



Development of Students' Worksheet Based on Inquiry Integrated STEM on Acid-Base Materials

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Abstract: The development of technology and science in the 21st century has been running very rapidly, with these developments students need to be equipped with 21st century skills to be able to compete in the era of globalization, especially in the field of education. The lack of use of learning media causes low motivation and interest in learning for students in understanding acid-base material. This can be proven based on a needs analysis of five chemistry teachers at public high schools in Langsa City. This study aims to determine the feasibility and attractiveness and responses of students about the Student Worksheet Based Guided Inquiry Integrated STEM on acid-base materials. This study uses the R&D model ADDIE. The instruments used in this study were a material and media expert validation questionnaire, a teacher response questionnaire and a student response questionnaire. The results of the student worksheet analysis showed that the validation assessments of material experts, media experts, teacher responses and student responses each reached a percentage of 84.80%, 89.34%, 89.82% and 95.56%, which means that student worksheet Based Guided Inquiry Integrated STEM on acid-base material is very suitable to be used as teaching material and the attractiveness criteria of student worksheet is very interesting.

Keywords: Acid-Base; Guided Inquiry; STEM; Students' Worksheet

Introduction

The development of science and technology in the 21st century has been running very rapidly. With this development, students need to be equipped with 21st century skills to be able to compete in the era of globalization, especially in the field of education (Scientific et al., 2017). One of the functions of the development of technology and science in the field of education is to help the learning process of students.

Chemistry is a science that studies matter or matter. Chemistry is considered difficult to learn, this is because there are several teaching materials in the form of concepts that are abstract and complex, so students find it difficult to understand representations of abstract things, because it cannot be observed directly by students, one of the materials What is considered difficult by students is acid-base material (Ristiyani & Bahriah, 2016).

Based on observations and interviews conducted at SMA Negeri in Langsa City, it was found that the

teaching materials used were still in the form of textbooks. Where the teacher only uses the lecture method which causes students to have difficulty in learning because they are not directly involved.

One of the alternatives used to overcome the problems above is to make teaching materials in the learning process. The rapid development of technology and information today has an impact on various fields, including education. Where the development of technology can create new patterns and strategies in the learning process (Fitriyah & Ghofur, 2022).

The presentation of teaching materials used is not only limited to print media but also utilizes digital media technology. One of the teaching media that can be used is the students' worksheet (Student Worksheet) which is packaged in the form of a website and can be accessed via mobile phones students' worksheet (Fitriani & Pratami, 2022).

Student' worksheet is part of *E-Learning* in the form of electronic or internet-based learning media that functions to support student learning activities

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(Farkhati and Sumarti, 2019). The selection of learning models and approaches in the presentation of teaching materials is needed so that students are actively involved in learning. One type of learning model that is often used in chemistry learning is guided inquiry. The advantages of the guided inquiry learning model are that the teacher provides opportunities for students to actively seek and find learning problems so as to make students the subject of learning, instill an attitude of curiosity in students, and the ability of students to solve problems well (Adnyani et al., 2020).

Learning model guided inquiry has the following stages or syntax: (a) Orientation, (b) Formulating problems, (c) Formulating hypotheses, (d) Collecting data, (e) Testing hypotheses, (f) Formulating conclusions (Ulandari et al., 2019). approach STEM stands for Science, Technology, Engineering and Mathematics (Syahirah et al., 2020).

Approach STEM is interdisciplinary sciences that are linked with world lessons or problems real so that students can apply science, technology, engineering, and mathematics in school (Hasibuan et al., 2022). Through STEM, it is hoped that students can develop critical power in the application of various sciences (Irwandani et al., 2019) approach *STEM* can also be applied to materials.

Method

This research was conducted at Universitas Samudra and at SMA Negeri 1 Langsa, SMA Negeri 2 Langsa, SMA Negeri 3 Langsa and SMA Negeri 5 Langsa from April to June 2022. This type of research is research and development. The method in this research is using the ADDIE research model. There are 5 stages in the ADDIE, namely the analysis, design (Planning), and teaching with science material. Chemistry is one of the materials in which the material contains many components related to STEM, so chemical material can be explained using STEM.

Due to time constraints and research limitations, in this study the researchers modified the EDDIE by limiting it only to the development stage (ADD). In this study, researchers conducted individual tests and group tests to determine the percentage of feasibility and attractiveness of the developed first, the researcher tested the validity of the product that had been developed, then performed an attractiveness test on several representative teachers from SMA Negeri 1 Langsa, SMA Negeri 2 Langsa, SMA Negeri 3 Langsa and SMA Negeri 5 Langsa. Finally conducted a limited trial to 10 students of class XI SMA Negeri 2 Langsa.

Types of data obtained from this research are qualitative and quantitative data. Qualitative data were obtained from suggestions and revisions that had to be improved, while quantitative data were obtained from

expert validation sheets, and teacher and student responses. The instruments used in this study consisted of 1) Expert validation questionnaires, 2) Teacher response questionnaires, and 3) Student response questionnaires. Expert validation questionnaire sheets were given to material expert lecturers and medical experts, teacher responses were given to chemistry teacher representatives and student responses were given to students who were the subject of a limited trial.

On the validation questionnaire sheet, validators are asked to fill out an assessment on each question with the following score provisions: 4) Very Eligible, 3) Eligible, 2) Less Eligible, 1) Not eligible. While the score provisions for teacher responses are: 4) Very Attractive, 3) Attractive, 2) Less Attractive, 1) Not Attractive. Score provisions for students: 4) Strongly Agree, 3) Agree, 2) Disagree, 1) Disagree. The results of the validation. At this stage, it includes the scope of needs analysis, while the needs analysis in this study is analyzed using the percentage technique, the percentage results are interpreted with the provisions of interpretation. The scores obtained from the validator responses, teacher responses and student responses to the items in each aspect are then presented using the Formula 1:

$$\% = \frac{F}{N} \times 100 \tag{1}$$

Note:

% = Percentage of bub variable

F = Total value of each sub-variable

N = maximum score

Criteria for interpretation of validation questionnaires, teacher and student responses.

Table 1. Interpretation Criteria

Percentage (%)	Criteria
81-100	Very Eligible/ Attractive/ Agree
61 - 80	Eligible/ Attractive/ Agree
41 - 60	Fairly Eligible/ Attractive/ Agree
21 - 40	Not Eligible/ Attractive/ Agree
0 - 20	Very Inappropriate/ Attractive/ Agree

Result and Discussion

The results obtained in this study are a series of processes for developing students' worksheet teaching materials in terms of the development process, the feasibility of development and the responses of teachers and students. The process of developing teaching materials for students' worksheet is explained as follows:

Analysis Stage

It was found that 100% of teachers needed teaching materials in the form of students' worksheet in chemistry learning due to the lack of teaching materials that became a reference for educators in learning. There are three selected materials in the needs analysis questionnaire that were selected by each chemistry teacher for the material needs of researchers in developing teaching materials in the form of students' worksheet. Based on the results of the needs analysis questionnaire response, the highest percentage of material needs was obtained, namely acid and base, this is in accordance with the research of Rosa et al., (2022) which states that acid-base material is one of the materials that requires innovative media to attract students' motivation in learning.

Design Stage

The second stage in the development process of this research is the design and manufacture of instruments. *The template* in the students' worksheet is designed using the Canva application, the use of the Canva application. The use of the Canva application can beautify the students' worksheet design so that it has a more attractive appearance so that it can be used in training students' critical thinking skills (Azizah, 2022). After the design is complete, students' worksheet is entered into a site, namely *Google Sites*, making it easier for students to access students' worksheet online and there is no time limit for studying. because it can be accessed anytime and anywhere. The use of online worksheets is in line with research, which found that students' critical thinking skills had increased by using project-based learning integrated virtual laboratories (Sari et al., 2020).

Development Stage

Finishing designing students' worksheet, then consulting with expert lecturers to get directions so they can continue research to the next stage. The next step is to validate the students' worksheet product. Data collection using a validation instrument is the most important stage in development research because it aims to determine the level of validity or feasibility of the teaching materials developed, which consist of validators of material experts and media experts (Ananda et al., 2021).

Table 2. Results of Validator Expert Material

Aspects	ΣF	ΣN	Percentage of eligibility (%)
Content of students' worksheet	162	192	84.37
Language	41	48	85.41
Average percentage			84.80
Criteria			Very feasible

Table 3. Recapitulation Validation of Media Experts

Aspects	ΣF	ΣN	Percentage of eligibility (%)
Simplicity	43	48	89.58
Content Design	86	96	89.58
Color	32	36	88.88
Average percentage			84.80
Criteria			Very feasible

Based on Tables 2 and 3 shows that the assessment of material expert validation and the media reached the very feasible criteria with an average percentage of 84.89% and 89.34%. Based on the research of Lestari & Muchlis, (2021) stated that students' worksheet the validity of the *Eis* obtained through the results of the validation sheet responses based on content and language criteria to produce theoretical feasibility given to expert lecturers. The percentage (%) of validation per aspect in the validation of this material is obtained from the number of respondents' answers (ΣF) per aspect divided by the maximum score (ΣN) per aspect multiplied by 100%. The average percentage is obtained from the total percentage (%) of the total of all aspects divided by the number of aspects. After obtaining the results, the interpretation criteria will be obtained. In Table 4, it can be seen that the percentage of validation in the content aspect of the students' worksheet is 84.70% and linguistically 85.41% while the average percentage reaches 84.40% with the criteria of Very Eligible. This is in accordance with Lailiah et al. (2020) research, which says that *E-based guided inquiry* very feasible to use because it is able to improve student learning outcomes, and is able to solve problems on their own like a scientist. The implementation of guided inquiry assisted by students' worksheet is also able to improve students' interpersonal skills (Lailiah et al., 2020).

Results of the media expert validator's assessment in each aspect, namely, the simplicity aspect of 89.58% with very decent criteria, content design aspects of 89.58% with very decent criteria, color aspect of 88.88% with very suitable criteria the average percentage obtained is 89.34% with the interpretation criteria Very Feasible. This is in accordance with Yuzan & Jahro, (2022) that teaching materials in the form of student worksheet in the form of electronically based guided inquiry developed are very interesting so that they can be used to support face-to-face (offline) and online learning activities independently in chemistry learning. In addition to supporting learning, electronic worksheet media is also able to improve students' critical thinking skills (Fitriyah & Ghofur, 2022).

Table 4. Recapitulation of Teacher Responses Assessed

Aspects	ΣF	ΣN	Percentage
Attractiveness	60	60	100.00
Practicality	38	40	90.00
Relevance to Syllabus	33	40	82.5
Presentation of Materials	68	80	85.00
Language	17	20	85.00
Audio	17	20	85.00
Usefulness	39	40	97.50
Average			89.20
Interpretation Criteria			Very Attractive

Table 5. Recapitulation of Students Responses

Aspects	ΣF	ΣN	Percentage
Display	76	80	95.00
Material	187	200	93.50
Language	40	40	100.00
Ease of Use	75	80	93.75
Average			95.56
Interpretation Criteria			Very Agree

From the Table 4 dan 5, it can be seen that, indicating that the assessment results obtained from the teacher's response to all aspects contained in the students' worksheet reached an average percentage of 89.20% with very interesting criteria, while the assessment results obtained from student responses against the students' worksheet reached percentage of 95.56% with the criteria of an average strongly agree.

Results of the assessment of 5 chemistry teachers on the questionnaire given by the researcher can be seen in Table 4. In the table it can be seen that the assessment of the attractiveness of the material aspect reached 100% (Very interesting) the practical aspect reached 95.00% (Very interesting), the relevance aspect with the syllabus reached the percentage of 82.50% (Very interesting), the presentation aspect of the material 83.75% (Very interesting), the linguistic aspect reached 85.00% (Very interesting), the audio aspect reached 85% (Very interesting), the usefulness aspect reached 97.5% (Very interesting). The overall percentage has an average percentage of 89.82% with the criteria that it can be used as very interesting material, as well as teaching in the teaching and learning process on acid-base material. This is in accordance with the research of Ananda et al., (2021) who said *E-based guided inquiry* has the advantage of being able to increase students' learning motivation because it can be accessed and is very practical, it is contained in smartphones that are carried every day, so that students can easily learn anywhere and anytime whether you are studying online or offline. Besides that, the existence of this students' worksheet is one of the solutions in helping teachers in the learning process. Sanggara et al., (2018) in the results of his research found that the difficulty that is often experienced by teachers is developing interesting teaching materials to explain some of the abstract concepts being taught, where many abstract concepts

are found in chemistry.

The results of the 10 students' responses to the students' worksheet can be seen in Table 4. In the table it can be seen that the display aspect assessment reaches a percentage of 95.00% (Strongly agree), material aspect reaches 93.50% (Strongly agree), language aspect reaches a percentage 100% (Strongly agree), and the ease-of-use aspect reached 93.74% (Strongly agree). The overall percentage has an average percentage of 95.56% with the interpretation criteria stated strongly agree and can make it easier for students to understand Acid-Base material. This is in accordance with the research of Yuzan & Jahro, (2022) which states that all students agree if teaching materials are developed in the form of guided inquiry-based students' worksheet as a support for learning activities on chemistry.

Conclusion

Based on the research result, it can be concluded that student worksheet based on *guided inquiry* integrated *STEM* on Acid-Base material is needed in the teaching and learning process based on the results of a needs analysis survey from 5 respondents, each teacher representative from SMAN 1 Langsa, SMAN 2 Langsa, SMAN 3 Langsa and SMAN 5 Langsa. Student worksheet based *guided inquiry* integrated *STEM* on Acid-Base materials has been declared suitable for use as teaching materials, this is based on the assessment of material experts and media experts with the percentage of eligibility respectively by 84.80% and media experts 89.34%, with very feasible criteria. Based on the results of the questionnaire responses of teachers and students to the student worksheet Based *Guided Inquiry* Integrated *STEM* on Acid-Base Materials developed were stated to be very interesting with each percentage reached 89.82% and 95.56% respectively.

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