Research Model Development: Brief Literature Review

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Research and development is a research method to develop and test products that will later develop in education. Various kinds of research models can be used as a reference in this Research and Development research; here are the different models used in research and development (Amali et al., 2019).

Borg and Gall Development Model
Borg & Gall 1983, this development model uses a waterfall path at the development stage. The Borg and Gall development model have relatively long sets because there are ten implementation steps: (1) research and data collection, (2) planning, (3) product draft development, (4) field trials, (5) refinement of initial product, (6) field trial, (7) perfecting the product of field test results, (8) field implementation test, (9) final product refinement, and dissemination and implementation (Hamdani, 2011). The steps are shown in the following chart:
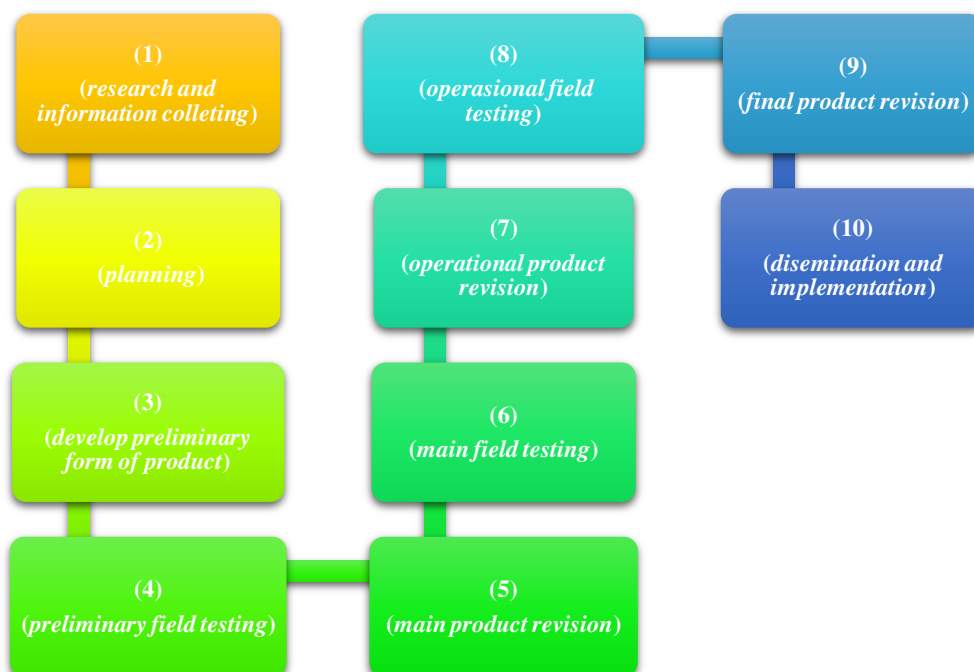

Figure 1. Development Research Model (Borg & Gall, 1983)

The stages carried out in the development of this research are in detail as follows.
Research and information collecting, included in this step, are literature studies related to the problems studied and preparation for formulating a research framework.

Planning includes formulating skills and expertise related to the problem, determining the objectives to be achieved at each stage, and, if possible/necessary, carrying out a limited feasibility study.

Develop a preliminary form of product, which develops the initial state of the product to be produced. Included in this step is the preparation of supporting components, preparing guidelines and manuals, and evaluating the feasibility of supporting tools.

Preliminary field testing, namely conducting initial field trials on a limited scale. By involving as many as 6-12 subjects. In this step, data collection and analysis can be done by means of interviews, observations or questionnaires

Main product revision, namely making improvements to the initial product produced based on the results of the initial trial. This improvement is very likely to be carried out more than once, in accordance with the results shown in a limited trial, so that the main product (model) draft is ready to be tested more widely.

Main field testing, the main test involving all students

Operational product revision, namely making improvements/improvements to the results of a more comprehensive trial, so that the product developed is already an operational model design that is ready to be validated

Operational field testing, which is a validation test step on the operational model that has been generated

Final product revision, which is to make final improvements to the developed model in order to produce a final (final) product.

Dissemination and implementation are steps to disseminate the product/model developed and apply it in the field.

The Borg and Gall development model have its advantages and disadvantages. The benefits of this model are that it can produce a product with a high validation value and encourages a continuous product innovation process, while the weakness of this model is that it requires a relatively long time because the procedure is fairly complex and requires a large amount of funding.

4D Development Model
According to (Thiagarajan, 1974) consists of four stages of development. The first stage is Define or often referred to as the needs analysis stage, and the second stage is Design, namely preparing a conceptual framework of models and learning tools, then the third stage is Develop. Namely, the development stage involves validation tests or assessing the feasibility of the media, and the last is the Disseminate stage, namely implementation on targets subject of research.
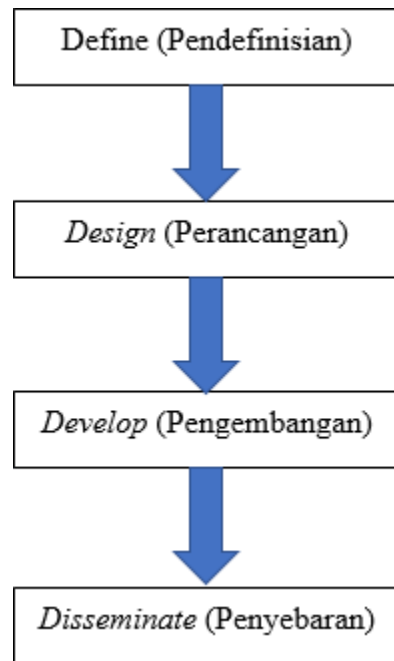
Figure 2. 4D Development Steps

The details of the development stages are as follows:

Define Stage (Defining)
The initial stage in the 4D model is the definition of development requirements. Simply put, this stage is the needs analysis stage. In product development, the developer needs to refer to the development requirements, analyze and collect information on the extent to which action needs to be carried out.

The stage of defining or analyzing needs can be done through an analysis of previous research and literature studies. (Thiagarajan, 1974) mentions that there are five activities that can be carried out at the defined stage, which include:

Front-end Analysis
The initial analysis is carried out to identify and determine the basic problems encountered in the learning process so that it is the background for the need for development. By conducting a preliminary analysis, the researcher/developer obtains an overview of facts and alternatives
solution. This can help in determining and selecting the learning tools to be developed.

Learner Analysis
Student analysis is an activity to identify the characteristics of students who are the target of developing learning tools. The characteristics in question are related to academic abilities, cognitive development, motivation and individual skills related to learning topics, media, formats, and languages.
Task Analysis

Task analysis aims to identify the skills studied by the researcher and then analyzed them into additional skill sets that may be needed. In this case, the educator analyzes the main tasks that must be mastered by students so that students can achieve the specified minimum competencies.

Concept Analysis
Concept analysis involves identifying the main concepts to be taught, putting them in a hierarchical form, and detailing individual concepts into critical and irrelevant matters. Concept analysis in addition to analyzing the concepts to be taught also arranges the steps that will be carried out rationally.

Specifying Instructional Objectives (Formulation of Learning Objectives)
The formulation of learning objectives is useful for summarizing the results of concept analysis and task analysis to determine the behaviour of the research object.

Design Phase (Design)
The second stage in the 4D model is designed. There are 4 steps that must be passed at this stage, namely the constructing criterion-referenced test (preparation of test standards), media selection (media selection), format selection (format selection), and initial design (initial design).
Constructing Criterion-Referenced Test The preparation of test standards is a step that connects the defining stage with the design stage. The preparation of test standards is based on the results of the analysis of the specification of learning objectives and the analysis of students. From this, a learning outcomes test grid was compiled. The test is adjusted to the cognitive abilities of the students and the scoring of the test results uses an evaluation guide that contains a scoring guide and an answer key to the questions.

Media Selection
Broadly speaking, the selection of media is done to identify learning media that are appropriate/relevant to the characteristics of the material. Media selection is based on the results of concept analysis, task analysis, characteristics of students as users, and distribution plans using various media variations. The selection of media must be based on maximizing the use of teaching materials in the process of developing teaching materials in the learning process.

Format Selection
The choice of format in the development of learning tools aims to formulate the design of learning media, the selection of strategies, approaches, methods, and learning resources.

Initial Design
The initial design is the overall design of the learning device that must be done before the trial is carried out. This design includes various structured learning activities and the practice of different learning abilities through teaching practices (Microteaching).

Development Stage (Development)
The third stage in the development of 4D model learning tools is development. The development stage is the stage to produce a product development. This stage consists of two steps, namely expert appraisal (expert assessment) accompanied by revisions and developmental testing (development trials).

Expert Appraisal
The expert appraisal is a technique to get suggestions for material improvement. By conducting an assessment by experts and getting suggestions for improvement of learning devices developed, then revised according to expert advice. Expert assessment is expected to make learning tools more precise, effective, tested, and have high techniques.

Developmental Testing (Trial Development)
Development trials were carried out to get direct input in the form of responses, reactions, comments from students, observers on the learning tools that had been prepared. Trials and revisions are repeated with the aim of obtaining effective and consistent learning tools.

Disseminate Stage (Dissemination)
The last stage in the development of 4D model learning tools is the dissemination stage. The final stages of final packaging, diffusion, and adoption are the most important though most often overlooked.

The dissemination stage is carried out to promote the product developed so that it is accepted by users by individuals, groups, or systems. Packaging material must be selective in order to produce the right shape. There are three main stages in the dissemination stage, namely validation testing, packaging, and diffusion and adoption.

In the validation testing stage, the product that has been revised at the development stage is implemented on the real target or target. At this stage, measurement of the achievement of objectives is also carried out which aims to determine the effectiveness of the product being developed. Furthermore, after being implemented, researchers/developers need to observe the results of achieving goals, the solutions that have not been achieved must be explained so that they do not repeat themselves after the product is disseminated.

At the stage of packaging and diffusion and adoption, product packaging is done by printing an application manual which is then disseminated so that it can be absorbed (diffusion) or understood by others and can be used (adopted) in their class.

Things that need to be considered in carrying out dissemination/dissemination are user analysis, strategies and themes, the timing of dissemination, and selection of dissemination media.

The advantage of the 4D model is that it does not require a relatively long time because the stages are relatively not too complex. The weakness of the 4D model is

that in the 4D model it only reaches the deployment stage, and there is no evaluation, where the evaluation is meant to measure the quality of the product that has been tested, product quality tests are carried out for results before and after using the product.

ADDIE Development Model
Dick et al. (2005) developed a development model, namely the ADDIE model, the model consists of five stages of development.
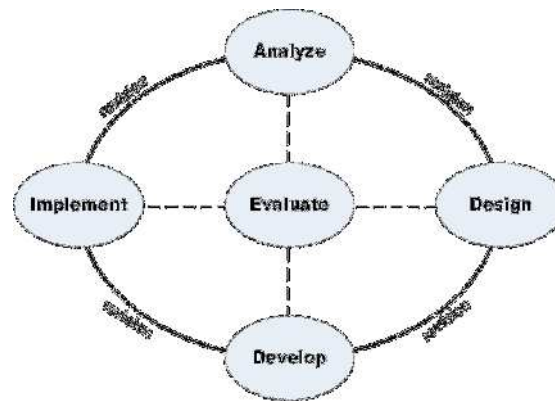

Figure 3. ADDIE Development Steps

The model involves the stages of model development with five steps/development phases including Analysis, Design, Development or Production, Implementation or Delivery and Evaluations.

ADDIE Development Research Model Stage
Analysis
In the ADDIE development research model, the first stage is to analyze the need for new product development (models, methods, media, teaching materials) and analyze the feasibility and requirements of product development. The development of a product can be initiated by a problem in an existing/applied product. Problems can arise and occur because existing or available products are no longer relevant to target needs, learning environment, technology, student characteristics and so on.

Design
Design activities in the ADDIE development research model are a systematic process that starts with designing the concepts and content in the product. Designs are written for each product content. Instructions for implementing the design or manufacture of the product are attempted to be written in a clear and detailed manner. At this stage, the product design is still conceptual and will underlie the development process at the next stage.

Development
Development in the ADDIE development research model contains activities for the realization of product designs that have previously been made. In the previous

stage, a conceptual framework for implementing a new product has been developed. The conceptual framework is then realized into a product that is ready to be implemented. At this stage, it is also necessary to make instruments to measure product performance. The application of the product in the ADDIE research and development model is intended to obtain feedback on the product being made/developed. Initial feedback (early evaluation) can be obtained by asking questions related to product development goals. The application refers to the product design that has been made.

Evaluation

The evaluation stage in the ADDIE model development research is carried out to provide feedback to product users so that revisions are made according to the results of the evaluation or needs that have not been met by the product. The ultimate goal of evaluation is to measure the achievement of development goals.

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