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Validity of Student Worksheets Based on Model Argument Driven Inquiry Integrated by STEM to Train Students' Argumentation Ability and Self-Efficacy in Chemical Equilibrium Material

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ABSTRACT

Objective: One of the teaching materials that can increase students' interest and learning motivation is student worksheet with an interesting learning model. This study aims to: (1) train students' argumentation abilities when they want to express their opinions regarding chemical equilibrium material and (2) train students' self-efficacy by bringing opinions related to equilibrium material. **Method:** The research method refers to the 4D model, namely definition, design, development, and deployment. However, it is only limited to the third stage. The data collection technique used the validation method by three validators, namely two chemistry lecturers and one high school chemistry teacher. The instruments used to assess the validity of the student worksheet are content validity sheets and construct validity sheets. The data obtained is then processed using the agreement percentage formula. **Results:** student worksheet 1, student worksheet 2, and student worksheet 3 are feasible in terms of content and construction validity with very valid categories. This is evidenced by the agreement percentage value on each student worksheet which is above 75%. **Novelty:** student worksheet modeled on STEM-integrated ADI will be developed to train students' argumentation skills and self-efficacy. This novelty can be assessed as being able to provide: (1) solutions related to students' interest in ideas on chemical equilibrium material, especially the sub-factors of shifting factors towards chemical equilibrium and (2) being able to increase students' confidence when conveying their ideas or other actions.

INTRODUCTION

Chemistry is part of learning science which plays an important role in life. With chemistry, the public can obtain information related to a substance, including other ingredients in it, its properties, changes that can occur, and its benefits for them (Kadek & Nyoman, 2020). All of that can be learned through the world of schooling. One of the chemicals at the high school level is chemical equilibrium (Adawiyah *et al*., 2021). In this material there is a sub-material, namely the factors of shifting the direction of the equilibrium listed in Basic Competency (BC) 3.9 namely analyzing the factors that influence the shift in the direction of the equilibrium and its application in industry and BC. 4.9 designing, conducting, and concluding and presenting the results of experiments on factors that influence shifts in the direction of equilibrium. Many students think that the sub-material is difficult because students apply Le Chatelier's principles without understanding it (Permatasari *et al*., 2022). Le Chatelier's principle is the basis for answering questions related to shifts in equilibrium (Fitri *et al*., 2022). Students often have misconceptions in drawing conclusions on each factor (Laksono, 2020; Pujianto *et al*., 2018; Suparwati, 2022). This problem is also experienced by some high school students. Based on the results of a survey conducted at SMA Cendekia

Sidoarjo, as many as 46% of students in class XI Science experienced misconceptions about the sub-matter of shifting factors in the direction of equilibrium.

Istiqomah (2021) states that in the real world of education there are still some teachers who think they have expertise in explaining material to students. So they often use conventional teaching materials, that is, without the effort to plan, prepare and compile them themselves. Based on this, we need a teaching material that is expected to be able to help solve students' problems. Teaching materials have a very important role in the learning process because they can increase students' interest and learning motivation (Febrita & Ulfah, 2019; Tafonao, 2018). One of the teaching materials that can increase students' interest and learning motivation is student worksheet (Farid & Sudarma, 2022). Student worksheet is a printed learning material that contains procedures for completing a series of tasks and instructions that can be designed online according to the cognitive development of students (Effendi *et al*., 2021; Hamidah & Haryani, 2018). The student worksheet can be made by the teacher according to the material and competencies to be achieved. In addition, the student worksheet is made with models and approaches that are appropriate to the problems of students.

Argument driven inquiry (ADI) is a learning model that is able to motivate students to conduct experiments and scientific arguments through research experience conducted in the laboratory (Demircioglu *et al*., 2015; Fatah *et al*., 2020; Utami *et al*., 2022). The ADI learning model consists of eight stages (Hasnunidah *et al*., 2015), that is: 1) identification of tasks by the classroom teacher, 2) laboratory-based experience, 3) production of an argument tentative, 4) argumentation session, 5) writing of the investigative report produced by, 6) double-blindpeer review, 7) subsequent revision of the report based on the results of peer-review, 8) explicit and reflective discussion about the investigation. At this time students have their own fear when they want to express their opinion. For this reason, students need to find ways to learn how to criticize and evaluate claims using the criteria assessed in science. While on the other hand the teacher requires them to be able to have these abilities. This shows that students need to engage in argumentation as an effort to better understand the content, for example arguing to learn. Increased content knowledge is also considered capable of influencing students to write better (Sumarni et al., 2021). Meanwhile, more accurate peer reviews over time will allow students to become more familiar with the system over the course of the study. The ADI model can also improve communication skills because students can convey their findings to others. This is closely related to argumentation and self-efficacy in students. Erika & Prahani (2017) states that self-efficacy is needed in argumentation skills. Self efficacy is also considered as one of the supporting aspects in one's thought process, motivation, attitude, and behavior (Ogan-Bekiroglu & Aydeniz, 2013).

Self-efficacy is the result of a cognitive process in the form of a decision, belief, or expectation about the extent to which an individual estimates his own ability to carry out certain tasks or actions needed to achieve the desired results (Ghufron & Risnawati, 2016). Yunianti (2016) states that the self-efficacy indicator refers to three dimensions, namely the magnitude dimension, generality dimension, and strength dimension. The aspect of magnitude has implications for the level of selection of behavior that is felt capable of doing and avoiding behavior that is beyond the limits of the ability that is felt (Fatimah et al., 2022). The strength aspect refers to the degree of individual stability in the beliefs they make (Wiguna & Khaerunnisa, 2020). While the generality aspect

relates to how broad the individual's actions are in believing in his abilities (Lunga *et al*., 2021). The level of self-efficacy possessed by students will affect the choice of student activities. When students with low self-efficacy are faced with difficult situations, they tend to give up easily. While students who have high self-efficacy will work hard to face the challenges that exist (Adiputra, 2015; Hasanah *et al*., 2019; Ningsih & Hayati, 2020).

One of the challenges faced by students today is the ability to communicate or argue. Students do not have the courage to convey ideas that cause them to become passive, feel shy, and feel insecure. Factors that influence communication include psychological, physical, semantic, and process factors (Astuti & Pratama, 2020; Urwani *et al*., 2018). The components of Toulmin's argument consist of claims, data, justification, backing, qualifiers and reservations (Fakhriyah *et al*., 2021). So there are indications stated by (Farida *et al*., 2018) that students can put forward claims, data (evidence), and justification (warrants) which show students can already be said to be arguing. Argumentation has an important role when students carry out the science learning process (Defni *et al*., 2022; Mujahidin *et al*., 2021; Widiastiningsih *et al*., 2022).

Barrett *et al*. (2014) states that students communicate their findings through arguments effectively when using holistic disciplines. These holistic disciplines are science, technology, engineering, and mathematics (Amirullah & Dirza, 2022; Davidi *et al*., 2021; Mu'minah, 2020). One learning approach that uses the four disciplines is the STEM approach (Bybee, 2013). STEM has been defined in a variety of ways, from disciplinary to trans-disciplinary approaches (Burke et al., 2014; Honey et al., 2014). STEM is able to encourage students to identify a concept or knowledge (science) by utilizing the technology (technology) they master as an effort to design a procedure (engineering) and analyze results based on mathematical thinking or calculations (math). With these several aspects, individuals are expected to be able to solve problems easily (Agung *et al*., 2022; Anggraini *et al*., 2022).

Suganda et al. (2023) stated that based on the research he had conducted, the STEM-integrated ADI model had a significant influence on improving students' critical thinking skills. While in this study, the STEM-integrated ADI model will be developed to train students' argumentation skills and self-efficacy. This novelty can be assessed as being able to provide solutions related to the problem of conveying ideas by students on chemical equilibrium material. In addition, it is also considered capable of increasing the confidence of students when conveying their ideas and other actions.

Based on the background above, the researcher is motivated to develop STEM-integrated ADI based worksheets. The student worksheet that was created aims to train students' argumentation abilities when they want to express their opinions regarding chemical equilibrium material. In addition, it is also to train students' self-efficacy through conveying opinions related to chemical equilibrium material. The feasibility of student worksheet in terms of validity to be used in assisting the learning process on the sub material shifting towards equilibrium factors.

RESEARCH METHODS

This research is a type of Research and Development (R&D) research. The model was adapted from Thiagarajan which refers to the 4D model, namely definition, design, development, and deployment (Ibrahim & Wahyusukartiningsih, 2014). However, the dissemination stage was not carried out due to the researcher's limited time and the

main objective of this study was to make valid student worksheet. The defining stage is useful for determining and defining needs in the learning process and gathering various information related to the product to be developed (Paradita & Suana, 2019). The define stage includes five main steps, namely curriculum analysis or content standards (frontendanalysis), learner analysis, concept analysis, task analysis and formulation of learning objectives (specifying instructional objectives). After getting the problem from the definition stage, then the design stage is carried out. The design stage aims to design learning devices (Tanjung & Nababan, 2019). Products that have been conceptualized are then developed according to the material, student needs, illustrations, etc. with the aim of producing gamification teaching materials that have been revised based on expert input. Limited trials and dissemination stages were not carried out due to researchers' time constraints and the main objective of this study was to create valid student worksheet.

The research instrument used to collect data is a validation sheet. The developed student worksheet validation was reviewed based on content validity including content criteria, suitability with the ADI model, and suitability with the STEM approach. Meanwhile, construct validity includes linguistic, presentation, and appearance criteria (Asri & Dwiningsih, 2022; Setiawan *et al*., 2022). After being reviewed by the reviewing lecturers, it was followed by validation by two chemist lecturers and one chemistry teacher. Three student worksheet in this development were made, namely student worksheet 1 based on the concentration factor, student worksheet 2 based on the temperature factor, and student worksheet 3 based on the volume and pressure factor. The following are the development steps that will be presented in Figure 1.

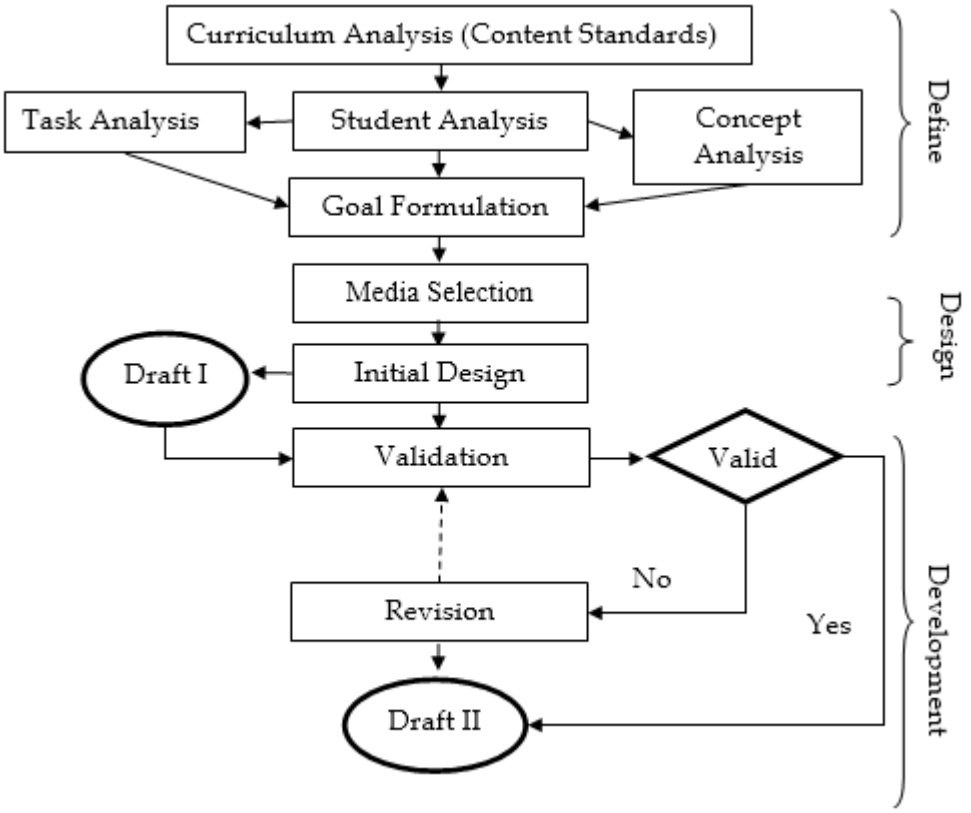


Figure 1. 4D development model without class trial and deployment stage.

The percentage of the results of the validation sheet uses a Likert scale calculation (Riduwan, 2018; Sevtia *et al*., 2022) as in Table 1.

Table 1. Likert scale.

Category	Scale Value
Totally Invalid	1
Not enough	2
Enough	3
Good	4
Very Good	5

The formula used to calculate the results uses a percentage of agreement which can be written as follows.

$$Percentage\ of\ agreement\ (R) = \left[1 - \frac{A-B}{A+B}\right] x\ 100\% \quad \text{.....(1)}$$

Information:
A : The highest validator score
B : The lowest validator score
R : Coefficient of percentage of agreement (R)
Student worksheet can be said to be valid if the value of R ≥ 75% (Borich, 1994)

RESULTS AND DISCUSSION

Results

One of the learning media is teaching materials that can increase students' interest and motivation in learning in the form of student worksheet (Julian, 2019). The following is the cover display developed by the researcher.

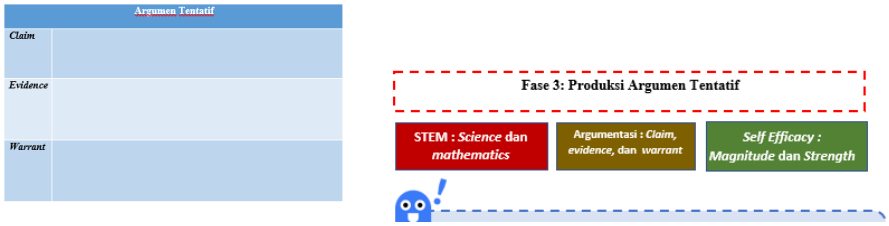
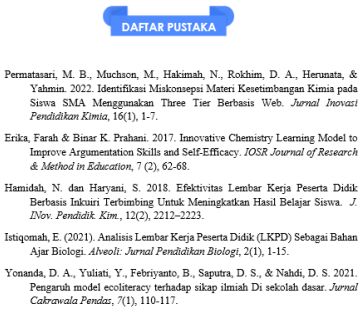
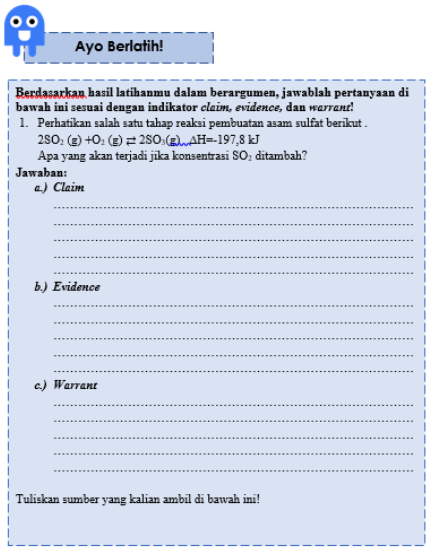
(a) (b) (c)

Figure 2. Display cover (a) student worksheet 1 (concentration factor), (b) student worksheet 2 (temperature factor), (c) student worksheet 3 (volume and pressure factor).

The student worksheet that has been designed then produces draft I and is followed by a review by expert lecturers to provide suggestions and comments. Then it was

revised and produced draft II which will be continued to the validation stage. The revised results in Table 2.

Table 2. Revision results.

No	Suggestion	Revision
1	There needs to be consistency in the indicators in the student worksheet	
2	Reference update of 5 journal articles in the last 5 years	
3	The indicators that are trained need to be bolded	
4	Additional training is needed to strengthen the skills to be trained	

After the researcher revised the student worksheet based on the review from the reviewing lecturers, three validators will then be validated. Validation in this study consists of content validity. Table 3 is the result of calculating the percentage of agreement for each student worksheet.

Table 3. Student worksheet 1 validation results (concentration factor).

No.	Statement	Validator Score			Mode	Percentage of agreement (%)		
		1	2	3		V1 & V2	V1 & V3	V2 & V3
Content Validity								
1.	The suitability of the material with the 2013 curriculum	5	4	5	5	89	100	89
2.	The suitability of the material with the core and basic competencies	5	5	5	5	100	100	100
3.	Compatibility of competency achievement indicators with basic competencies	4	5	5	5	89	89	100
4.	Conformity of learning objectives with indicators of achievement of competence	4	5	5	5	89	89	100
5.	Appropriateness of phenomena with the level of student cognition	4	5	4	4	89	100	89
6.	Appropriate practicum with the material	5	5	4	5	100	89	89
Content Validity								
7.	Compatibility with Argument Driven Inquiry (ADI)	5	5	4	5	100	89	89
8.	STEM compatibility	4	4	4	4	100	100	100
9.	Compatibility with the component of argumentation skills	5	5	4	5	100	89	89
10.	Compatibility with self-efficacy components	5	5	4	5	100	89	89
11.	The suitability of the video concept with the material	4	5	5	4	89	89	100
Construct Validity								
1.	Language	4	5	4	4	89	100	89
2.	Presentation	5	5	4	5	100	89	89
3.	Appearance	5	5	4	5	100	89	89

Besides student worksheet 1, there is student worksheet 2 which discusses temperature in influencing shifts in the direction of equilibrium. The following presents the results of the validation in Table 4.

Table 4. Student worksheet 2 validation results (Temperature Factor).

No.	Statement	Validator Score			Mode	Percentage of agreement (%)		
		1	2	3		V1 & V2	V1 & V3	V2 & V3
Content Validity								
1.	The suitability of the material with the 2013 curriculum	5	4	5	5	89	100	89
2.	The suitability of the material with the core and basic competencies	5	5	5	5	100	100	100
3.	Compatibility of competency achievement indicators with basic competencies	4	5	5	5	89	89	100
4.	Conformity of learning objectives with indicators of achievement of competence	4	5	5	5	89	89	100
5.	Appropriateness of phenomena with the level of student cognition	4	4	4	4	100	100	100
6.	Appropriate practicum with the material	5	5	4	5	100	89	89
7.	Compatibility with Argument Driven Inquiry (ADI)	5	5	4	5	100	89	89
8.	STEM compatibility	4	4	4	4	100	100	100
9.	Compatibility with the component of argumentation skills	5	5	4	5	100	89	89
10.	Compatibility with self-efficacy components	5	5	4	5	100	89	89
11.	The suitability of the video concept with the material	4	5	4	4	89	100	89
Construct Validity								
1.	Language	4	5	4	4	89	100	89
2.	Presentation	5	5	4	5	100	89	89
3.	Appearance	5	5	4	5	100	89	89

Besides student worksheet 1 and 2, there is student worksheet 3 which discusses volume and pressure in influencing shifts in the direction of equilibrium. The following presents the results of the validation in Table 5.

Table 5. Student worksheet 3 validation results (volume and pressure factor).

No.	Statement	Validator Score			Mode	Percentage of agreement (%)		
		1	2	3		V1 & V2	V1 & V3	V2 & V3
Content Validity								
1.	The suitability of the material with the 2013 curriculum	5	4	5	5	89	100	89
2.	The suitability of the material with the core and basic competencies	5	5	5	5	100	100	100
3.	Compatibility of competency achievement indicators with basic competencies	4	5	5	5	89	89	100
4.	Conformity of learning objectives with indicators of achievement of competence	4	5	5	5	89	89	100
5.	Appropriateness of phenomena with the level of student cognition	4	4	4	4	100	100	100
6.	Appropriate practicum with the material	5	5	4	5	100	89	89
7.	Compatibility with Argument Driven Inquiry (ADI)	5	5	4	5	100	89	89
8.	STEM compatibility	4	4	4	4	100	100	100
9.	Compatibility with the component of argumentation skills	5	5	4	5	100	89	89
10.	Compatibility with self-efficacy components	5	5	4	5	100	89	89
11.	The suitability of the video concept with the material	4	5	4	4	89	100	89
Construct Validity								
1.	Language	4	5	4	4	89	100	89
2.	Presentation	5	5	4	5	100	89	89
3.	Appearance	5	5	4	5	100	89	89

Based on the results in Tables 3, 4, and 5, it was found that student worksheet 1, student worksheet 2, and student worksheet 3 were said to be very valid. These results are reviewed from the mode obtained (Supardi & Azizah, 2022). The mode obtained is that ten criteria get a score of 5 and four criteria get a score of 4 on each student worksheet. Meanwhile, the three student worksheets also received an average percentage of agreement of 89% and 100%. This is in accordance with the statement of

Borich (1994) which states that the assessment of the device is considered valid if the R value ≥ 75%.

Discussion

Defining Stage

Preliminary Analysis

This stage has the goal of identifying the basic problems that result in the development of STEM-integrated ADI-based student worksheets to train students' argumentation abilities and self-efficacy. The curriculum used at SMA Cendekia Sidoarjo is the 2013 curriculum. Based on the Regulation of the Minister of Education and Culture No. 65 of 2013 it is explained that education should be held in an interactive, inspiring and fun way (Mukhibat *et al*., 2018; Pinasti *et al*., 2018). This is also in accordance with interviews with several students who stated that they felt that there was no media to help them with their difficulties.

Student Analysis

This stage is able to make researchers know the level of compatibility between student worksheets developed with the abilities of students from the aspect of maturity (Haspen *et al*., 2021). The results of the researchers' observations showed that students were between the ages of 15 to 16 years. Nursalim (2017) states that in this age range, students are considered capable of developing cognitive potential and solving problems including using teaching materials, namely student worksheet. Based on the results of the pre-research conducted, 83% of students thought that in learning chemical equilibrium with the sub-material the shifting direction of the equilibrium factor, they had not used media or methods that could make it easier for students to understand it.

Task Analysis

This stage has a goal so that researchers are able to identify tasks that need to be done by students (Muqdamien *et al*., 2021). The task is based on basic competencies 3.9 namely analyzing the factors that influence shifts in the direction of equilibrium and their application in industry and basic competencies 4.9 namely designing, conducting, and concluding and presenting the experimental results of the factors that influence the shift in the direction of the equilibrium. From this BC, there are learning indicators that are made, including 1) Linking Le Chatelier's principle with factors that affect shifts in the direction of equilibrium, 2) Predicting the direction of shifts in the equilibrium of a reaction based on factors that affect shifts in the direction of equilibrium, 3) Formulating problems from phenomena that have been presented regarding the factors that influence the direction of the shift in equilibrium, 4) Making a hypothesis from the formulation of the problem that has been made, 5) Determining the experimental variables, 6) Designing and conducting experiments, 7) Concluding experimental results through arguments based on experimental data, 8) Presenting arguments in a orally and in writing in the form of a written report.

Concept Analysis

This stage has the goal of determining the concept of the developed student worksheet. The results of the preliminary research and the results of interviews with several students of class XI SMA Cendekia Sidoarjo showed that 46% experienced

misconceptions about the sub-matter of the shifting factor in the direction of equilibrium. So that the concept developed is related to the relationship between Le Chatelier's principle and the shift in the direction of equilibrium.

Formulation of Learning Objectives

This stage is the formulation of learning objectives that are closely related to learning indicators. Based on this, the learning objectives are: Students are able to 1) Connect Le Chatelier's principle with factors that influence the shift in the direction of equilibrium, 2) Predict the direction of the shift in the equilibrium of a reaction based on factors that affect the shift in the direction of equilibrium, 3) Formulate a problem from the phenomenon that has been presented regarding the factors that influence the direction of the shift in equilibrium, 4) Making a hypothesis from the problem formulation that has been made, 5) Determining the experimental variables, 6) Designing and conducting the experiment, 7) Concluding the results of the experiment through arguments based on the experimental data, 8) Presenting the arguments orally and in writing in the form of a written report.

Designing Stage

At this stage the researcher will select the media. One of the media is teaching materials that can increase students' interest and motivation in learning in the form of student worksheet. Student worksheet is a printed learning material that contains procedures for completing a series of tasks and instructions that can be designed according to the cognitive development of students (Hamidah & Haryani, 2018). The following is the cover display developed by the researcher. In this study, the researchers made three worksheets, each of which was adjusted to the shifting factors in the direction of the equilibrium. The student worksheet that had been designed then produced draft I and was followed by a review by two expert lecturers and one chemistry teacher for suggestions and comments. Based on the results of the revision, there are several points that are of concern to the researcher. The first point is related to the consistency of writing argumentation indicators. Next is related to the addition of references in the last five years. Then it is related to the addition of exercises to strengthen the skills to be trained. The results of the revision resulted in draft II which would later proceed to the validation stage.

Developing Stage

Student Worksheet Validation

After the researcher revised the student worksheet based on the review from the reviewing lecturers, three validators will then be validated. Validation in this study consists of content validity. Content validity is a criterion related to concepts and materials in student worksheet (Utomo, 2019). Meanwhile, construct validity is a picture that shows the extent to which the measuring instrument shows results that are in accordance with the theory (Ihsan, 2016). There are three aspects of the construct that will be validated, including language, presentation, and appearance (Mardia & Sundara, 2020). To obtain information related to the conclusion of validity, the calculation of the mode (the score that appears most frequently) and the percentage of agreement are used. This is used as a reinforcement that there is an understanding of the three validators (Borich, 1994).

Yayuk *et al*. (2019) stated that in the developed student worksheet there are several aspects of the variables that must be interconnected and listed in it. One of these aspects is the ADI learning model. ADI is a learning model that is able to motivate students to conduct experiments and scientific arguments through research experience conducted in the laboratory (Demircioglu *et al*., 2015). The model is considered suitable for the activities in the student worksheet, for example, by arguing about the factors that influence shifts in the balance. Students are given case examples so they are able to communicate the results of their thoughts. In addition, according to Nurrahman *et al*. (2018) the ADI model is closely related to practicum. This is also considered suitable for this material because students need concrete evidence in solving problems.

Apart from the ADI model, this student worksheet is also integrated with STEM. STEM is able to encourage students to identify a concept or knowledge (science) by utilizing the technology they master as an effort to design a procedure (engineering) and analyze results based on mathematical thinking or calculations (math). With these several aspects, individuals are expected to be able to solve problems easily (Izzati *et al*., 2019). The sub-matter of the factor of equilibrium shift is considered very suitable when integrated with STEM. This is due to the frequent appearance of industry-related phenomena in the problem, such as the manufacture of ammonia on an industrial scale. In addition, this student worksheet is also equipped with a QR Code that is able to support students in solving their problems. Suggestions for further research are related to the selection of laboratory scale practicum which is more innovative and can be developed into a product. Due to practicum, the sub-material factor of shifting the direction of equilibrium tends to be monotonous and difficult to develop.

The two components above led to the formation of the idea of a STEM-integrated ADI learning model. The model is considered capable of training students' argumentation skills. The argumentation component used in this student worksheet is Toulmin's argument. Toulmin's arguments consist of claims, data (evidence), justification (warrants). Arguments play an important role in the main practice of science (Fakhriyah *et al*., 2021; Yonanda *et al*., 2021). In addition to training argumentation, this model is also considered capable of training students' self-efficacy. When students try to argue, their self-efficacy automatically increases. Self-efficacy is the result of a cognitive process in the form of a decision, belief, or expectation about the extent to which an individual estimates his own ability to carry out certain tasks or actions needed to achieve the desired results. (Ghufron & Risnawati, 2016).

In supporting the success of this research, the researcher provides several video sources to support students in solving their problems. This is supported by research from Yunianti (2016) which states that one of the technologies that can be utilized as a learning medium is video media. Video is an audio-visual media that has been circulating in the community and is in great demand (Busyaeri *et al*., 2016). The video presented is of course also related to the activities carried out in the student worksheet.

On the construct side, there are several aspects that need to be discussed, namely language, presentation, and appearance. The linguistic aspect is very important in writing student worksheet. PUEBI is presented as a form of progress in a more complete Indonesian language (Syahputra, 2022). The language used in scientific writing is a variety of written language that is clear, straightforward and communicative so that readers can easily understand the intent of the researcher (Hulu & Dwiningsih, 2021; Indrastuti, 2018; Nurhayatin *et al*., 2018). Meanwhile, in the aspect

of presentation, student worksheet does not only contain words or pictures, meaning that there is a combination of pictures and writing (Yunus & Alam, 2015). In the developed student worksheet, there is a QR code that can be scanned using the student's gadget. This feature is able to make it easier for students to access supporting resources other than student worksheet which of course can help them solve problems. The last aspect of construct validity is appearance. Sujarwo & Oktaviana (2017) states that the display of text colors that support a student worksheet content greatly affects students' memory.

CONCLUSION

Fundamental Findings: Based on research related to the development of STEM-integrated argument driven inquiry (ADI)-based student worksheet to train argumentation skills and self-efficacy on chemical equilibrium material, it can be concluded that: (1) student worksheet 1 (concentration factor) are in valid category, (2) student worksheet 2 (temperature factor) are in valid category, and (3) student worksheet 3 (volume and pressure factor) are in valid category. **Implications:** Based on the results of this study, the implications can be stated: (1) The ADI learning model is considered to be able to influence students' ability to argue, (2) Students' ability to argue affects self-efficacy or self-confidence in students, and (3) STEM which is integrated in this study can be implemented in the learning process and worksheets so that it makes it easy for students to understand the material. **Limitations:** One of the factors that constrained this study was time constraints and the difficulty of determining an attractive laboratory scale practicum. **Future Research:** Based on the conclusions that have been described, several recommendations can be submitted going forward, namely: (1) Enough time is needed so that limited trials can be carried out and (2) Being able to innovate regarding the selection of laboratory-scale practicums that are in accordance with STEM.

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