

RESEARCH AND DEVELOPMENT (R&D) METHOD AS A MODEL DESIGN IN EDUCATIONAL RESEARCH AND ITS ALTERNATIVES

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ABSTRACT: The growth of educational research as one of scientific research has come to the state where the researchers in this field make their studies to generate a model for better educational practices. One of the most outstanding model designs is Research and Development (R&D) Method by Borg & Gall (1983), nevertheless, the widely use of this method prompts a question whether it is the only proper method in educational research. This paper is aimed to discuss in depth the R&D Method in some educational research by comparing the simplified steps and characteristics in those research. This paper also provides some alternatives of model design for educational research in which the usage and its implementation are adjusted in accordance to the research context and researchers characteristics.

Keywords: Educational research, model design, research and development method

Scientific research is conducted to test, revise, or even discover scientific theories. It is oriented to find more reliable state of the theories themselves and applied to all branch of sciences including education. Educational research is conducted in relation to education fields within there are theories from other disciplines regardless the methodologies, principles, and concepts (Yates, 2004). Research in education commonly conducted to check, modify or develop new information related to fundamental phenomena in education, which is also known as *basic approach* and practices in education or *applied approach*. Lodico, Spaulding, & Voegtle (2010) in their book mentioned *basic approach as academic research*, which they argued to seek the truth or to develop educational theories. Meanwhile, *applied approach* is mentioned as *contractual research* focusing on finding solution to educational problems through practices. Specifically, in applied approach or contractual research, the methodologists might design and/or test a product or model to elucidate existing educational problems.

The researchers in education fields applied a *research and development (R&D) method* by Borg & Gall (1983) as a method to develop and validate their educational products. In fact, this method has been tremendously applied by education practitioners and pedagogues in designing their models of educational products (Gay, 1991). The favorable of this R&D Method, hence, questions whether R&D Method by Borg & Gall (1983) as the only model design in educational research. Here after, this paper is intended to explore the R&D Method as a model design in educational research as well as offers some alternatives of model designs for educational products.

LITERATURE REVIEW

In 1960s, R&D (also written as *R+D* and *R'n'D*) method, alias Research and Technological Development (RTD) in Europe, became a dominant approach in the fields of development

in technology and investment in business. It refers to activities for innovation by institutions or corporations to develop or improve their existing products or services. The purpose was to maximise human understanding in order to improve society as a whole. The activities were varied and different from one corporation to others. However, regardless to the differences, this method gained attention from other fields due to its linearity and turned into a default model for innovation.

Later on, in 1980s, this method was coined out by Borg and Gall as a model design for educational research. It is applied in the process for developing and validating educational products (Borg & Gall, 1983). It is also concerned with the development of product-oriented research used in education (Borg & Gall, 2003) and the improvement of education quality as it is connected to the evaluation program in education domain (Gall, Fall & Borg, 2007). Additionally, Gay(1992) also argued that R&D is not merely to evaluate theories in education but mainly to develop effective products for special school programs like teaching and learning materials and media.

R&D Method Steps by Borg & Gall (1983)

In their book, Borg & Gall (1983:775) proposed ten steps in conducting R&D Method. The steps are organized in the following order.

1. Research and Information Collection

The research is started by studying the related literatures, need analysis, and framework preparation.

2. Planning

It includes formulating skills and expertise regarding the problem of the research, formulating objectives of each stage, and designing research steps and necessary feasibility study.

3. Developing Preliminary Form of Product

In this step, the preliminary educational product, some named it as 'trial product', is developed by preparing and evaluating the supporting components, and also its guidelines and manuals.

4. Preliminary Field Testing

The preliminary product is tested in limited scale to some selected parties(3-4) through interview, questionnaire or observation to gain and analyze the data for next step.

5. Revising Main Product

The preliminary/trial product is revised using the data gained in step four. The revision is likely to be done more than once depends on the results of trial product. The revision is ready for wider testing.

6. Main Field Testing

This step is also called main testing in which the revised educational product is tested in wider scale to many parties (5-15). The data are commonly collected by qualitative method. Some products need to be carried out in an experimental research design to get the precise feedback/data for next step.

7. Revising Operational Product

The revised product in this step is revised again based on the gained data in step six. The product is then developed as an operational model design to be validated.

8. Operational Field Testing

The validating of operational model is conducted to massive parties (30-40) through interview, observation, or questionnaire. The data are the bases for revising the product in the final step. It is intended to ensure whether the model completely set for using in educational fields without the researchers as the counsellors.

9. Revising Final Product

The product is completely revised by the gained data in step eight and launched as the final educational product.

10. Disseminating and Implementing

The product dissemination is conducted to public especially in education field through seminars, publication, or presentation to related stakeholders.

The flow of R&D Method steps is organized in the following chart.

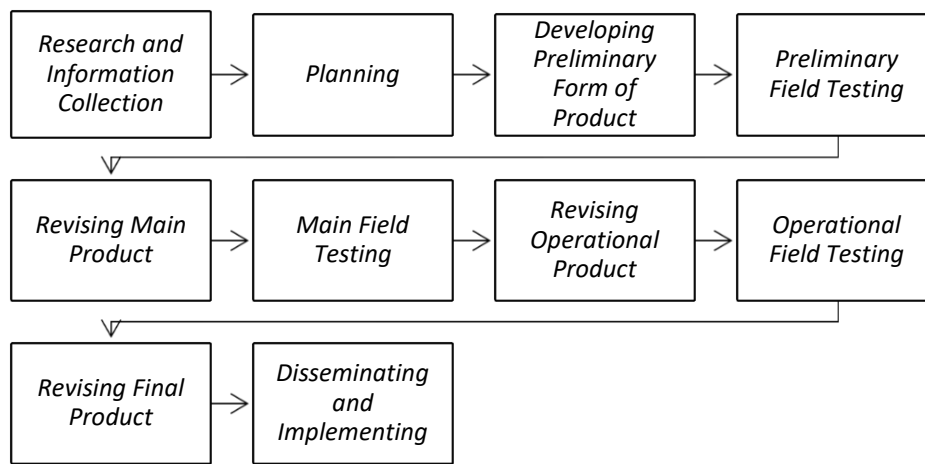


Figure 1. R&D Method Steps (Borg & Gall, 1983)

Nevertheless, in the implementation some educational researchers modified the ten steps into simpler steps due to the need and context of their research. There are twelve studies using the R&D Method by Borg & Gall (1983) taken for examples how the steps are simplified. The simplification is summarized in the following table.

Table 1. Summary of Borg & Gall’s R&D Method Steps Simplification

Researcher	Topic	Steps Simplification
Buchori & Setyawati (2015)	a learning model of character education through e-comic	5 steps: the preliminary research (literature study field study); design (design model and the media); realisation/construction (design assessment-revised design); test, evaluation and revision

		(improvement products hypothetical); and implementation
Buchori, Setyosari, Dasna, & Ulfa (2016)	a character-building model learning using augmented learning	4 steps: revising design; trial usage; revising product; and mass production.
Daulay & Zaman (2012)	an online tutorial model through FAQ application	6 steps: collecting information, designing product; developing preliminary product; preliminary testing; revising; field testing.
Divayana, Adiarta, & Abadi (2003)	a computer program evaluation	5 steps: research and collecting information; planning; design development; preliminary field testing; and preliminary product revision.
Febriana (2016)	a pedagogical material for student-teacher	3 steps: preliminary study; development; and validation
Hidayah, Ramli, & Hanafi (2018)	a modeling technique for improving student's life	3 steps: preliminary study through literature and needs; product development planning, and preparation and development of prototyping modelling techniques
Putri & Wardoyo (2017)	accounting learning tools	8 steps: need analysis; financial accounting learning tools design development; validation; product revision I; limited field trial; product revision II; field trial; final product.
Rofii, Murtadho, & Rahmat (2018)	a writing module	4 steps: preliminary research; model development planning; validation; evaluation and revision; and model implementation
Rosnawati, Kartowagiran & Jailani (2015)	A formative assessment model of critical thinking in learning mathematics	5 steps: preliminary study; developing a design; developing the product and validation of the product; a field trial; and dissemination/ implementation.
Suharso (2012)	a model learning using Augmented Reality	4 steps: system planning; developing program application; testing; and evaluation
Utomo, Muslimin, & Darsikin (2015)	an interactive learning material using multimedia approach	5 steps: product analysis; product developing; expert validating & revising; limited testing; and final product.
Wenno (2010)	a learning module for exact science using problem solving	6 steps: preliminary survey; designing proposed model; product testing; product developing; validation; and socialisation & implementation

The Table 1 indicates that the steps were modified into 3-8 steps, but most of the researchers using 5 modified steps. All researchers started their research by preliminary study as suggested by Borg & Gall (19983), only Buchori et.al. (2016) started their research by revising design due to the context of their research.

R&D Method as a Model Design in Educational Research

R&D methodologists in educational research are obligatory to generate effective and efficient products or services related to pedagogical or educational practices. This method develops or designs the proposed models for educational practices in some steps as mentioned above. As Yang, You, & Chen (2005: 167-168) argued that a model is a narrative description to describe the procedure or steps in achieving a specific goal, and these steps can be used to measure success or failure in achieving the goal. The models are, either products or service, produced through R&D Method are intentionally planned to the improvement, development and evaluation of education system. The models are concerned as the representative of the real system. In line with Yang et.al. (2005), Kauffman (2009) also argued that a model based on a certain concept refers to the rational system of objects as products. It is not the actual practice of the objects. Having Yang and Kauffman's argument, it can be concluded that a good proposed model must have the following characteristics: (1) descriptive narrative; (2) logical procedures or steps; (3) specific purpose; (4) measurable success; and (5) representative of a system.

Furthermore, the produced model has its own classification. There are four types of models as proposed by Gati & Asher (2001): predictive; prescriptive; descriptive; and normative. Predictive model refers to a model with narration of the processes steps to achieve a goal. It is a conceptual model which needs to be tested for its validity in order to meet theoretical and scientific standards from some experts, policy makers, or people involved in the model. It is disseminated in a broad scope if needed. Meanwhile, prescriptive model describes the making processes by a framework in achieving a goal. Then, descriptive model describes and explain the steps in achieving a goal and the influence of each step on the other steps in a more actual way. Finally normative model provides a rational description and functions relationship in achieving a goal. In the implementation this model often adapted in accordance to the context due to limited cognition, time and budget. Therefore, methodologists of R&D Method refer to these types of model in designing a model for educational practices.

In other words, Draganidis & Mentzas (2006) claimed that a good model provide the following items: (1) framework identity; (2) detail of each stage the framework; (3) improvement for detail modification; (4) model arrangement; and (5) model revision. Nevertheless, as a final step, a good model must have a verification step in order to be accepted and useful for the users. This verification step is a prerequisite for validation step and an interpretation of conceptual simulation models into work programs (Law & Kelton, 1991).

THEORETICAL FRAMEWORK

As mentioned previously above, Borg and Gall (1983) had proposed ten steps in R&D Method. In reality, there were some experts who proposed other R&D methods with their particular steps.

Hoge, Tondora & Marelli's Model

R&D method was also a proposition of Hoge, Tondora, & Marelli (2005) work. These experts proposed seven steps in developing a model and each step is interrelated each other.

1. *Defining the Objectives*

This first step includes planning of goal of the model, instrument analysis, caretaker, and time.

2. *Obtaining Sponsor Supports*

This refers to funding availability, and experts to involve in researching and developing the model.

3. *Developing and Implementing a Communication and Education Plan*

This step develops communication to other prospective parties who will get involved in managing and planning the literature about the proposed model through related previous theories and models.

4. *Planning the Methodology*

The methodology of the research is brought about to the model in this step.

5. *Identifying and Creating the Model*

The data collection is done by identify the components, procedures and final goal.

6. *Applying the Model*

It is intended to test the model in accordance to the need.

7. *Evaluating and Updating the Model*

The results from step 6 decide whether the generated model is applicable or not. The data identify the strength and weakness of the model, in which the weakness will be fixed for the final product.

Draganidis & Mentzas's Model

In their article, Fotis & Mentzas (2006) developed a R&D Method for developing competency model in the nine following steps.

1. *Creation of Model System Team (CST)*

This team consists of people who responsible holistically in the making processes of model design. They are responsible for establishing and specifying the activities and processes in designing the model.

2. *Identification of Performance Metric and Validation Sample*

This step determines the scale for the level of work of the superior, medium and limited person in charge in working the model.

3. *Development of Tentative Needs List*

In this step, the CST develops a list of preliminary competencies as a basis for forming the model. A good list is done by considering other organizations work and integrating with the organizational strategy plans.

4. *Definition of Models and Processes Indicators*

This stage collects information regarding the needs of model components in order to construct it through group discussions or field surveys.

5. *Development of a Preliminary Model*

The CST develops the preliminary needs of the model based on the data from step four which collected and analyzed in quantitative or qualitative.

6. *Cross-Check of Preliminary Model*

The cross-check is done by interviewing the model maker or by making additional groups discussion to people who are not involved in the model previously.

7. *Model Refinement*

Model Refinement is conducted using the same analysis that has been used in the preliminary development stage for model selection.

8. *Validation of the Model*

This step is conducted to validate the developed model for legal acknowledgement.

9. *Finalization of the Model*

The unnecessary components and processes during the model designing are eliminated to make the model more effective and efficient for the users.

Plomp's Model

In 1997, Plomp proposed a model design with five steps. The model, then, was considered more flexible by some experts because each step could be adjusted with the context of the research and the characteristics of the researchers.

1. *Investigation*

The preliminary investigation step is carried out by analyzing the problem or analyzing the needs such as gathering and analyzing information, defining the problem, and following up of the project.

2. *Designing*

Designing step aims to design problem solving in designing the model based on the results of working plans or written plans which will be realized in the realization step (step 3).

3. *Realization/Construction*

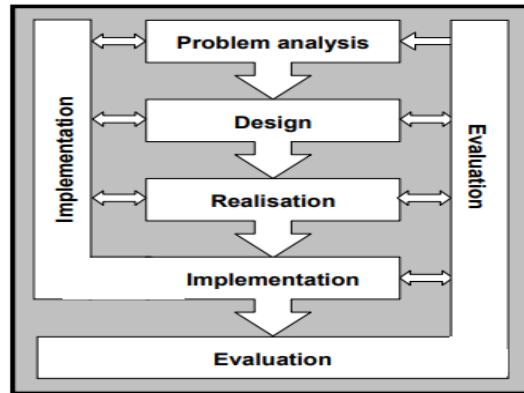
This step is conducted through producing activities, like developing textbook, creating teaching and learning materials, producing service models for training or workshop.

4. *Testing, Evaluation, and Revision*

These three steps are carried out through the process of collecting, processing and analyzing collected information systematically. It is done in order to obtain the results of problem solving. The developed model is tested to have the data for the evaluation, then the data are treated as feedback for model revision.

5. *Implementation*

Having the completion in step four, the model in this step is implemented to the users.



Generic model for educational design

Figure 2. Plomp's Model (Plomp, 1997)

Luther's Model

Luther's model is also known as Multimedia Development Life Cycle (MDLC). This cycle is used particularly in designing multimedia products with proper quality for learning processes. Nowadays, this model has been applied to generate multimedia products for education. It designs a model in six steps.

1. Conception

This step determines the purpose and the users of the product program. It reflects to the goal and types of organization to be reached.

2. Designing

It refers to making specifications regarding program architecture, style, appearance, and material for the program. The specifications are focused on the next step, namely material collecting and assembling. The design step also includes storyboards, Unified Modeling Language (UML) diagrams, Use Case Diagrams, Activity Diagrams, Sequence Diagrams, flow diagrams and Screen layouts.

3. Collecting Material

The materials are collected due to the requirements of the product such as clip art images, photos, animations. Those can be obtained free or by designing which adjusted to the design.

4. Assembling

The step of making all objects or multimedia materials for the application is based on the designing step, such as storyboards, flowcharts, and/or navigation structures.

5. Testing

The testing is conducted after completing the manufacturing phase (assembly) by running the application/program of the product to check the errors availability.

6. Distribution

In this step, the application of the product will be stored in a storage medium and distributed to users.

The Luther's model or Multimedia Development Life Cycle (MDLC) steps are show in the following Figure 3. However, this model in its implementation is compared to *The Waterfall Model* as another model design for multimedia product. However, the last model is hardly to find in educational research (Sutopo, 2009).

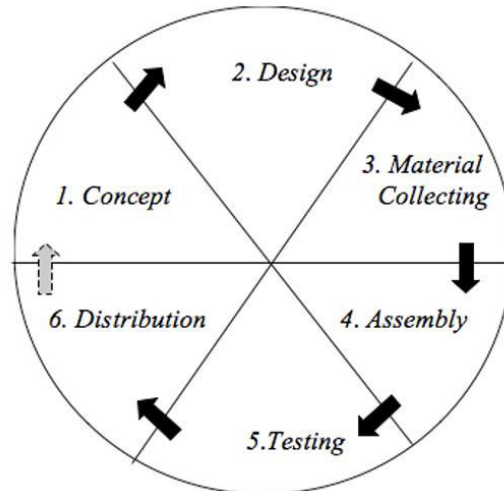


Figure 3. Luther's Model (Sutopo, 2003)

CONCLUSION

Due to its linearity to some educational fields, The R&D Method by Borg & Gall has been applied and implemented widely in educational research. It is as a model design for educational practices in all levels of education. The fact that its ten steps are every so often simplified or modified by educational researchers in their studies, it also develops other alternatives model design. Some of the alternatives are likewise implemented in educational fields, however, still few of them are a matter of references only.

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