Figure 9. QR-Code to Access the Developed Module

Relevant Studies

The gap between this research and other relevant studies is in the application use even the others also develop modules and GIS (Geographical Information Systems). The advantages of this research compared to relevant research are in the dissemination stage, where the relevant research only distributes products via the Google Drive link, while it is completed with QR code module poster for the developed module of the Route Analysis Based on Google Earth Road Classification.

The results of the research show that the learning module is suitable for use. The resulting module provides an update compared to the results of similar studies. This learning module is designed not only to convey material but also to integrate the use of Google Earth software, which is equipped with steps for using Google Earth. Apart from that, this research used QR code posters to disseminate the module. This is different from previous research, which used Google Drive to disseminate research results. However, on the other hand, this module is only relevant for use in

the location that is the subject of research and may not necessarily be used in other locations. Because the problems faced at this research location are not necessarily the same as at other locations, in further development research, it would be better if there were not just one research location, but samples taken from different locations so that the problems are more complex. and the results can be generalized.

## Conclusion

The development of learning module of Route Analysis Based on Google Earth Road Classification in the Geomatics Course involved: (1) define stage which referred to the need based on the competencies of the Geomatics course, especially in operating the Google Earth application; (2) design stage which involved with four learning activities of A4 paper size and 12pt arial font; (3) develop stage which was completed with the validation results from the material experts of which 122 scores with an average of 4.07 (suitable), from the media experts of 201 scores with an average of 4.28 (very feasible), as well as the feasibility results from the user of 3666 scores with an average of 4.52 (very feasible); (4) Disseminate stage of which the researcher make the printed version only for assessment of the material and media expert. The dissemination of the learning module was packaged in PDF format in the form of a softcopy and QR code. Those were uploaded to Google Drive, so the learning module can be widely used for the Geomatics course.

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