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THE VALIDATION OF DIGITAL ANALYSIS TOOL-ASSISTED REAL-WORLD INQUIRY (DIGITA-RI) AS A MODIFICATION OF THE INQUIRY-BASED LEARNING MODEL IN THE DIGITAL AGE

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ABSTRACT

Inquiry-based learning has been tested to improve conceptual understanding, reduce misconceptions, and provide students with experiences in scientific work. However, in its implementation, inquiry-based learning is often faced with scientific facts from the real world with data which hard to analyze using traditional methods. Therefore, a breakthrough is needed to overcome the weaknesses of inquiry-based learning by integrating digital analysis tools and the concept of real-world learning. This integration produces a new learning model, the Digital Analysis Tool-Assisted Real-World Inquiry (Digita-RI). This study aims to test the feasibility and practicality of the Digita-RI learning model. This Research and Development (R&D) use the steps proposed by Borg & Gall. The feasibility test of the Digita-RI model was carried out through the Focus Group Discussion (FGD) method and the assessment of the Digita-RI model book involving seven experts. The practicality test was carried out through the Think Aloud Protocol (TAP), and the assessment of the Digita-RI model guidebook involved five practitioner lecturers and six students. The results of expert, practitioner, and user assessments were analyzed using the Aiken coefficient (Aiken's V). The results showed that Digita-RI is a feasible and practical learning model. Therefore, it can be concluded that Digita-RI has the feasibility and practicality to be used in science learning in the classroom.

Keywords: inquiry-based learning; digital analysis tools; real world learning

INTRODUCTION

Inquiry-based learning is increasingly popular in science curricula, international research, and various development projects, as well as in-classroom instructional practices (Pedaste et al., 2015). Various studies have shown the success of inquiry-based learning in solving learning problems. The implementation of the inquiry-based learning model is proven to increase students' creative thinking and reduce the percentage of students' misconceptions (Zubaidah et al., 2017; Haidar et al., 2020). Moreover, on the topic of "magnetism", the inquiry-based learning model implementation in Kuala Kangsar, Malaysia, showed a significant difference in learning outcomes compared to the control group with traditional learning (Ong et al., 2020).

A meta-analysis study of quasi-experimental research that compared the learning outcomes of the inquiry and traditional learning obtained an average effect size of 0.50, which indicates that inquiry learning is more successful in improving students learning outcomes (Furtak et al., 2012). A qualitative case study with a pre-test/post-test design found that inquiry-based learning helps students understand the particulate nature of the matter in the gas phase (van Riesen et al., 2018).

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The implementation of inquiry-based learning in the everyday classroom, however, still leaves some problems. Teachers in classroom learning do not widely use Inquiry-based learning because of various perceived obstacles (Silm et al., 2017). Studies on the readiness of science teacher candidates at Hamzanwa University, Malaysia, show that science teacher candidates have not been able to engage in inquiry learning appropriately. They still need guidance and development to teach using the inquiry model (Fatmawati & Rustaman, 2020). Research shows that the application of the inquiry process in classroom learning is a challenge for teachers.

A study conducted by Effendi-Hasibuan et al. (2019) aims to describe the implementation of inquiry-based science learning in Jambi, Indonesia, in the era of curriculum reform. The results are that limited educational supports and ill-fit situational beliefs affected the minimal adoption of inquiry-based science learning in Indonesia. Inquiry-based learning research so far has focused more on analyzing the quality of learning outcomes, not on how to promote the effectiveness of inquiry-based learning (Dobber et al., 2017).

A systematic critical review study also found that one of the problems in implementing inquiry learning is resource support (Khalaf & Zin, 2018; Naezak et al., 2021). The inquiry process can be hampered if it is not supported by tools that can assist students in analyzing data from real-world phenomena. Real-world learning is essential to apply because it can help students retain key concepts taught during the course (White et al., 2017). By utilizing data from real-world phenomena in learning, students can be guided to analyze, interpret, and report quantitative data (Erwin, 2015).

Students are often exposed to many types of real-life phenomena. However, it is not easy for them to obtain and analyze the complete data without digital technology support. For example, students will find it hard to do an inquiry process on parabolic motion due to difficulties observing its varied physical data (e.g., speed, acceleration, altitude, distance). Therefore, digital analysis tools to assist students in obtaining and analyzing data from real events are necessary.

One of the digital devices used to support the data analysis process is the Tracker Video Analysis. Through this device, students can analyze various types of motion, including the parabolic motion to find mathematical models and equations of motion so that students can find equations of motion and basic concepts of parabolic motion by themselves (Wee et al., 2012). Research conducted by Mamombe et al. (2020) on several pre-service science teachers shows that implementing Inquiry-based Practical Work (IBPW) through computational thinking can help students solve problems.

Therefore, it is crucial to research how to modify inquiry-based learning in this digital era. The modification is intended so that inquiry-based learning can teach science concepts from real-world events by utilizing digital analysis tools. Therefore, modifications are made by integrating inquiry-based learning with digital analysis tools and real-world learning concepts. The learning model is "Digital Analysis Tool-Assisted Real-World Inquiry," in the future referred to as Digita-RI. As a new learning model that intends to overcome the weaknesses of the old model (Inquiry-Based Learning), Digita-RI needs to examine its feasibility and practicality. Therefore, the problem of this research is: "What is the feasibility and practicality of the Digita-RI learning model as a modification of Inquiry-based learning in the digital era?"

METHODS

The research design used was Educational Research and Development (R&D), following the steps proposed by Borg & Gall (2003). The R&D stages of Borg & Gall consist of 10 stages. However, this article only reports the first five stages, they are as follow: (1) research and information collecting; (2) planning; (3) developing a preliminary form of product; (4) preliminary field testing; (5) main product revision. This study uses only five of the ten steps in the Borg & Gall model because it adapts to the research objectives to test the feasibility and practicality of product development. According to Borg & Gall, the first five steps of the R&D model are sufficient to achieve this goal (Borg & Gall, 2003). Steps 6 to 10 will be continued in the subsequent research. Figure 1 presents the research procedure. From Figure 1, The Research and Information Collecting stage was carried out using the literature study method. A conceptual draft of the Digita-RI model was prepared at the Planning stage.

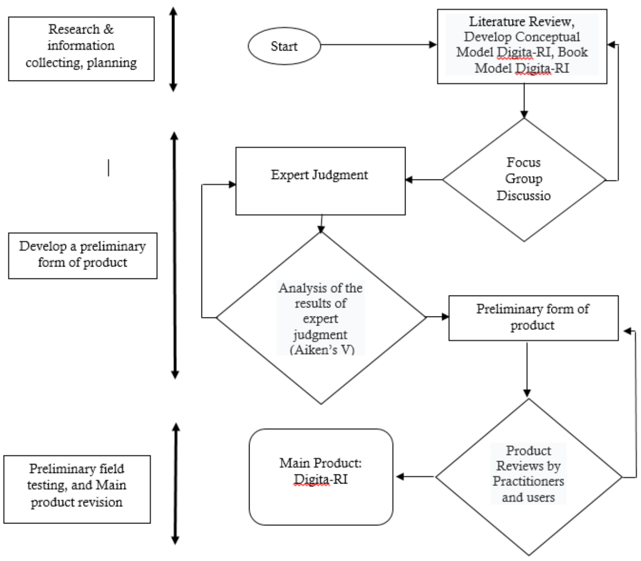

Figure 1. The Research Procedure

The Develop the Preliminary Form of the Product stage is carried out using Focus Group Discussion (FGD) and expert judgment on the Digita-RI model. FGD and expert judgment involving seven science education lecturers with the qualifications of professor or associate professor. FGD aims to obtain data from a deliberately selected group of individuals, not from a statistically representative sample of the broader population (Nyumba et al., 2018). Both methods are used to test the feasibility of the Digita-RI model. At the Preliminary field-testing stage, practicality tests were carried out through the Think Aloud Protocol (TAP) technique and product reviews by practitioners (lecturers) and users (students). The practicality test involved five science education lecturers and six final-year students. The fifth stage is product revision to create the main product.

The instruments used in this study were: (1) the Digita-RI Model Book Assessment Sheet for the expert judgment process; (2) the Digita-RI Model Guide-Book Assessment for practitioners (lecturers); (3) Practicality Test Instruments for users (students). The instrument was developed by the researcher based on the components of the learning model according to Joyce & Weil (2003), Arends (2012), and Kilbane & Milman (2015). After the instrument was compiled, it was assessed by experts, then analyzed using the Aiken coefficient (Aiken's V). The assessment results of experts, practitioners, and users are analyzed using Aiken's V to calculate the content-validity coefficient based on the assessment results of n-assessors on an item (Retnawati, 2016).

The formula proposed by Aiken is as follows:

$V = \sum s / [n (c-1)]$

$s = r - lo$

lo = the lowest number of validity assessments

c = the highest validity score

r = number given by the assessor

The results of the calculation of Aiken's coefficient are then consulted in the Aiken table.

RESULTS AND DISCUSSION

At this stage, a literature review is carried out to synthesize which components of the learning model will be used, synthesize inquiry-based learning syntax, and develop a conceptual Digita-RI model. According to Joyce & Weil (2003), the learning model is a plan or pattern used to compile the curriculum, design learning materials, and provide guidelines for learning activities in class and other settings. Eggen & Kauchak (1988) state that the learning model is a learning strategy designed to achieve learning objectives used by teachers during learning planning, implementation, and evaluation processes. More specifically, Kilbane & Milman (2015) state that the learning model is a specific method to facilitate the learning process, designed to obtain specific learning outcomes through precisely structured activities.

Learning design is referred to as a learning model if there are several inherent components. Joyce & Weil (2003), Arends (2012), and Kilbane & Milman (2015) mention the components of the learning model. This study refers to the components of the learning model from the three sources because these sources are the most popular in the study of learning models. Joyce & Weil are pioneers of learning models, Arends is a figure in learning strategies, while Kilbane & Milman offer learning models relevant to the 21st century. Based on these three sources, a more comprehensive component of the learning model can be synthesized as presented in Table 1. Based on the synthesis as shown in Table 1, the components of the learning model used in this study are obtained: Theoretical rationale, Syntax of Learning, Social System, Principle of Reaction, Support System, Instructional and Nurturant Effect, and Technologies to Integrate.

Table 1. Synthesis of Learning Model Components

Joyce & Weil, 2003	Arends, 2012	Kilbane & Milman, 2015	Researcher's Synthesis	Description
Syntax	Theoretical rationale	Definition of Model	Theoretical rationale	Learning theory that underlies the development of learning models
Social System	Learning objectives	Knowledge Supported	Syntax of Learning	Learning steps that students must do
Principle of Reaction	Teaching behavior	Syntax	Social System	Setting the roles of teachers and students during learning
Support System	Learning Environment	Added Value	Principle of Reaction	Student response to teacher stimulation
Instructional and Nurturant Effect		Technologies to Integrate	Support System	Learning media, tools, and materials to support learning success
			Instructional and Nurturant Effect	Expected learning outcomes
			Technologies to Integrate	Use of technology in learning

Inquiry-Based Learning, according to Jerrim et al. (2020), accommodates at least nine criteria: (1) students are allowed to express ideas; (2) students conduct practical experiments in the laboratory; (3) students argue about science questions; (4) students conclude from the experiments that have been carried out; (5) teacher explains that a scientific idea can be applied to several different phenomena; (6) students are allowed to design their experiments; (7) there is a class debate about the investigation; (8) teacher explains the relevance of science concepts to our lives; (9) students conduct investigations to test ideas. These criteria are then applied in the learning steps, then referred to as the syntax of the inquiry learning model. Joyce & Weil (2003) presents Schwab's idea about the essential steps (syntax) of an inquiry-based learning model called the Biological Science Inquiry Mode as following: (1) the area of investigation is posed to the students; (2) students structure the problem; (3) students identify the problem in the investigation; (4) students speculate on ways to clear up the difficulty. In addition, Kilbane & Milman (2015) also propose a more general inquiry-based learning syntax. Pedaste et al. (2015) conduct a literature review of 32 articles discussing the steps of inquiry-based learning, then successfully synthesized its five main phases and seven sub-phases. This study adopts the syntax of inquiry-based learning according to Pedaste et al. (2015), with a slight change in terminology following Kilbane & Milman's (2015) ideas. The adaptation process is presented in Table 2.

Table 2. Adaptation of Inquiry-Based Learning Syntax

Kilbane & Milman (2015)	Pedaste et al. (2015)	Researcher's Adaptation	Description
Identifying a problem or question	Orientation	Orientation	-
Making hypotheses	Conceptualization -Questioning -Hypothesis Generation	Conceptualization -Questioning -Hypothesis Generation	-
Gathering data	Investigation -Exploration -Experimentation -Data Interpretation	Investigation -Exploration -Experimentation -Data Interpretation	-
Assessing hypotheses (Analyzing data)	Conclusion	Generalizing About findings	According to Pedaste et al. (2015), the fourth phase of Inquiry-based learning is "Conclusion." This term was changed using Kilbane & Milman's idea, namely "Generalizing About findings." This change was made to eliminate the impression that "conclusion" seemed to be the last step; there was no discussion after the conclusion. In fact, after the fourth step, there is still the fifth step.
Generalizing About findings	Discussion -Communication -Reflection	Analyzing the process -Communication -Reflection	According to Pedaste et al. (2015), the fifth phase of Inquiry-based learning is "discussion." This term was changed using Kilbane & Milman (2015), namely "Analyzing the process," to clarify what was discussed in the fifth step.
Analyzing the process			

Based on table 2, the syntax of the inquiry-based learning model has been synthesized as follows: Phase 1 (Orientation), Phase 2 (Conceptualization with two sub-phases: Questioning and Hypothesis Generation), Phase 3 (Investigation with three sub-phases: Exploration, Experimentation and Data Interpretation), Phase 4 (Generalizing About findings), and Phase 5 (Analyzing the process with two sub-phases: Communication and Reflection).

The conceptual model of the Digita-RI was developed based on the synthesis of the components of the learning model as presented in Table 1: (1) Theoretical Rationale; (2) Syntax; (3) Social Systems; (4) Principles of Reaction; (5) Support Systems; (6) Instructional and Nurturant Effect; and (7) Technologies to Integrate.

The learning theory that underlies the Digita-RI model is constructivism. The meaning of constructivism varies according to one's perspective and position. There is a philosophical meaning of constructivism and personal constructivism in education as described by Piaget, social constructivism described by Vygotsky, radical constructivism advocated by von Glasersfeld, and constructivist epistemology according to Mathews (Tan, 2017).

Piaget's main view is to see that learning is a constructive process, and each individual will build knowledge through his interaction with their environment (Arends, 2012). According to Piaget, the process of forming new knowledge is through assimilation and accommodation. Assimilation refers to the process in which the subject inserts a perceived stimulus into an existing scheme (Zhiqing, 2015). Accommodation occurs when individuals change existing schemes to respond to new ideas or situations (Arends, 2012). Thus, the constructivism process consists of stimulation, assimilation, accommodation, and equilibrium. Inquiry-based learning facilitates the process. For example, in the early phase of inquiry-based learning, students will be facilitated by the stimulation process when problem orientation is presented to students. The conceptualization step facilitates assimilation. Meanwhile, the accommodation process occurs when students investigate to prove the hypothesis. Finally, in the last step of inquiry-based learning, students are expected to reach equilibrium. In addition to Piaget's theory of personal constructivism, Vygotsky also offers the ideas of social constructivism theory. Social constructivism emphasizes the social context, culture, and the collaborative side of Learning (Bay et al., 2012) and views students' knowledge as a product of social interaction, interpretation, and understanding (Vygotsky, 1986). Therefore, the Digita-RI learning model was developed in such a way to facilitate the students' social processes during learning, such as collaborative work.

In the theory of social constructivism, there are two essential concepts proposed by Vygotsky: Zone of Proximal Development (ZPD) and scaffolding. Zone of Proximal Development (ZPD) is a place where the spontaneous concepts of a child obtained empirically in everyday life in an irregular structure meet with the systematics and logic of adult reasoning (Vygotsky, 1986). As a result, the weakness of spontaneous reasoning is compensated by the strength of scientific logic. A study conducted by Fernando & Marikar (2017) found three main pillars of learning based on constructivism learning theory such as: (1) learning is an active experience; (2) the ideas students have about the subjects and topics being taught will become part of their learning experience; and (3) social and cultural-based learning. Therefore, the Digita-RI learning model in its implementation must provide a learning experience that can facilitate students to learn actively.

The Digita-RI syntax makes inquiry-based learning phases its primary reference. After the inquiry-based learning phases are obtained (Table 2), the next step is integrating the real-world learning components and the digital analysis tool into the inquiry-based learning phases. In the Orientation phase, the concept of real-world learning is integrated to become a real-world problem orientation. In addition, in the third phase, investigation, it is modified to become a Digital Analysis Tool-Assisted Real-World Investigation. Thus, the concepts of real-world learning and digital analysis tools are all integrated into the third phase. Table 3 presents the Digita-RI syntax in detail.

Table 3. Phases and Sub-Phases of Digita-RI

No	Phase	Sub-Phase	Activity
1	Real-World Problem Orientation	-	Problem statements from natural phenomena (Real World) to stimulate curiosity
2	Conceptualization	Questioning	The process of formulating problems (research questions)
		Hypothesis generation	The process of compiling a hypothesis following the formulation of the problem
3	Digital Analysis Tool-Assisted Real-World Investigation	Exploration	It is the process of planning and collecting data systematically on natural phenomena aided by digital devices. This process is based on research questions.
		Experimentation	Process for designing and carrying out experiments assisted by digital devices to test hypotheses.
		Data interpretation	The process for interpreting the data that has been collected and processed is using the Digital Analysis Tool. Based on this process, students can synthesize new knowledge.
4	Generalizing about findings	-	The process of making conclusions based on data, comparing the data obtained with hypotheses/research questions/theories, and other experiments.
5	Analyzing the process	Communication	Process for presenting Inquiry results to others and receiving feedback from others.
		Reflection	The process of describing, criticizing, evaluating, and discussing all or part of the inquiry process carried out

Table 3 shows that the Digita-RI syntax has five main phases: Phase 1 (Real-World Problem Orientation), Phase 2 (Conceptualization, with sub-phase: Questioning and Hypothesis generation), Phase 3 (Digital Analysis Tool-Assisted Real-World Investigation, with sub-phases: Exploration, Experimentation, and Data interpretation), Phase 4 (Generalizing about findings), and Phase 5 (Analyzing the process, with sub-phase: Communication and Reflection).

As a learning model based on inquiry, Digita-RI makes the center of learning activities available to students, while lecturers act as facilitators (Dobber et al., 2017). The essential things in inquiry are encouraging students to focus on learning thinking skills, developing a culture of inquiry, supporting inquiry, and promoting Nature of Science (NOS), provide information on research topics and focus on conceptual understanding, organize students to learn in groups and focus on the collaborative process (Dobber et al., 2017). Moreover, a cooperative, rigorous climate is desired. Because the students are to be welcomed into a community of seekers who use the best techniques of science, the climate includes a certain degree of boldness as well as humility (Joyce & Weil, 2003).

The teacher's task is to nurture the inquiry by emphasizing the inquiry process and inducing the students to reflect on it (Joyce & Weil, 2003). The reactions of students during Learning on the Digita-RI model are: (1) capturing real problems presented by lecturers; (2) formulating problems and hypotheses; (3) investigating (investigations assisted by digital analysis tool) and interpreting data; (4) compiling conclusions; (5) communicating learning outcomes, reflecting on processes and learning outcomes. The principle of reaction is under the study of Brookes et al. (2020) regarding students' activities in the real-world investigation process: (1) observing and collecting observational data; (2) identifying patterns using appropriate representations; (3) developing mathematical explanations or models, and testing them in experiments.

Inquiry-based learning needs support from flexible instructors skilled in the inquiry process, a plentiful supply of real areas of investigation and their ensuing problems, and the required data sources from which to conduct an inquiry into these areas provide the necessary support system for this model (Joyce & Weil, 2003). More specifically, in Digita-RI learning, students need digital analysis tool software support. Howland et al. (2012) stated that technology could support the representation and simulation of real-world contexts in a meaningful way.

Models and strategies of learning that can improve analytical thinking skills (as part of HOTS) generally start from presenting the problem. The problem is formulated to be proven together with the group by looking for relevant information, observing/ experimenting, concluding the results, and communicating (Sartika, 2018). In addition, Limbach & Waugh (2010) proposed five learning criteria that could facilitate HOTS, they are as follow: (1) determine the learning objectives; (2) teach through inquiry; (3) practice; (4) review, refine and improve understanding; and (5) practice feedback and assess learning. The syntax in Digita-RI is relevant to the terms proposed by Sartika (2018) and Limbach & Waugh (2010). Therefore, the impact of Digita-RI is that it can improve learning outcomes at the level of High Order Thinking Skills (HOTS).

Based on a literature review, real-world learning as one of the supports for Digita-RI has contributed significantly to improving various competencies such as problem-solving, linking knowledge to action, and collaborative work, while applying concepts and methods from the field (Brundiers & Wiek, 2011). Meanwhile, using digital analysis tools in the Digita-RI model can also improve inquiry skills such as problem-solving, formulating questions and hypotheses, planning and carrying out experiments, collecting and analyzing data, presenting the results, and drawing conclusions (Mäeots et al., 2008). Ernst et al. (2017) added that one of the main pillars of inquiry-based learning is collaborative work. The findings of Mäeots et al. (2008), Brundiers et al. (2010), and Ernst et al. (2017) illustrate that Digita-RI can facilitate the improvement of students' 21st-century skills.

In inquiry-based learning, lecturers can integrate technology into learning. One example is digital video/ audio recording to present or retrieve data or express learning (Kilbane & Milman, 2015). The use of digital technology in inquiry-based learning can help train students to work independently, be actively involved in learning, and encourage discussion during the research (Heindl, 2018). In the Digita-RI model, technology integration is carried out by using various digital analysis tools. One example is Tracker Video Analysis which can help investigate physical quantities in the phenomenon of motion.

The conceptual model of Digita-RI compiled in a model book is validated by seven experts. The validation process is carried out in two steps, Focus Group Discussion (FGD) and assessment of model books using the Digita-RI Model Assessment Sheet instrument. Table 4 presents a list of the experts involved in the FGD and the assessment of the Digita-RI model book. It shows that the experts involved in this study have very suitable qualifications to provide input and assessment of the Digita-RI model book product.

Table 4. Expert List: Validator of Digita-RI Model Book

Expert's Title	Institution	Expertise
E-1: Professor	Universitas Negeri Yogyakarta	Physics Education
E-2: Professor	Universitas Negeri Yogyakarta	Science Education
E-3: Professor	Universitas Negeri Yogyakarta	Evaluation in Science Education
E-4: Professor	Universitas Sebelas Maret	Science Education
E-5: Associate Professor	Universitas Sebelas Maret	Science Education
E-6: Associate Professor	Universitas Sebelas Maret	Science Education
E-7: Associate Professor	Universitas Negeri Yogyakarta	Science Education

FGD is a technique for collecting qualitative data, where a group of people discusses under the direction of a facilitator or moderator about a topic (Paramita & Kristiana, 2013). The FGD process was carried out following the steps suggested by Rum & Heliati (2018): (1) presentation of information regarding the components of the Digita-RI model, which is a combination of the concepts of inquiry-based learning, real-world learning, and digital analysis tool; (2) open discussion, the panelists were asked to provide suggestions and input on the development products that have been described. Based on the results of open discussions, revisions were made to the product development; (3) drawing opinion and consensus. At this stage, the panelists were asked to assess the revised product after an open discussion. Based on the results of the FGD, several parts of the Digita-RI model book were revised. Table 5 presents a summary of the revised Digita-RI model book based on the FGD.

Table 5. List of Revised Digita-RI Model Book based on FGD

No	Aspect	Revision
1	Constructivism	Vygotsky's theory of social constructivism is added.
2	Inquiry-Based Learning	Wenning's level of inquiry is added. In its application, Wenning (2011) proposes a division of levels of inquiry-based on the roles of teachers and students: Discovery Learning, Interactive Demonstration, Inquiry Lesson, Inquiry Laboratory, Real-world Applications, Hypothetical Inquiry.
3	Digital Analysis Tools	It made Digita-RI more universal by presenting various digital analysis tools that can be applied to various materials, not only tracker video analysis. For example, CamToPlan, Angle meter, GPS Speedometer: Speed Tracker, HUD, Odometer Sound Analysis Oscilloscope Signal Generator Advanced Spectrum Analyzer Sound Meters Vibration Meter Vibration & seismic meter Ambient Light Sensors (ALS) Gaus Meter Star Walk, Stellarium.
4	Syntax	An argument why Digita-RI has the syntax is proposed, especially in the communication section, at why it appears after generalization. In the Generalizing step added: comparing findings with other standards/theories/methods.
5	Social System	A classroom layout system in the section "Social Systems" is added. In face-to-face learning, the table setting must be arranged to be used to support collaborative work. On the other hand, online learning requires a Breakout Room and Google Docs to support online collaboration.
6	Instructional Effect	A nurturant effect is added.

Through the revision process on the items shown in Table 5, the Digita-RI learning model book became complete and improved quality.

Furthermore, the assessment of the Digita-RI model book is carried out using a five-scale assessment sheet consisting of 47 items. These items were developed based on nine aspects of assessment, they are: (1) Background; (2) Theoretical Review; (3) Theoretical Rationale; (4) Learning Syntax; (5) Social Systems; (6) Principle of Reaction; (7) Support System; (8) Instructional Effect; (9) Technology to Integrate. Aspects number three to nine are components of the learning model used in this study. The results of the assessment were analyzed using the Aiken coefficient (Aiken's V). The calculation results were consulted with the Aiken table, with a scale of five and the number of raters of seven; the minimum item validity limit was 0.75 (Retnawati, 2016). After calculating, all items are found to be valid. A summary of the results of the experts' judgment is presented in Table 6.

Table 6. Results of Expert Judgment on the Validity of the Digita-RI Model Book

Components of the Digita-RI Model		Experts									
		E-1	E-2	E-3	E-4	E-5	E-6	E-7	S	Aiken's V	Validity
Background	Score	4.2	4.7	4.2	3.8	4.7	4.7	4.5	23.7	0.845	Valid
	S	3.2	3.7	3.2	2.8	3.7	3.7	3.5			
Theoretical Review	Score	4.6	4.4	4.2	4.4	4.6	5.0	4.6	24.8	0.886	Valid
	S	3.6	3.4	3.2	3.4	3.6	4.0	3.6			
Theoretical Rationale	Score	4.8	4.6	4.0	3.8	4.6	5.0	5.0	24.8	0.886	Valid
	S	3.8	3.6	3.0	2.8	3.6	4.0	4.0			
Learning Syntax	Score	4.7	4.6	3.4	3.9	4.7	4.8	4.6	23.6	0.844	Valid
	S	3.7	3.6	2.4	2.9	3.7	3.8	3.6			
Social System	Score	4.8	4.8	4.0	3.5	4.8	5.0	5.0	24.8	0.884	Valid
	S	3.8	3.8	3.0	2.5	3.8	4.0	4.0			
Principle of Reaction	Score	4.3	4.0	4.0	4.0	4.8	5.0	4.3	23.3	0.830	Valid
	S	3.3	3.0	3.0	3.0	3.8	4.0	3.3			
Support System	Score	4.5	4.0	4.0	3.8	4.5	5.0	4.3	23.0	0.821	Valid
	S	3.5	3.0	3.0	2.8	3.5	4.0	3.3			
Instructional Effect	Score	5.0	5.0	3.5	4.0	4.5	5.0	4.0	24.0	0.857	Valid
	S	4.0	4.0	2.5	3.0	3.5	4.0	3.0			
Technology Integration	Score	4.7	4.7	4.0	4.0	4.0	5.0	5.0	24.3	0.869	Valid
	S	3.7	3.7	3.0	3.0	3.0	4.0	4.0			

Information
Score: The mean score of all items in each component of the Digita-RI Model; S: Score-1; S: Total S value of each component

Based on the experts' judgment (Table 6), it seems very clear that the Digita-RI Model is a learning model that has academic feasibility. Whether seen from the aspect of why the Digita-RI Model was compiled (Background and Theoretical Review) and how the Digita-RI model was applied (Digita-RI Component), all experts provided an adequate assessment Digita-RI model could be said to have the feasibility for application. After experts declare the Digita-RI model feasible, the next step is to test its practicality on practitioners (lecturers) and users (students). At this stage, it involved five practitioner lecturers with science education backgrounds and six pre-service science students. Table 7 present a list of lecturers involved in the practicality test.

Table 7. List of Practical Examiner (Lecturers)

Practice	Background	Institution
P-1	Doctorate in Science Education	Universitas Negeri Yogyakarta
P-2	Master's in science education	UIN Sunan Kalijaga Yogyakarta
P-3	Master's in science education	UIN Sultan Thaha Syaifudin Jambi
P-4	Master's in science education	Universitas Negeri Yogyakarta
P-5	Master's in science education	Universitas Negeri Yogyakarta

Based on Table 7, the practitioners selected to provide input consist of lecturers with a minimum education of master's in science education.

Table 8 present a list of students involved in the practicality test. It shows that the students involved are final-year students with adequate basic knowledge and learning practices.

Table 8. List of Practical Examiners (Student)

Student	Study Program	Year
S-1	Bachelor of Science Education	4th
S-2	Bachelor of Science Education	4th
S-3	Bachelor of Science Education	4th
S-4	Bachelor of Science Education	4th
S-5	Bachelor of Science Education	4th
S-6	Bachelor of Science Education	4th

The practicality assessment of the Digita-RI Model was carried out using a five-scale assessment sheet consisting of 41 items. These items were developed based on the seven aspects of the assessment of the Digita-RI Model components: (1) Theoretical Rational; (2) Learning Syntax; (3) Social Systems; (4) Principle of Reaction; (5) Support Systems; (6) Instructional Effect; (7) Technology to integrate. Through the items provided, the practitioners will assess whether the Digita-RI Model can be applied practically in classroom science learning or not. The results of the assessment were analyzed using the Aiken coefficient (Aiken's V). The calculation results were consulted with the Aiken Table. Table 9 shows the results of practitioner-lecturer assessments. On the practicality examiner by the lecturer, with a scale of five and the number of raters of five, the minimum item validity limit was 0.80 (Retnawati, 2016).

Table 9. Assessment Results of Practitioners (Lecturers)

Components of the Digita-RI Model		Practitioners							
		P-1	P-2	P-3	P-4	P-5	S	Aiken's V	Validity
Theoretical Rationale	Score	4.2	4.8	5.0	5.0	5.0	19.14	0.96	Valid
	S	3.2	3.8	4.0	4.0	4.0			
Learning Syntax	Score	4.5	4.8	5.0	5.0	5.0	19.31	0.97	Valid
	S	3.5	3.8	4.0	4.0	4.0			
Social System	Score	4.9	4.8	5.0	4.8	5.0	19.38	0.97	Valid
	S	3.9	3.8	4.0	3.8	4.0			
Principle of Reaction	Score	4.8	5.0	5.0	5.0	5.0	19.75	0.99	Valid
	S	3.8	4.0	4.0	4.0	4.0			
Support System	Score	4.0	5.0	5.0	4.3	5.0	18.25	0.91	Valid
	S	3.0	4.0	4.0	3.3	4.0			
Instructional Effect	Score	4.7	4.7	5.0	5.0	5.0	19.33	0.97	Valid
	S	3.7	3.7	4.0	4.0	4.0			
Technology Integration	Score	5.0	5.0	5.0	5.0	5.0	20.00	1.00	Valid
	S	4.0	4.0	4.0	4.0	4.0			

Information
Score: The mean score of all items in each component of the Digita-RI Model; S: Score-1; S: Total S value of each component

Table 9 shows that the value of Aiken's V in all components is above 0.80, then all components of Digita-RI are declared valid. Finally, practitioners-lecturers assess the Digita-RI learning model as practical to use in classroom learning.

Table 10 shows the results of the practitioner-student assessment. In the practicality test by students, with a scale of five and six raters, the minimum item validity limit was 0.79 (Retnawati, 2016).

Table 10. Assessment Results of Users (Students)

Components of the Digita-RI Model		Student S-1	S-2	S-3	S-4	S-5	S-6	S	Aiken's V	Validity
Learning Syntax	Score	5.0	5.0	4.7	5.0	5.0	5.0	19.67	0.82	Valid
	S	4.0	4.0	3.7	4.0	4.0	4.0			
Social System	Score	5.0	5.0	5.0	5.0	5.0	5.0	20.00	0.83	Valid
	S	4.0	4.0	4.0	4.0	4.0	4.0			
Principle of Reaction	Score	5.0	5.0	5.0	5.0	5.0	4.8	19.97	0.83	Valid
	S	4.0	4.0	4.0	4.0	4.0	3.8			
Support System	Score	4.9	5.0	5.0	4.9	5.0	5.0	19.71	0.82	Valid
	S	3.9	4.0	4.0	3.9	4.0	4.0			
Technology Integration	Score	5.0	5.0	5.0	5.0	5.0	5.0	20.00	0.83	Valid
	S	4.0	4.0	4.0	4.0	4.0	4.0			

Information
Score: The mean score of all items in each component of the Digita-RI Model; S: Score-1; S: Total S value of each component

Table 10 shows that the value of Aiken's V in all components is above 0.79. All components of Digita-RI are declared valid. Finally, practitioners-students assess the Digita-RI learning model as practical to use in classroom learning. The assessment can be seen from the compelling Aiken coefficient values, most of which are close to 1.0, which means that all practitioners consider the Digita-RI model practical to use.

Based on the assessment of practitioners, lecturers, and students, it seems very clear that the Digita-RI model is a learning model that is practically applied in science learning. Based on Borg & Gall (2003), the number of participants at this stage ranged from 6 to 12. Therefore, the number of lecturers and students involved met the standards set by Borg & Gall.

After the lecturers and students gave an assessment using the instrument, the next step was the Think Aloud Protocol (TAP) to ensure the opinions of practitioners and users on the practicality of the Digita-RI model. When conducting a product usability test, professionals use a TAP (Alhadreti & Mayhew, 2018). Usability practitioners use the TAP method to explore what users think of a product. The TAP method is used to discover how a product can be used and explore users' expectations and reactions. The TAP used in this study is how users express their thought processes after completing the task, as Fan et al. (2021) mentioned. Several studies have shown that the TAP method improves product performance, product safety, user productivity, and user satisfaction (Alhadreti & Mayhew, 2017). Through TAP, lecturers and students were interviewed to determine the extent of their understanding of the research product. Then, after studying the manual of the Digita-RI model, they were asked to explain the steps of Digita-RI according to their understanding. As a result, both lecturers and students, in general, can explain the steps of learning Digita-RI perfectly. Therefore, the Digita-RI model manual has been well prepared to guide practitioners to apply it in classroom learning.

Thus, a new learning model, the Digita-RI, has been found through a series of research and development activities to answer the weaknesses of inquiry-based learning. Digita-RI model combines inquiry-based learning with the concept of real-world learning and digital analysis tools.

CONCLUSION

This research has produced a new learning model to overcome the weaknesses of inquiry-based Learning. A Digital Analysis Tools-Assisted Real-World Inquiry (Digita-RI) model has been generated by integrating digital analysis tools and real-world learning into inquiry-based learning. The Digita-RI syntax can help the inquiry process, especially when using digital analysis tools to take data from real-world phenomena. A series of experts and practitioners' assessment processes found that Digita-RI is a learning model with feasibility and practicality in science learning in the digital era. These findings have a significant impact on science learning practices. If previously the inquiry process was often hampered by failing to retrieve data from real-world observations, then the inquiry process can run well through the application of Digita-RI. Digital analysis tools support data processing from natural phenomena into mathematical models to aid in concept discovery. In the next stage, it is necessary to conduct a field test to determine how effective Digita-RI is on learning outcomes at the High Order Thinking Skills (HOTS) level. This study can be carried out through a quasi-experimental research design on several pre-service teacher students.

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