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Research Article

Problem-Based Instructional Development Model At Senior High School In Manado, North Sulawesi, Indonesia

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Abstract

This study aims to develop Biology subject matter problem-based instructional development model at both senior high schools. It is a qualitative research and development with four stages. They are needs assessment, model designing, model development, and model implementation. The research result showed that the instructional development model had never been implemented, so that the revision result towards the instructional model had must be done in several time. The Biology subject matter expert, model designing expert, and media expert stated that it was proper to be implemented. According to one-to-one and small group evaluation, it was very good model. And based on the prime field trials, self-reflection, expert review, and effectiveness testing, it was concluded effective to improve the student achievement, output and outcome of learning Biology. The end product of this study was categorized very good and it was very proper to use as the instructional model which can make the student interested, enjoying, and it did not make boring to students to learn Biology. The products were consisted of Biology subject matter instructional materials, teacher guide book, and student work sheet book.

Keywords: Biology subject matter, Problem-based instructional development model

Rationale

Every teacher in high school hopes the instructional activities applied in the class was effective, efficient, enjoy and motivated in order the active teaching and learning process is going to be towards all students. To make this hope will be gathering, the teacher developed suitable instructional design which was related to the experience, knowledge, talent, and all of the resources prepared and supported each activity optimally to the instructional acts.

The application of instructional principles, theories, approaches, methods, and strategies was seen best and correlated for being the teacher capital in designing and developing instructional acts. These were being the teacher task and profession for gathering instructional hopes. One of the instructional hopes which ensure the learning event is when learners engaged in solving real-world problems (Raiser and Dempsey, 2007, p. 63). In the level of senior high school, Biology subject matter was instructed in almost all schools passively (passive learning) and boring because of the instructional process is still centered to the teacher, so the student's capacity to make analysis is still minimum, learning individually, and minus to the acts for focus to problem solving. That is why many students experienced problems in doing learning and bored. Each student can learn actively if teacher can make and keep learning process in conducive and conditioning. It is needed suitable competence which can get performance not only to knowledge mastering, behavior and skills. Teacher competence has to focus and context of real life

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and it is formed through integration and application from various abilities which reflect balancing knowledge, attitude, behavior and skills (Munthe, 2012, p. 27). And in order to improve the instructional quality of Biology subject matter, teacher has to implement innovative instructional process like problem-based instructional model (Miarso, 2004, pp. 559-560). Problem-based instructional model implementing by teacher in the way he/she give problems to students which consists of context of real world, and getting closer to the real world will be good influence and increase to student skills (Amir, 2009, p. 22). Based on these reasons, the study was done in order to get an instructional model of Biology subject matter by implementing problem-based instructional model.

Research Methodology

This study aims to develop problem-based instructional model of Biology subject matter to senior high school concluding instructional materials, student work sheet and teacher guide book. It was used research and development model developed by Borg and Gall (1979) which consists of a cycle stages concluding (1) investigating the findings correlated to the kind of product which is going to develop, (2) develop the product based on the result finding, (3) doing field testing in the setting where the product is going to use, and (4) make revision towards the weaknesses found in the field testing. The study was done in four stages as the following: (1) needs assessment, (2) model design, (3) model development, and (4) validation and model implementing. Referencing to Borg and Gall (1979, p. 626), the study is a research cycle development which consists of 10 main steps. They are (1) investigation and information collection including literature study, observation and preparing the main report, (2) planning, (3) developing the early form of the product, (4) early field testing, (5) revision of the main product, (6) main field testing, (7) revision of the operational product, (8) field testing operational, (9) revision of the end product, and (10) product dessimination and distribution. The research method is described in the following figure 1.

The instructional model implementation resulted as being the instructional operational model/prototype is shown in the following figure 2.

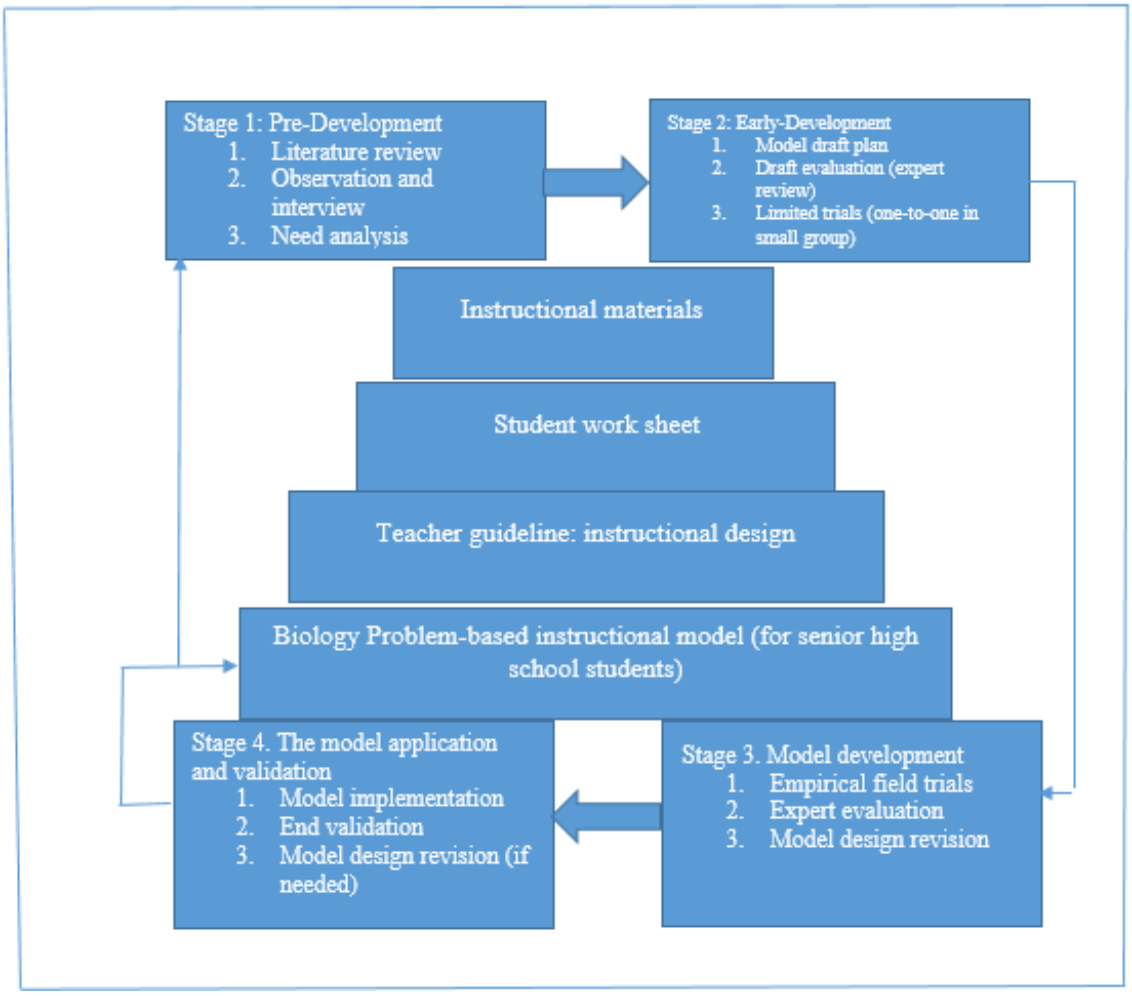


Figure 1.The development stages and the instructional model product trials

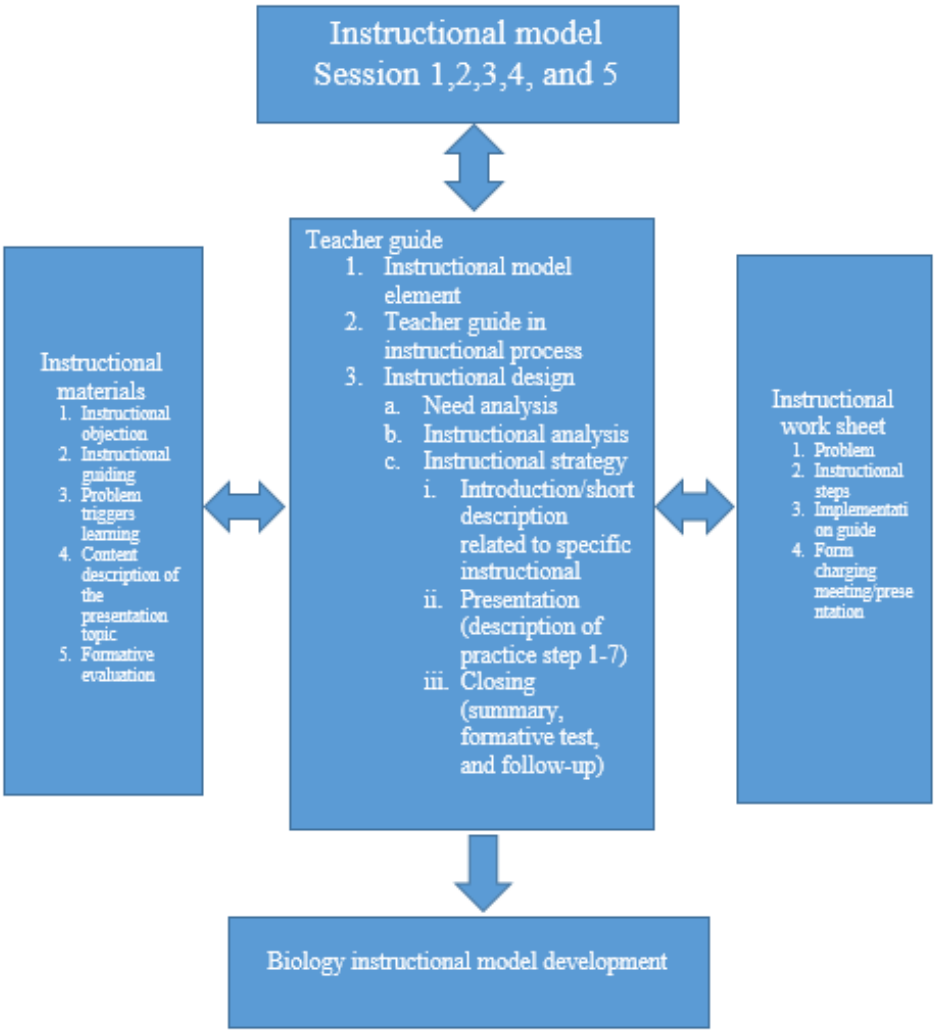


Figure 2.The development of Biology instructional model

Theoretical Framework

Model development

Talking about model development, of course we talk first about design and instruction. Design is the form of the process for stating the learning condition and the way of activities using various learning resources (Seels and Richey in Dewi at.al., 2000, p. 32). Design stresses to the process and learning condition which functions as a framework to identify ability or capability which is the result of instruction. The instructional result in the form of instructional objectives is developed first and then it designs based on the instructional acts which supports the instructional stages (Gredler, 2011, p. 197). The design component of the instructional systems design process results in a plan or blueprint for guiding the development of instruction (Gagne, at.al., 2005, p. 26). Instructional design is being the afford for understanding, improving, and construction building based on the blueprint (Reigelut, 1983, p. 8). The instructional development is being the technique of management in looking for instructional problem solving to optimize learning resource usage to improve education (Harjanto, 2008, p. 110).

The development of instructional system is to combine the analysis, design, improving, and evaluation components (Dick and Carey, 2009, p. 3). That is why, the instructional design results a plan or blueprint for gathering model/ prototype. Instructional design and development are being the activities to result a sample for instructional model. The prototype of instructional is functional version of an instructional unit, usually in an unfinished state, whose effectiveness and efficiency can be tested (Gentry, 1994, p. 160). So, development is the process of translating the design specification into physical form. And the design concept is on four domains: (1) instructional system design, (2) messages design, (3) instructional strategy, and (4) instructional characteristics. And then for instructional development model is needed the steps as the following: (1) to identify, (2) to develop, (3) to evaluate, and (4) to revise. The activities are to design, develop, implementation and evaluation, and then revision. So, design as the foundation

of development is needed the acts of definition, designing, demonstrating, developing, and presentation (Cennamo and Kalk, 2005, p. 10).

The nature of problem-based instructional model

Instructional model is the planning which used to design instructional materials in and out of the class and useful as guiding in planning the instruction in and out of the class, such as tutorial and to state the learning set of equipment in order to get the instructional objectives (Bruce, Weil and Calhounl, 2009, p. 6). Problem-based instruction is the instructional strategy as being solution designed to improve learning process in the way to bring, to deliver, to requisite students learn the instructional material content when solve the problem. In this context, problem-based learning is an instructional strategy. That is, it is an instructional solution designed to improve learning by requiring students to learn content while solving problems (Jonassen, 2011, p. 154). And in instructional strategy, there are four aspects of instructional acts which is important. They are (1) problem-focused (students starts learning with simulations towards real problems which are not clear or ill-structured problems and then go to the problem construction focused, (2) student-centered (teacher does not dictate in instructional process), (3) self-directed (students individually or collaboratively responsible to give issues or problems which will be learned and doing self- learning process through assessment or by classmate evaluation), (4) self-reflective (the student monitor the self-development of knowledge and trying to adjust with the learning strategy) (Amir, 2009, p. 33). The instructional process usually has the steps of (1) students are grouped into five to eight in order they can say ideas about the problems and the group afford to define and construct problem and objective of instructional, identify knowledge which had been known and the acts needed, (2) self-directed study (individually student finishing the tasks to understand problem and make solution and then to learn and collecting various relevant resources for constructing the group report), (3) students share their learning result in group, listen again to the problem, and constructing new hypothesis or rejected based on their learning result, and (4) student summarize and integrating their learning result from each group.

Problem-based instructional model has seven characteristics, they are (1) the problem is used as early instructional process, (2) the problem used usually is the real world problem which is presenting in ill-structured, (3) the problem needs multiple perspective, (4) the problem make students challenge for getting new instructional strategy, (5) it is so prioritizing learn independent or self-directed learning, (6) it uses various knowledge resources, and (7) collaborative, communicative, cooperative and constructive instructional (students construct their knowledge and then working in group, interaction, peer teaching and doing presentation.

There are seven steps in problem-based instruction, they are (1) classification of unclear concept and expression in order to make sure that the group member understand various expression and concepts of the problem, and they start from the same way of seeing the expression and the concepts in the problem; (2) formulate the problem (the phenomenon in the problem needs explanation of what relationships which become among them and sometimes there is relationship which is still unreal among the phenomenon or there are sub problems which must be explained clearly before); (3) analyzing problem (the group member present his/her knowledge related to what had been known and discuss the factual information for brainstorming process, here the group member has opportunity to practice how to explain, see alternative or hypothesis related to the problem); (4) arranging ideas and systematically make deep analysis (this become afford to arrange something to be parts which are formed); (5) formulate the instructional objections (the group formulate the instructional objections because of they had been known where knowledge which is miss and unclear, the instructional objections are correlated to problem analysis which had been made, this will be the ideas base which will be made in the report and it will be the base for individual and group tasks); (6) looking for addition information from other resources (this time the group had been known what information which does not have and it had have instructional objection, the group member must look for additional information, make a schedule, and determine the source of information, every member has to be able to do self-learning effectively in order he/she can get relevant information such as to determine keyword in the alternative, estimates topic, the author, publication from the instructional sources and summarize the instructional sources with their own sentences and to write their resource clearly); and (7) to synthesis and testing new information and then to make report, from the reports of individual and group which were presented in front of the members and the other group members get new information, and who are listen to presentation must be critical about the report presenting. In this step, the group had been able to synthesis and combine the relevant things.

The nature of Biology as science

For centuries man involved to an afford to understand the natural environment, so they formulate observation and knowledge systematically. The important thing to understand the natural environment is to learn the human being condition in the earth. The human knowledge to understand the earth then they arrange it scientifically and then formed a scientific discipline which was called Biology,

that is the science of life itself (Nelson and Robinson, 1992, p. 1). To most students Biology is learned in the way to see animals in a laboratory, to remember the scientific names from each part of the animal and making collection of plants and insects. The learning acts like this it is not yet reflect a Biology study characteristic because of the right focus in Biology is the whole life itself.

Biology as a science treat life as a set of process which its characteristic can be investigated through observation and experiment. This process included very large phenomenon, start from how the cubicle develop to be tissues and organism until changing in organism in long time. It is also about living organism get energy from well chemistry, how can certain organism control and manage the plant functions and animal and how the organism developed from one generation to other generation hereditary. And the information variety of the whole life make human being understand the details of life itself. So that, it can be concluded that Biology is the human knowledge of all human being world life. Biology is a science of living and living in Biology can be defined as a set of process which its characteristic can be learned through observation and experiment.

In the context of human characteristic, William and Kuteon (1996, p. 1) stated that life is as shape into which something has been formed which inflict life with dead and defined dead from life. Some inflict between inanimate object and be dead according to Robert (1986, p. 3) is as the following: (1) movement, organism character is it can move itself. The plant cannot walk but its cells performed movement or there is growth; (2) give response, all organism react to a stimulation. Response to the sun beam for growing; (3) growth, a crystal will be growth with addition of material on it. Organism grow from itself by a process which involved taking new material from outside and then combine into internal structure from the organism. This is called assimilation; (4) eating, organism spontaneously take and assimilating material for growing and care. Animal is generally eating hetero-tropic nutrition, while plant take food from simple an-organic for manner to be complex organic molecule or autotropic nutrition; (5) reproduction, all organism are able to do reproduction to itself. Reproduction involved replication from certain mythical gigantic demon. Complex molecule is in all organism start from virus to human being. This is known as essential characteristic of life; (6) liberty of energy, in order to still life, organism has to be able to freedom the energy in the form of controlling and usefulness. This can help adenosine triphosphate and it is prepared when respiration; (7) disposal, chemistry reaction which become to organism cause poison formation from un-useful production which must be lost and stored in the form of not being peril. That is why, one can state that a life organism is the ability system to produce for growing and to manage its needs by its energy. Life is a number of system and the ability to live.

In the context of Biology instructional materials, Biology is the study of organism which is being the natural science branch. Its subject is very large because of involving much of sciences such as chemistry, physics, mathematics, geology, and psychology. Physical science and agriculture need also Biology. And traditionally, subject of Biology divided of three important branches, they are (1) Zoology, (2) Botanical, and (3) Microbiology. Zoology is studying about animal and Botanical is studying about plants. Microbiology consists of a big number micros-copy organism which much are not suitable with animal and plant world.

The way to learn Biology was stated by Miller and Blaydes (1978, p. 12) as the following: (1) information gathering (mainly consists of remembering practice and the fact is from sources, such as reading, lecture and observation, (2) developing of thinking method, (3) inductive and application; and (4) behavior formation. Core materials of Biological science instructional in senior high school according to competency-based curriculum are (1) working scientifically, (2) classification of various living things, (3) living things and their environment, (4) structure and function, (5) inheriting attitude, and (6) biological application (Depdiknas, 2001, pp. 1-3). And the objection of biology instruction in senior high school according to competency-based curriculum are (1) improving the environmental awareness, (2) understanding of biology concepts with their relation, (3) develop power of logical reasoning for problem solving, (4) problems face in daily life, (5) develop basic skill of Biology for gathering concepts and to build scientific behavior, (6) implementation of Biology concepts and principles for resulting simple technology related to human needs, and (7) to give basic knowledge for going to next level of education (Depdiknas, 2001, pp. 4-6).

In the context of instructional model system component, the instructional development is also consider supporting system component which was got from the early investigation and theoretical framework which were being the bases on the development. The system component are (1) instructional material component: (a) instructional objection, (b) instructional guide, (c) problem triggers learning, (d) description of the instructional material content, and (e) formative evaluation; (2) teacher guide book consists of (a) elements of instructional model, teacher guide for instructional process, (b) instructional design which consists of need analysis, instructional analysis, and instructional strategy (introduction or short description relevant with specific instructional), presentation (description, practice start from step 1-7 of the instructional model), and closing (summary, formative test, and follow-up), (c) instructional work sheet and student guide book which

consists of problem, instructional steps, instructional model implementation guideline, form charging of the first session to the third session, and teacher role reflection sheet.

The design of the instructional model based on literature review and field study result towards Biology instructional implementation in senior high school. That is why, the component refer to system approach as the instructional model development design which was used (1) the research primaries (identification process of instructional need and analyzing the input); (2) instructional design (component development process and sub component in instructional product); (3) instructional design result (instructional product as the evaluation stage which still in the form of prototype which was ready to use); and (4) revision of each sub component. The following figure describe the research problem-based instructional development model.

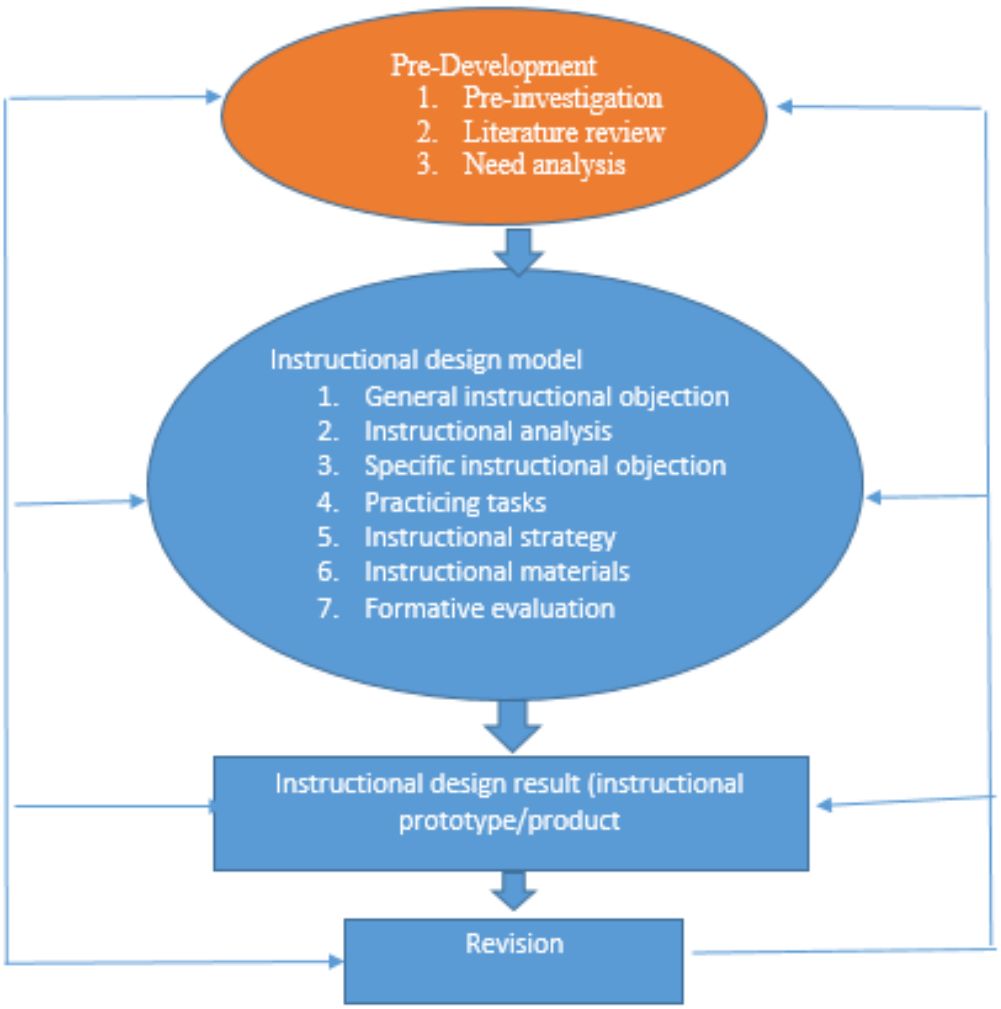


Figure 3.The Research Problem-Based Instructional Development Model

Research Finding

The final development was problem-based instructional model product together with teacher guide book, instructional materials, and student work sheet. Based on the formative evaluation result, it was stated that the product after analyzed generally had the category of "the best". So, it was being the end product which was reasonable to use as draw, enjoyable, and not boring instructional model.

Based on the Biology subject matter instructional analysis which was being the criteria for the student who learn Biology, they must mastery: Biology and its roles to live, virus and its roles, kingdom archaebacteria and eubacteria, kingdom protista and its roles to live. And the standard competencies which were hoped can be mastery by the students by following the instructional process were: (1) the function and its roles in life, (2) biodiversity, (3) kingdom plantae and its roles in life, (4) kingdom animal and its roles in life, and (5) ecosystem. So that, the ability needed by the students to solve the problems was directedly related to their daily life or their real life as described in the following table 1.

Table 1.Standard competence and the basic competence

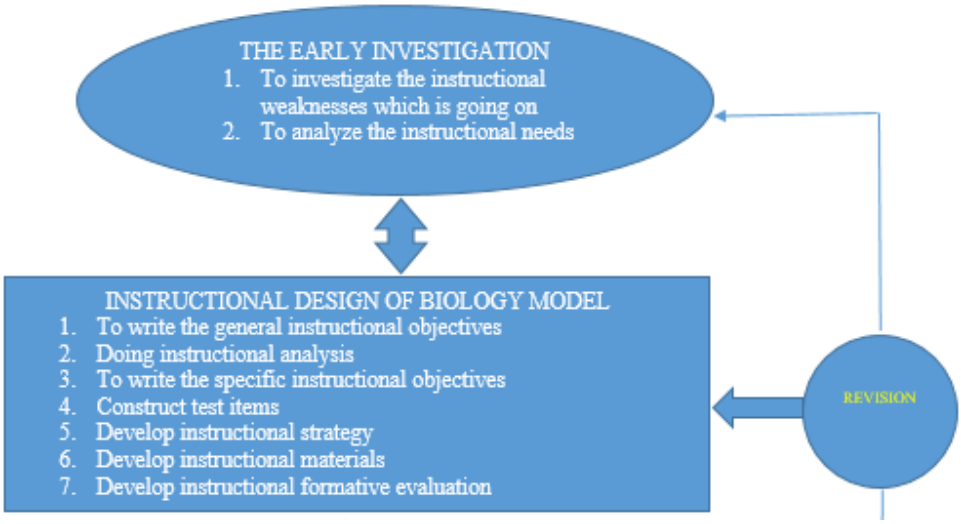
Instructional materials	Standard competence	Basic competence
Function and its roles	Application concepts of Biology in life	Identify various functions suitable with the right usefulness/usages
A wide diversity of living beings	Idem	Classification and preserve living creature
Kingdom plantae and its roles in life	Idem	Classification the division members of kingdom plantae for living
Kingdom animals and its roles in life	Idem	Identify kingdom animals, explain the roles of kingdom animals in life
Ecosystem	Idem	Explain about ecosystem, identify component to arrange ecosystem and to keep the balancing for survival

In identify of the need analysis, there were two steps applied, the first was to analyze of were there any problems being in Biology instruction and solution analysis from the above problems. The problems were in Biology instruction as described in the following table 2.

Table 2.Need analysis result of the instructional model

The problems being	Current condition	The condition of the should
The instructional objective	Did not pay attention to the competence which needed by the students such as skill process, effective domain, the competence developed was only to cognitive domain	It is better to pay attention to the technological development and the needed competence by students in instructional process such as process skill, affective domain and cognitive domain
The teacher	The teacher less of creativity to develop surrounding which were needed by the students related to process skill, affective and cognitive domains	The teacher should have creativity in developing instructional competence by using the real environment condition as Biology instructional model, not only focus to cognitive domain and the curriculum target
Instructional process	Teacher-centered only (the teacher was active and the students were passive to listen so the instructional process was being not enjoyable and then make boring	The instructional must be focus on the students so they can be active, creative, motivating and not boring (student-centered instructional process)

The instructional development model of Biology subject matter which was being success to develop is described in the following figure 4.



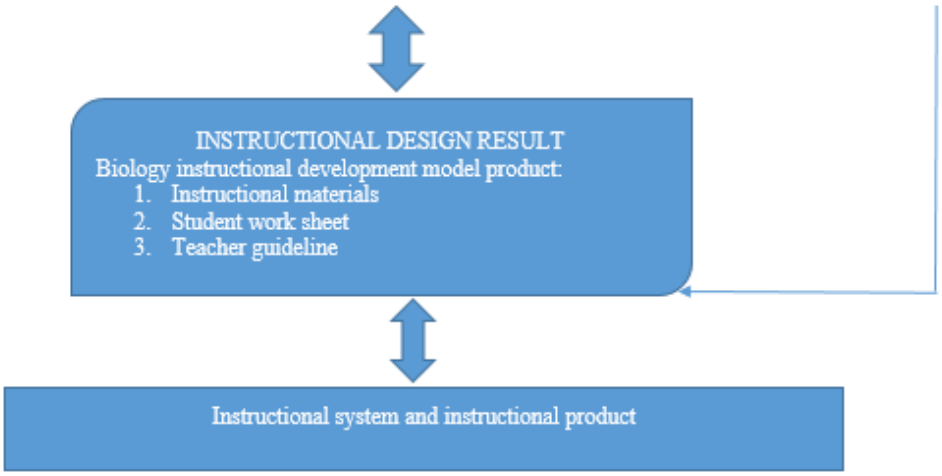


Figure 4.The result of the operational Biology subject matter instructional development model

The result of Biology subject matter instructional development model is described as the following figure 5.

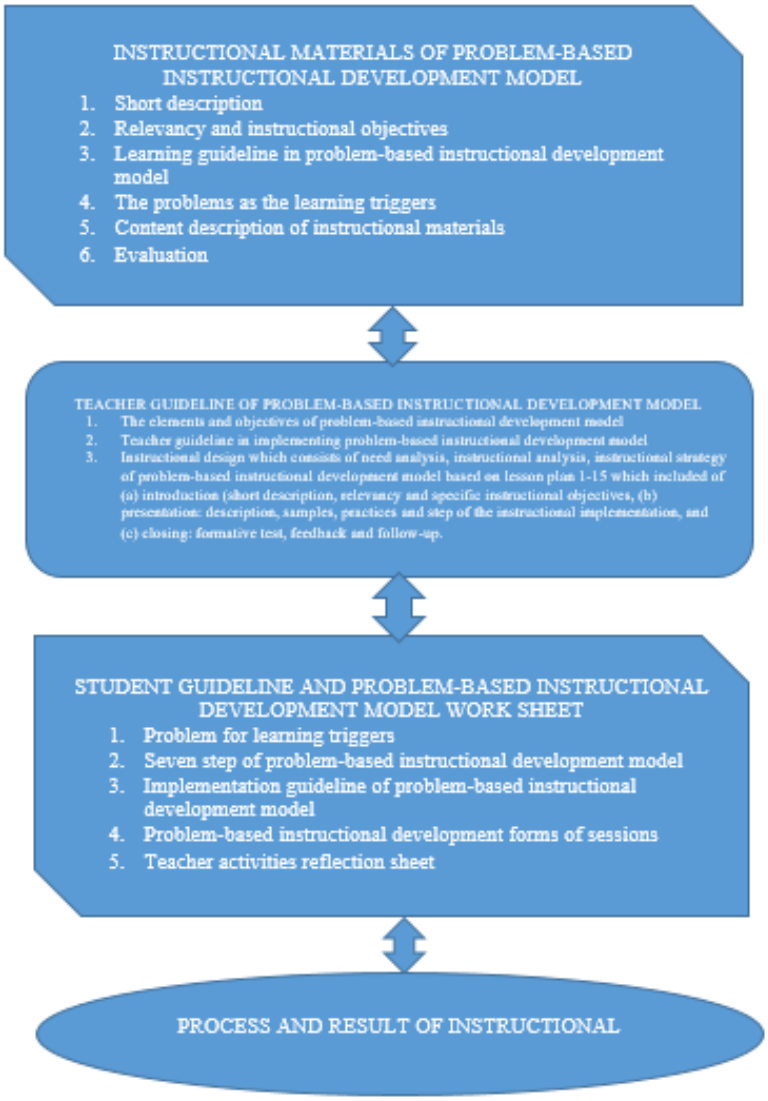


Figure 5.The result of the operational Biology subject matter instructional development mode

Conclusion, Implication and Suggestion

Conclusion

Based on the problem statements, research objection, data analysis and the description got from the Biology instructional development model, it can be concluded that (1) the problem-based instructional development model can be implemented to senior high school students which was never implemented the model in the instructional process; (2) the revision model result for Biology had been done several times, they were (a) based on the expert review and the practitioners (Biology experts), the expert of instructional design, and the media expert stated that the Biology instructional model had been reasonable/ proper to use, (b) based on the one-to-one evaluation or to the small group evaluation it was stated that the Biology instructional model was the best one. This was done in early development of the model, (c) the next stage was the model development based on self-description, expert review, and practitioners evaluation in the main field trials, and (d) based on the self-description and expert review in the field operational trials in the stage of model validation and implementation (model testing effectiveness); (3) the final product of problem-based instructional development model consists of (a) teacher guide for implementation of instructional model included of instructional model implementation guideline, instructional design which consists of need analysis, instructional analysis, general instructional objective, specific instructional objective (standard competency) instructional strategy which consists of lesson plans 1-15, (b) instructional materials which consists of chapter one included short description, relevancy and instructional objective, learning guideline, chapter two included kingdom function and its roles in life, chapter three included the diversity of living beings, chapter four included plantae kingdom and the role to the life, chapter five included animal kingdom and their roles in life, chapter six included ecosystem and each end of the chapter there is formative evaluation which has to be done by the students, (c) instructional student work sheet which consists of problem as the learning triggers, instructional implementation steps, instructional model implementation guideline, instructional session declaration/form, and peer assessment; (4) evaluation towards the instructional model product with the stages of instructional materials, design, media expert review, small group trials and field trials after analyzed generally, it has the best category, so it was being the final product model which is proper to use as the enjoyable instructional model; (5) there was significant improvement between the main field trials result with operational trials result after the instructional model had been revised and it being perfected; and (6) instructional model developed for Biology instructional on five topic discussion it was very effective for reaching instructional objective along with to consider the instructional facilities, tutor preparation, the availability of the source of learning and other supporting factor.

Implication

This research result implicates to (1) the system component identified from early investigation was being the point for instructional model development; (2) the instructional model development result with using physical model such as instructional prototype was being the learning printed/ media printed which was designed based on the student characteristic and suitable with the learning condition and the instructional prototype procedures gave impact to the instructional process quality perfected so it can result the learning completely; (3) the model component which had been resulted can be used as the sample for perfecting the instructional design limitation, specifically to Biology subject matter in order the implementation on the instructional process can be done better; (4) the physical model in instructional process (instructional prototype) such as instructional materials, teacher guideline and student instructional work sheet consists of instructional implementation process guideline had the effect to motivate students to always doing learning and supported to self-learning, group learning to develop problem-solving ability and improving instructional process quality; and (5) the instructional implementation by using the model gave rashness and learning acts which very various and it can fulfill the student learning needs based on the learning speed which impact to the learning condition so it can get the high quality of the instructional process.

Suggestion

Based on the conclusion and the research implication, it can be stated suggestion as the following: (1) the sustainability of Biology instructional model to senior high school students needs to pay attention and implementing to the future. The instructional model which had been developed needs to be perfected and suited to the instructional facilities condition; (2) the problem development as the instructional triggers should be dynamic and suited to the real world environment condition and to arrange based on daily problems faced by the students; (3) to the other candidate researcher who wants to continue or replicate the Biology problem-based instructional model is hoped to pay attention the research limitation so the next research can be perfected; (4) teacher empowerment as tutor or facilitator needs to be done for fulfillment their competences, such as to mastery the instructional materials, to understand the method of teaching which can empowering students potentialities for learning and working individually and group, understanding and mastering of process and product evaluation competences and have good verbal and non-verbal ability for developing and directing the group

discussion perfectly; and (5) the other teachers can use the instructional model because this has characteristics which can do in group, afford to develop student competence and the problem can be the triggers in instructional process of the topic discussion.

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