

Aquascape Media as A Tool in Learning The Interaction Between Living Creatures and The Environment to Improve Students' Mastery of Concepts and Communication Skills

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Abstract: The process of learning interactions between living things and the environment requires direct observation by students, but in reality the school is located in the city center with a less than optimal surrounding environment. The availability of learning media for this material has not been widely developed by students. The research aims to produce aquascape media that is suitable as an aid in learning interactions between living things and the environment to improve students' mastery of concepts and communication skills. The research uses a 4D development model which includes Define, Design, Develop, and Disseminate. The test subjects were taken using a cluster random sampling technique and a sample of 66 students at SMPN 12 Yogyakarta was obtained, consisting of experimental and control classes. The field test used quasi-experimental research with a nonequivalent control group design. The feasibility, teacher practicality, and effectiveness of assessing aquascape media as an aid in learning interactions between living creatures and the developed environment are included in very good and practical.

Keywords: Aquascape; Learning media; Mastery draft; Skills communication.

Introduction

Knowledge Natural Science (IPA) is A encompassing knowledge various field base ie chemistry, physics, and biology are used For explore phenomenon natural in a way systematic and structured in a way regular (Gordon et al., 2018). IPA does not only just science which is gathering knowledge form fact, concept, or principle but it is also a process of discovery through result data set observation and experimentation (Radmehr & Drake, 2018). Objective science learning at the level School Intermediate First (SMP) is with embed attitude scientific in students, developing skills, and apply science concept for finish problems (Permendikbud, 2016). Science learning is best held in a way inquiry (scientific inquiry) for grow ability think, work and behave scientific, as well communicate it as aspect important proficiency his life (Suyatna et al., 2018). Science learning is also one of them eye potential

lessons big in increase skills needed in the 21st century (Sally, 2016).

Skills education the 21st century is required skills owned participant education that requires it participant educate own ability soft skills that can be obtained used For face problems and changes patterns society in the future come (Anitah, 2012). According to change pattern think the including development expected demands of the world of education can prepare participant educate control Skills 21st century (Redhana, 2015). Skills the 21st century brought to in the world of education moment this will demand participant educate for finish problem in activity good in the learning process nor life his daily life through knowledge knowledge that has been obtained, as well give chance for can finish problems in his daily life (Wang et al., 2016).

One of the learning media that can be used is Aquascape media. Aquascape is aquarium art that is aesthetically arranged in arranging water, stones and

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wood which shows an artificial water ecosystem (Setyadi, 2018). Pratiwi (2017) explains that the main purpose of aquascape is to create an underwater landscape, which is supported by several factors including lighting, and maintaining carbon dioxide at a level sufficient to support underwater photosynthesis. Application of material in Class VII middle school science learning which can be assisted with aquascape media, namely interactions between living things and the environment (Slavin, 2018). The process of learning material about interactions between living things cannot be separated from a media that supports learning. Based on the results of observations made by (Komala et al., 2016), one of the problems that occurs is the lack of supporting media in the learning process of interaction between living creatures and the environment, so this affects students' learning completeness. Ideally, in the process of learning interactions between living things and the environment, students learn directly in the surrounding environment, but generally the school location is always in the city center so observing interactions between living things and the surrounding environment is less than optimal (Wangsa et al., 2017).

Based on the results of interviews with science teachers and observations at SMP Negeri 12 Yogyakarta, the percentage of daily test scores with material on interactions between living things and the environment in class VII was only 37 students who got a score above the Minimum Completion Criteria (known with KKM) 75% (in the 2018-2019 semester 2 academic year). While the remaining 63% scored below the KKM. Learning activities regarding the interaction between living things and the environment do not yet provide real learning media that can support the learning process. Students are only given book media in which there are pictures that support the material. Experimental activities and direct observations in the school environment are also rarely carried out, because teachers prefer to provide material in the form of lectures and discussions. Teachers give students worksheets to work on individually which means there is no interaction between students, resulting in a lack of honing students communication skills in the learning process.

Method

The development model for aquascape media as a tool in learning interactions between living things that was developed was the 4D model which consists of four stages of development, namely definition, planning, development and dissemination. (disseminate). Research that is based on specific problems that have been analyzed using certain methods with the aim of developing the novelty of a product, model, procedure,

technique and tool is called development research (Sugiyono, 2015).

Research and Development (R&D) research using the 4D model has 4 stages of development with the following explanation

First Stage: The defining stage (Define) is a guide in the preparation of products that contain the results of analyzing the information needed in research and development activities. In this development research, the information includes preliminary analysis of the science learning process at the junior high school level with observations at school, learner analysis to determine the characteristics of students in science learning during class, curriculum analysis / task analysis is the stage of analysis carried out to determine science teaching materials based on Core Competencies and Basic Competencies contained in the 2013 curriculum for junior high school science/MTs, concept analysis to identify facts, concepts, principles, and theories from the material of interactions between living things and the environment using Aquascape media as a learning medium that is adjusted to the basic competencies and specifications of learning objectives (specifying instructional objectives) formulating learning objectives from the results of curriculum analysis/task analysis and concept analysis that refer to core competencies (KI), basic competencies (KD), and indicators that will be achieved from activities to study material on interactions between living things using aquascape media.

Second Stage: The design stage is the first step in preparing the initial product draft. This stage aims to create a product design that will be developed, namely aquascape media and the preparation of a grid of research instruments for media and material experts, teachers and students as well as question instruments to measure mastery of concepts and observation sheets to see the skills of students during learning using aquascape media. Media selection is adjusted to the material on the interaction between living things and the environment in basic competencies 3.7 and 4.7, as well as concept analysis and observation of the characteristics of students so that it can improve students' mastery of concepts and communication skills in science learning. Format selection for the media to be developed adapts to the indicators of concept mastery and communication skills of students. The material specifications (materials) used in making aquascape media consist of tools and materials that are tailored to the needs of making media, as well as aquascape media guidebooks. The preparation of assessment instruments (constructing criterion-referenced tests) is carried out by compiling a grid of research instruments, then proceeding with the preparation of product assessment instruments and instruments used to measure mastery of concepts and

observe students' communication skills (Hardianti et al., 2017).

Third Stage, The development stage (develop) is the stage for validating the feasibility of aquascape media products that have been designed previously. The results of these stages are products that have gone through revisions based on suggestions and feasibility validation assessments by material and media expert lecturers, junior high school science teachers, and students on a limited trial scale and field trials. Validation by experts was carried out to assess aquascape media, guidebooks and student worksheets (LKPD) for aquascape media, pretest and posttest questions for concept mastery. Limited trials for aquascape media were conducted on junior high school students in grade VII as many as 9 students. Field trials were conducted to determine the effectiveness of aquascape media developed to see an increase in concept mastery and communication skills of students (Karpen & Welch, 2016).

Fourth Stage, The disseminate stage is the final stage of research and development with the 4D model. The purpose of this stage is to distribute and disseminate aquascape media products to the research school, namely SMP Negeri 12 Yogyakarta. An explanation of Research and Development (R&D) research using the 4D model (define, design, develop, and disseminate) can be depicted in Figure 1.

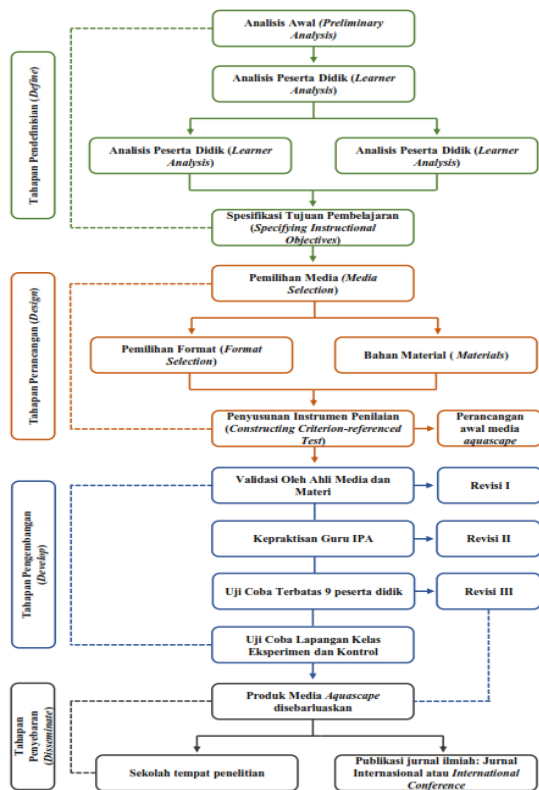


Figure 1. Research and Development (R&D) stages that use the 4D model

The aquascape media product trial in this research aims to obtain data regarding the quality of aquascape media from the aspect of using learning media directly in the classroom so that its feasibility and effectiveness can be determined (Basuki & Hariyanto, 2017). Part of the product trial is trial design, trial subjects, data collection (school and student observations, science teacher interviews, questionnaires and tests), and data analysis (results of validity, practicality and effectiveness of the Aquascape media product being developed) (Arsyad, 2014).

The trial of aquascape media products in this study aims to obtain data on the quality of aquascape media from the aspect of using learning media in class directly so that its feasibility and effectiveness can be known (Asyhar, 2012).

- Limited trials were conducted with the aim of knowing the feasibility of aquascape media by involving media and material expert lecturers, science teachers and 9 seventh grade junior high school students who have different cognitive abilities, namely, 3 students have high cognitive abilities, 3 students have moderate cognitive abilities, and 3 students have low cognitive abilities. The results of the limited trial were revisions to aquascape media products obtained from the results of suggestions and input from material and media expert lecturers, science teachers and students.
- Field trials were conducted with the aim of knowing the effectiveness of using aquascape media as a tool in learning material on interactions between living things and the environment as expected, namely to improve students' mastery of concepts and communication skills through pretest and posttest results.
- The subjects of the limited trial in the aquascape media development research were junior high school science teachers, and 9 seventh grade students of SMP Negeri 12 Yogyakarta who did not become experimental or control classes, namely 3 students who had high cognitive abilities, 3 students who had moderate cognitive abilities, and 3 students who had low cognitive abilities as test subjects for product readability. One junior high school science teacher as the subject of the aquascape media product practicality test
- Field trial subjects in aquascape media development research are two classes of students of SMP Negeri 12 Yogyakarta grade VII even semester with a total of 66 students. The two classes became experimental and control classes selected using cluster random sampling technique by randomly drawing from 4 VII classes at SMP Negeri 12 Yogyakarta).
- Data collection in the study was obtained from several ways, namely school and student

observations, science teacher interviews, questionnaires, and tests. School and learner observations and science teacher interviews were used to observe the school

Data analysis in research is used to determine the results of the validity, practicality, and effectiveness of the aquascape media products developed. The data analysis carried out is described as follows (Desstya, 2015).

1. Aquascape media feasibility analysis is used to determine the validity and practicality of aquascape media products that have been assessed by media and material expert lecturers, as well as science teachers and students. The steps taken to analyze the feasibility of aquascape media are described as follows
 - a. Processing of feasibility data obtained from validation of media and material expert lecturers, science teacher practicality and student readability produces data in the form of categories consisting of scores (4) for very good/very feasible/very practical categories, scores (3) for good/feasible/practical categories, scores (2) for quite good/quite feasible/quite practical categories, and scores (1) for less good/less feasible/less practical categories.
 - b. Data obtained from media and material expert lecturers, science teachers and students are tabulated for each assessment aspect of the assessment items on the research instrument.
 - c. The values that have been tabulated for each aspect of the assessment from the results of the assessment of media and material expert lecturers and the practicality of the science teacher are then converted into interval data according to the formula and classification of Likert scale categories
2. Empirical test analysis of concept mastery assessment instruments is used to determine the validity and reliability of question items. The analysis used SPSS Statistic 20 (Statistical Package for the Social Science version 20) software application. The significance value for testing validity uses Pearson Correlation, while the significance value for testing reliability uses Cronbach Alpha. The results obtained from the reliability analysis refer to the Cronbach Alpha value and its category.
3. The effectiveness analysis of aquascape media looks at the improvement of students' abilities from the variables of concept mastery and students' communication skills. Effectiveness analysis is obtained from pretest and posttest data of experimental and control classes through the MANOVA statistical test. The test can be carried out if it has gone through the prerequisite test and

obtained results that meet the 9 assumptions of the prerequisite test. N-gain score calculation is done in order to know the difference in concept mastery and communication skills of students between experimental and control classes. Data from the concept mastery test results are interval data and data from the observation of students' communication skills are ordinal data. The ordinal data was converted into interval data using the MSI (Method of Successive Interval) method.

Result and Discussion

This research produces products in the form of Aquascape media as a tool in learning interactions between living things and the environment to improve communication skills and mastery of the concept of students. The Aquascape Media product produced was developed using the 4D development model (Four D Models) which consists of define, design, develop, and disseminate. The 4D development model in this study can be described as follows.

First, The initial analysis stage at SMP Negeri 12 Yogyakarta involved interviews with science teachers, classroom observations, and identifying issues in science education to develop effective media solutions. The interview results revealed that the school uses the 2013 curriculum revised in 2017, with teaching materials including lesson plans, teacher and student books, and assessment sheets. Commonly used methods are lectures, discussions, and experiments within the 5M, Problem-Based Learning, and Discovery Learning models, though experiments are rarely conducted. Available teaching media include books, modules, e-books, and teaching aids, but some materials are still taught conventionally without experiments. Teachers face challenges in implementing student-centered learning, low student motivation, and difficulties in creating questions at Bloom's taxonomy levels C4-C6. The use of 21st-century skills (4C) is also underutilized in cognitive and attitude assessments (Djamarah & Aswan, 2013).

Second, The student analysis phase observed the characteristics of students in science classes, focusing on age, science KKM, learning outcomes (science concept mastery), and communication skills. Findings from teacher interviews revealed that seventh-grade students at SMP Negeri 12 Yogyakarta are typically 13-14 years old, with an average class size of 30-32 students. The KKM for science is 75, with only 37% of students scoring above this threshold on tests about interactions between living organisms and their environment, indicating suboptimal concept mastery. Communication skills are low, as students often do not pay attention, engage in

off-topic discussions, and prefer to stay silent rather than ask questions or present their ideas during class discussions.

Third, The stage of curriculum analysis or task analysis is carried out to determine science teaching materials based on Core Competencies and Basic Competencies contained in the 2013 curriculum for junior high school science. This stage details the tasks and content of the teaching material in outline so that Aquascape media can be used as a means of learning media to improve students' communication skills and mastery of concepts.

Fourth, The concept analysis stage includes the identification of facts, concepts, principles, and theories from the material of interactions between living things and the environment using Aquascape media as a learning medium that is adjusted to the Basic Competencies. Concept analysis is made so that teachers become easier in delivering material based on the core concepts that have been determined.

Fifth, Core Competencies (KI), Basic Competencies (KD), and indicators of competency achievement produce learning objectives from the material of interactions between living things and lingan using Aquascape media.

The design stage is the stage of designing the initial product draft that has been determined in this study in the form of aquascpe media. Aquascape media is a learning media that is hardware media. The media can be used in science learning materials, especially on the material of interactions between living things and the environment which is adjusted to the Competency Standards and Basic Competencies in the 2013 curriculum (Iriantara, 2014).

First, Aquascape media is designed to meet the learning needs of materials on interactions between living things. The development of this media considers material aspects (learning objectives, subject matter, activities, and language) and media aspects (grammar, language, and presentation). These aspects are translated into assessment indicators for material and media experts. The selection of aquascape media allows students to observe ecosystem components such as rocks, sand, plants, and aquatic life in one integrated medium. It aims to make concepts of interactions between living things and their environment easier to understand and to encourage active communication during discussions with teachers and peers (Pujiati et al., 2013).

Second, Aquascape media is presented for science material on interactions between living things and the environment that has been adapted to the needs of teachers in learning. Aquascape media can help students to understand the concept of knowledge through the

activities contained in the guidebook. The guidebook is used as a guide for students when doing each activity.

Third, The tools in aquascape media consist of 1 guidebook, a 50x30x30cm tank, a 2cm thick cork base with a surface area of 50x30cm 1 filter of the hanging filter type, 1 set of 36 Watt HPL (High Power Led) LED lights, DIY CO2 injector, 1 bubble counter tube, 1 diffuser, several small aerator hose dop cop, 1 thermometer, and a small aerator hose \pm 3 meters. Materials in aquascape media consist of clean water, sodium bicarbonate (NaHCO₃) or baking soda, citric acid (C₆H₈O₇) or better known as citron or citrun, Ohko rocks, poor sand, Rasmala wood, and several types of aquatic plants, fish, shrimp, and water snails.

Fourth, The Aquascape media product is a development product that is used as a tool in learning interactions between living things and the environment. Aquascape media development products consist of aquascape media as real media or real objects and a guidebook which includes LKPD for 4 meetings. Aquascape media was developed to help students when studying material on interactions between living things and the environment. Aquascape media is designed with safe materials so that students can use aquascape media comfortably. The media is placed in the science laboratory, so that students can see, observe and care for the media so that the aquascape media remains optimal for use as a learning medium. The material used in developing aquascape media is material for interactions between living things and the environment The Aquascape media guidebook consists of the guidebook cover, foreword, table of contents, concept map, core competencies and basic competencies, instructions for use, getting to know Aquascape media, Aquascape product description, tools and materials in Aquascape media, Aquascape media animal catalogue, catalogue. Aquascape media aquatic plants, LKPD with 4 activities, and bibliography.

Fifth, Aquascape media that has been developed and the resulting instruments are then validated for feasibility by media experts, material experts, teacher practicality tests, limited trials of students and field trials (Wahono et al., 2017).

Validation by media and material experts is conducted to determine the feasibility of the developed aquascape media and its supporting instruments, such as guidebooks and student worksheets (LKPD), before practical tests by teachers and trials with students. Media experts assess three aspects: grammar, language, presentation of aquascape media, guidebook display effectiveness, and LKPD display effectiveness. Material experts use two questionnaire sheets to validate the feasibility of concept mastery items, evaluating the aquascape media guidebook and LKPD for learning objectives, subject matter, activities, and time

allocations. The validation results are converted into quantitative data on a 4-point scale (Rompegading, 2021).

The validity and reliability of concept mastery questions were empirically tested using SPSS Statistics 20. The questions had previously been validated by material experts. Validity was assessed using Pearson Correlation, while reliability was evaluated using Cronbach's Alpha. The test included 20 multiple-choice and 5 essay questions, involving 83 eighth-grade students at SMP Negeri 12 Yogyakarta who had studied interactions between living things and their environment. Of the 20 multiple-choice questions, 16 were valid with a Cronbach's Alpha of 0.748, indicating high reliability. For the essay questions, 3 out of 5 were valid with a Cronbach's Alpha of 0.176.

The practicality test by science teachers consisted of an assessment of aquascape media products, aquascape media guidebooks and LKPD (Kementrian Pendidikan dan Kebudayaan, 2013b). This test was conducted on 1 7th grade science teacher at SMP Negeri 12 Yogyakarta. Additional devices such as lesson plans for both experimental and control classes, and concept mastery question instruments also helped the assessment and response of science teachers to the aquascape media products developed. The science teacher practicality test sheet was made into 2, namely media and material assessment. The media assessment consists of an assessment of aquascape media and guidebooks and LKPD, while the material assessment consists of learning objectives, subject matter, learning activities, language and time allocation of aquascape media guidebooks and LKPD (Grabau, 2016).

The validation results show that the Aquascape media product received a score in the very good category. Science teachers as practitioners assess the practicality of aquascape media directly. The results of the practicality test for Aquascape media received a score in the very practical category (Komala et al., 2016). The aquascape media which had been revised according to input from media experts, material experts and science teachers was tested on a limited number of 9 students. The results of the students limited trial assessment of the developed aquascape media were in the very good category. Results are obtained from questionnaires that students have filled out. Based on the results of this assessment, the aquascape media product developed is ready and suitable for use in school learning (Manik, 2016). The concept mastery question instrument that was tested empirically contained 20 multiple choice questions and 5 essay questions. This test involved 83 class VIII students at SMP Negeri 12 Yogyakarta who had studied material on interactions between living things and the environment. The results of the validity and reliability of multiple

choice questions show that of the 20 questions, there are 16 valid questions based on the Pearson Correlation significance value and the Cronbach Alpha value is 0.748. The reliability of multiple choice questions is in the high category. The essay questions were also tested for validity and reliability with results based on the Pearson Correlation significance value, there were 3 valid questions out of 5 questions tested empirically with a Cronbach Alpha value of 0.176. The reliability of the essay questions is in the high category (Neka et al., 2015).

The Aquascape media product as an aid in learning interactions between living things has been developed and shows a visible influence from the differences in the results of the experimental and control classes on the variables of students' mastery of concepts and communication skills (Triawan & Sardi, 2020). The experimental class used aquascape media, while the control class used the environmental media of a pond in the school garden in learning about interactions between living things (Kementrian Pendidikan dan Kebudayaan, 2013a). These differences are known based on the results of the MANOVA test analysis. MANOVA test analysis on the posttest scores obtained from the experimental and control classes shows that the aquascape media that has been developed has a significant effect on students' mastery of concepts and communication skills, where the fulfillment of H1 conditions is accepted and H0 is rejected with a Sig value. $0.000 < 0.05$. The effectiveness of aquascape media as a tool in learning interactions between living things to improve students' mastery of concepts and communication skills is shown by the Partia Eta Squared value of 0.983 in the high category. Another analysis result that can show that the MANOVA test hypothesis is accepted is the result of the Test of Between Subject Effect where the Sig. $0.000 < 0.05$ so it can be said that aquascape media as a tool in learning interactions between living things and the environment can simultaneously increase the variables of students' mastery of concepts and communication skills.

The guidebook contains the front cover of the guidebook, foreword, concept map, Core Competencies and Basic Competencies as well as learning objectives, instructions for use for both teachers and students, introduction to aquascape media, images of media products, tools and materials, animal and plant catalogues, instructions Aquascape media maintenance, as well as student worksheets (LKDP) for 4 meetings. Activities at meeting-1 discussed the environment, activities at meeting-2 discussed interdependence, activities at meeting-3 carried out activities related to patterns of interaction of organisms, and activities at meeting-4 carried out experiments to discuss human interaction patterns affecting the environment.



Figure 2. Guidebook Cover Aquascape Media



Figure 3. Limited Student Trial

Field trials were carried out in two class VII of SMP Negeri 12 Yogyakarta, namely class VII-A as the experimental class and class VII-B as the control class with each number of students being 33 people.

Conclusion

This study developed an aquascape media product to enhance the learning of interactions between living things and their environment for junior high school students. Using the 4D development model, the aquascape media was designed, developed, validated, and tested. The validation process, involving media and material experts, as well as science teachers, confirmed the media's feasibility and practicality. Empirical testing showed high validity and reliability for the concept mastery questions. Limited trials with students indicated that the aquascape media was highly effective

in improving students' mastery of concepts and communication skills. The feasibility of the aquascape media was rated very highly by media and material experts. Teachers assessed the practicality of the aquascape media as very practical for learning interactions between living creatures and the environment. The effectiveness of the aquascape media was demonstrated by a significant increase in the average score in the posttest for both the experimental and control classes. The Partial Eta Squared value and the Test of Between Subject Effect in the MANOVA test indicated a significant improvement, categorizing the aquascape media as effective in enhancing students' mastery of concepts and communication skills. Overall, the aquascape media proved to be a valuable educational resource, significantly enriching the science learning experience for students. The experimental class using the aquascape media showed substantial improvement compared to the control class, underscoring its effectiveness as an innovative learning tool for fostering scientific understanding and communication abilities.

Acknowledgments

Schools can make aquascape media of a larger size which can be placed in school corridors, not only can it be used as a learning medium but can create a more beautiful school environment. Aquascape media can be used as a substitute for water ecosystems so that students can see interactions between creatures and the environment in water that are usually difficult to see. Further research, aquascape media can be presented in various schools with activities that can assess other aspects besides students' mastery of concepts and communication skills.

Author Contribution

Authors of articles contribute significantly to the preparation of these scientific papers through ideation, research design, data collection and analysis, result interpretation, manuscript drafting, article writing, revisions, and research funding acquisition.

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Conflicts of Interest

The authors make it clear that there isn't any conflict of interest.

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