

# Electronic module protist material based on ASICC learning strategies

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**Abstract:** The process of scientific argumentation skills in biology learning at SMAN 1 Kediri is nonoptimal yet. This study aimed at improving students' scientific argumentation using ASICC-based electronic modules. This Research and Development employed Plomp development model. The subjects of this study were X graders of MIPA SMAN 1 Kediri which consisted of 32 students. There were three stages of the Plomp model conducted i.e., preliminary research, prototyping, and assessment. The expert validation score gained for subject matter and linguistic was 85% (valid category), the validation score for design and media professionals' validation is 81% with a valid category, the teacher validation score is 93% with a very valid category, and the small group test score is 88% with a very valid category. Implementation of the ASICC-based electronic module had results such as 25 of 32 students got the N-Gain score in the high category, 5 students in the medium category, and 2 students in the low category. The ASICC-based electronic module on protist material is valid and effective to improve the scientific argumentation skills of class X MIPA students in SMAN 1 Kediri.

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## 1. Introduction

Scientific argumentation is one of the skills that students need to develop in learning process (Astira et al., 2019). Argumentation skills include several aspects such as claims (statements addressed), evidence (scientific data to support a statement) and reasoning (justification related to statements and evidence) (Deane & Song, 2014). Some advantages include supporting students' cognitive and metacognitive processes; growing competence in communication and critical thinking; supporting the development of students' reasoning; increasing scientific literacy; and empowering students in scientific speaking and writing (Astira et al., 2019). Scientific argumentation skills are proven to be skills that help students achieve learning goals (Anwar et al., 2019). One of the goals of science learning is scientific argumentation because students need to know scientific explanations for natural phenomena, use them to solve problems, and understand other findings they receive (Lorenza et al., 2020).

In a preliminary study conducted by researchers, the meta-cognitive ability of 48 students of SMAN 1 Kediri on information management strategies and indicators was still low (Rohmania et al., 2021). According to Rohmania et al. (2021), information management strategy is student's ability to process information related to the learning process carried out. This is in line with the need to develop students' scientific argumentation skills, which are the cognitive abilities needed to develop the ability to make reasons,

think, explore, and answer questions (Yacoubian & Khishfe, 2018). Learning activity which is still teacher-centered leads students’ scientific argumentation skills to be less developed and make students passive in conveying arguments. According to Sakti et al. (2020), another hindrance faced by students in honing scientific argumentation skills is mental attitude in terms of shame, fear, anxiety, and self-confidence, which causes students depressed during learning. Therefore, teachers are required to be smart in choosing and applying teaching materials and learning strategies that can improve students’ scientific arguments.

Based on these problems, the researchers designed a solution by developing an electronic module based on the ASICC learning strategy (Adapting, Searching, Interpreting, Creating, and Communicating). Electronics modules are teaching materials in digital form that can assist teachers in facilitating students’ learning (Astira et al., 2019). The use of electronic modules can help improve students’ scientific argumentation skills (Puspitasari, 2019). The electronic module was chosen with various considerations, such as being able to be accessed easily anywhere and anytime and making the student learning process more interesting, interactive, and not monotonous. Efforts to improve scientific argumentation skills cannot be separated from appropriate methods to support the learning process. The ASICC learning strategy is one of the right strategies to support the learning process. Selection of the right learning strategy can maximize and hone students’ abilities. In accordance with previous research by Santoso et al. (2021) ASICC learning strategy is a learning strategy developed to empower higher-order thinking skills, argumentation, and collaboration. The ASICC learning strategy consists of four stages: adapting, searching, interpreting, creating, and communicating. This study aims to develop an ASICC-based electronic module to improve students’ scientific arguments.

**2. Materials and Methods**

This research model followed the Plomp development model (Plomp & Nieveen, 2013), which consisted of three stages which are depicted in Table 1.

**Table 1.** The stages of the Plomp model

Phase	Description	Instrument
<i>Preliminary Research</i>	An analysis of student needs includes: a. Meta-cognitive Awareness Inventory (MAI) questionnaire adapted from Schraw and Dennison (1994) with main indicators of information management strategies. b. The Learning Style Questionnaire, adapted from the University of Texas Learning Center (2006), with three types of learning styles i.e., visual, audio, and tactile.  Questionnaire: the problems with learning biology (adapted from the Fatih Education Faculty, Karadeniz Technical University, Trabzon, Turkey).	Questionnaire
<i>Prototyping Phase</i>	ASICC-based electronic module testing by expert validators. Expert validation and small group testing comprised of electronic module testing. The instruments used include validation sheets for subject matter and linguistic experts; validation sheets for design and media professionals’ experts; and validation sheets for biology subject teachers adapted from Erinawati’s research from	Validation sheet 1. for subject matter and linguistic experts. 2. for design and media professionals’ experts. 3. for Biology subject teachers

	<p>Yogyakarta State University Expert validators in this study include the following:</p> <ul style="list-style-type: none"> <li>a. Subject matter and linguistic experts' validation.             <ul style="list-style-type: none"> <li>1) Tutut Indah Sulistyowati, S.Pd., M.Sc. (lecturer of microbiology and innovative learning at Universitas Nusantara PGRI Kediri).</li> <li>2) Ida Rahmawati, S.Pd., M.Sc. (lecturer of biology at Nusantara University, PGRI Kediri).</li> </ul> </li> <li>b. Validator for design and media professionals' experts.             <ul style="list-style-type: none"> <li>1) Wuri Cahya Handaru, S.ST.,M.Ds. (lecturer of the graphic design study program at Universitas Brawijaya).</li> <li>2) Restu Dwi Ariyanto, M.Pd (lecturer of learning media guidance and counseling at Universitas Nusantara PGRI Kediri).</li> </ul> </li> <li>b. Validator for Biology subject teachers.             <ul style="list-style-type: none"> <li>1) Dra. Fatnatin (Biology teacher at SMAN 1 Kediri).</li> </ul> </li> </ul> <p>Eni Farida, S.Pd. (Biology teacher at SMAN 1 Kediri).</p>	<p>Small group test using the small group test sheet.</p>
<p>A small group test was given to eight students from X MIPA A and XII A classes. The electronic module was designed using Articulate Storyline software. Students can test their understanding of protist material using the evaluation questions feature. Students can be motivated to learn protist material by using text, pictures, and videos. The use of HOTS questions in student worksheets improves higher thinking skills, especially scientific argumentation skills.</p>		
<p><i>Assessment Phase</i></p>	<p>Class X MIPA ASICC-based electronic module testing was given to 32 students of class X MIPA at SMAN 1 Kediri. The data were obtained from the results of pretest and posttests which were then analyzed using scientific argumentation rubric adapted from (Suwono et al., 2017). The improvement of the students' scientific argumentation skills was determined by analyzing N-Gain of pretest and posttest.</p>	<p>Pretest and posttest</p>

*ASICC-based electronic module feasibility analysis*

For the feasibility analysis of ASICC-based electronic modules, using the results of subject matter and linguistic experts as well as design and media professionals, experts, the analysis using the Formula 1.

$$\text{Validity} = \frac{\text{score validator}}{\text{maximal scores}} \times 100\% \tag{1}$$

The validation results will be categorized based on validity criteria adopted from Akbar (2013). The validation classification criteria as shown in Table 2.

**Table 2.** Validity criteria expert validation

No	Score	Validity criteria
1.	85.01 ± 100.00 %	Very valid
2.	70.01 ± 85.00 %	Valid enough
3.	50.01 ± 70.00 %	Less valid
4.	1.00 ± 50.00 %	Invalid

*ASICC-based electronic module effectiveness analysis*

The effectiveness of the ASICC-based electronic module can be seen from the N gain analysis used to determine the learning outcomes and the level of students' scientific argumentation. The analysis uses the results of the pre-test and post-test with the formula of Hake (1999) (Formula 2).

$$N\text{ Gain} = \frac{\text{score post test} - \text{score pretest}}{\text{ideal scores} - \text{score pretest}} \tag{2}$$

The N-gain data were categorized according to the criteria shown in Table 3.

**Table 3.** Validity criteria of N gain based on Hake (1999)

No	Score	Validity criteria
1.	$g > 0.7$	High
2.	$0.3 \leq g \leq 0.7$	Medium
3.	$g < 0.3$	Low

**3. Results**

3.1 Preliminary study results

3.1.1 The MAI questionnaire results

**Table 4.** MAI Questionnaire Results for scientific argumentation skills.

	Category	Mean
<b>Knowledge About Cognition</b>	Declarative Knowledge	2.4
	Procedural Knowledge	5.1
	Conditional Knowledge	4.1
<b>Regulation Of Cognition</b>	Planning	2.6
	Information Management Strategies	1.6
	Comprehension Monitoring	2.9
	Debugging Strategies	4.4
	Evaluation	3.2

### 3.1.2 Questionnaire results on learning style

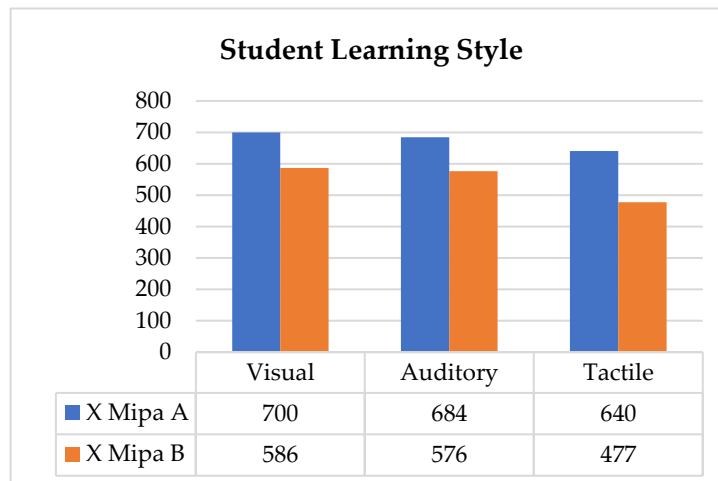


Figure 1. student learning styles

### 3.1.3 Questionnaire results on learning biology

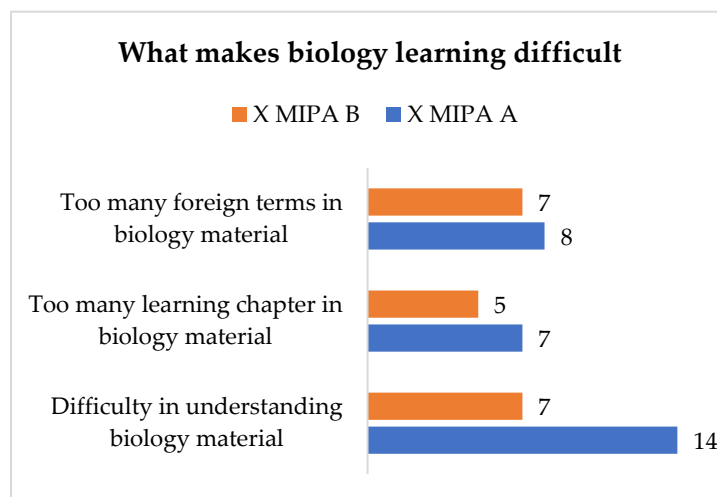


Figure 2. What makes biology learning difficult

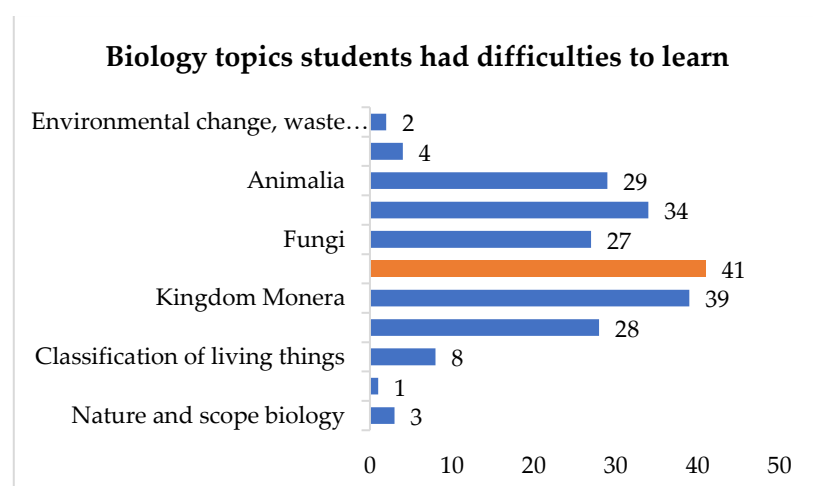


Figure 3. The biology topics that students had difficulties learning

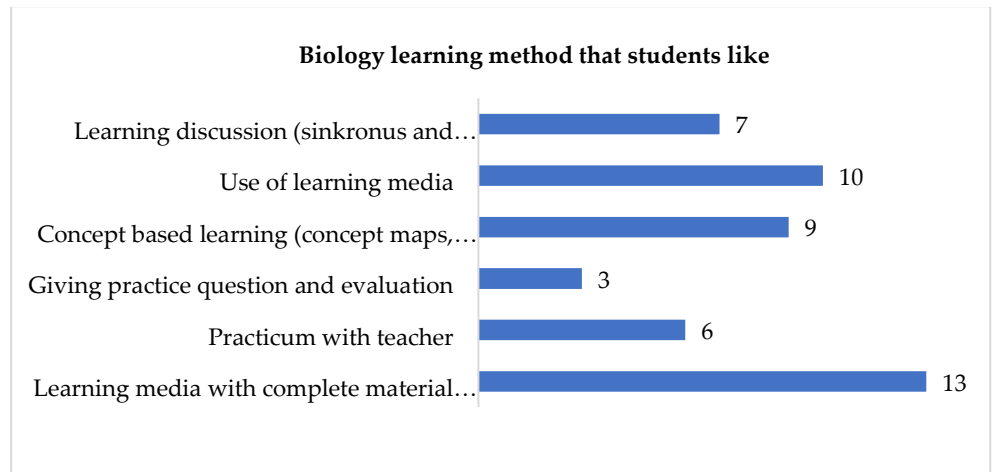


Figure 4. The biology learning method that students like

### 3.2 Prototyping study results

#### 3.2.1 Validation Results of ASICC Protista-based electronic modules

Table 5. Expert Validation Results of ASICC Protista-based electronic modules

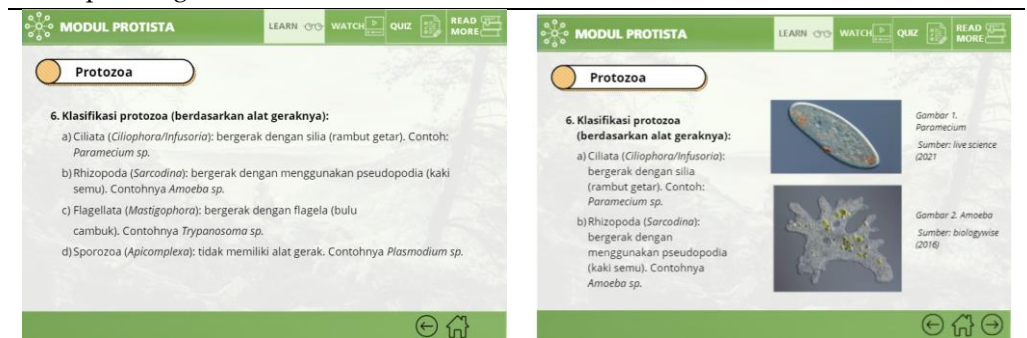
Validation	Assessment aspect	Average Percentage (%)	Validity Criteria
Subject matter and linguistic expert	1. Content eligibility	85%	Quite valid
	2. Language Eligibility		
	3. Presentation		
Design and media professionals' expert	1. Technique Presentation	81%	Quite valid
	2. Serving Eligibility		
	3. Feasibility of Graphics		
Biology teacher	1. Content eligibility	93%	Very valid
	2. Eligibility		
	3. Presentation Language		

#### 3.2.2 Revised electronic modules

Table 6. Revision of ASICC-based electronic modules

#### Module improvement in terms of subject matter and linguistic

Improvement: preferably in each classification of protists accompanied by an example image.



Before

After

### Improvements in terms of design and media professionals

Improvement: in the protist role menu, the table needs to be made in different colors. For example, animal-like protists are green, then yellow, and so on.



#### 3.2.3. Small group test results

Table 7. Table of small group test results

Validation	Assessment aspect	Average percentage (%)	Validity criteria
Class X and XII students	1. Learning Aspect	88%	Very valid
	2. Media		

#### 3.2 Assesment study results

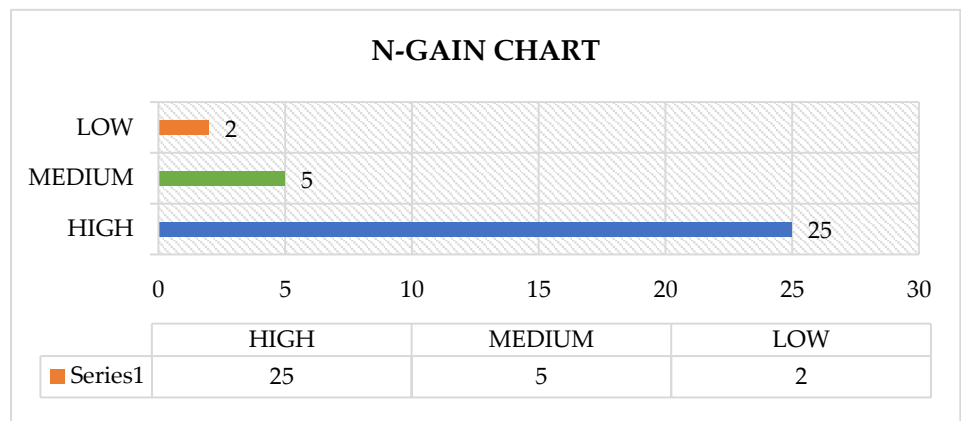


Figure 5. Protist N-gain Result

### 4. Discussion

#### 4.1 Preliminary study results

The development of argumentation skills can affect the development of students' meta-cognitive skills, support students in developing competence in communication and critical thinking, and support the development of students' reasoning (Astira et al., 2019). The application of appropriate learning strategies can improve metacognitive skills, especially scientific argumentation (Lorenza et al., 2020).

Table 4 shows the results of the Meta-cognitive Awareness Inventory (MAI) questionnaire (Schraw & Dennison, 1994), which was given to 48 students (24 students from class X MIPA and 24 students from class X MIPA B). The results of the interview showed that the teacher had difficulty in delivering the material because it was constrained by the



media in learning (especially online learning) so that the process of delivering the material was not optimal.

Figure 1 shows the various learning styles of 48 X grade students of SMAN 1 Kediri. A person's learning style is a person's way of processing all the information received. Learning styles are divided into 3 types, namely visual, auditory, and kinesthetic learning styles (Widayanti, 2013). Through the results of the learning style questionnaire, it is seen that visual learning styles are more dominant than other learning styles. A visual learning style is one of the student learning styles that emphasizes how a student more easily understands information through seeing, viewing, or observing the object of his study. By seeing, looking at, and also observing the object being studied, it will help students focus and concentrate on the learning material so that they will more easily understand the material (Afifah et al., 2021). Making electronic modules needs to adapt to the characteristics of students' learning styles so that information can be conveyed properly.

Based on the results of the questionnaire on problems in learning biology, the causes of biology subjects' being difficult to understand are shown in Figure 2, such as the number of foreign terms, the number of materials that need to be studied, and difficulties in understanding biological materials. Biological topics that are difficult to study are shown in Figure 3, including material for the kingdoms of Protista, Monera and Plantae. Figure 4 shows the preferred ways to study biology, such as using media with complete material and discussion, using interactive learning media, concept-based learning (such as using concept maps, mind mapping, etc.), and discussing.

Based on the results of the preliminary study, the researcher designed a teaching media in the form of an electronic module to help students learn independently. The selection of media as a source of independent learning can enrich the learning experience and help students' readiness to get material to be taught at the next meeting (Puspitasari, 2019). Electronic modules can be used as learning media because they have the advantage that they can be accessed anywhere and integrate content with video, audio, and images that help understand lessons (Nurhidayati et al., 2018). Based on Figure 3, the topic used is protist material.

#### 4.2 Prototyping Phase

The ASICC-based electronic modules that have been compiled and developed will be tested by expert validators for validation. Subject matter and linguistic expert validators, design and media professionals, and biology subject teacher validators are among the expert validators who will test the electronic module. The module validity test is done by asking for input from experts (Arip et al., 2013). Through validation tests, researchers can improve the quality of the module according to the validator's input. Table 5 shows the results of the validation of subject matter and linguistic experts with a fairly valid category, the results of the validation of design and media professional experts with a fairly valid category, and the validation results of biology subject teachers with a very valid category. The validity of the electronic module was also measured based on small group testing. The small group test was carried out by eight students in grades X and XII MIPA, which focused on learning and media aspects. Table 7 shows that the results of the ASICC-based electronic module validity test are classified as very valid criteria. Thus, the protist E-module that has been developed is valid to be used in protist learning material.

#### 4.3 Assessment Phase

The results of N-gain are used to measure the effectiveness of ASICC-based electronic modules in improving students' scientific argumentation skills. The instrument used is in the form of pre-test and post-test scores. The A level of students' scientific argumentation was analyzed using the scientific argumentation rubric adapted from (Suwono et al., 2017). Pre-test and post-test questions are given in essay form. The choice of essay questions is because essay questions can encourage students to show a response or answer to each question rather than just choosing an answer (Santoso et al., 2021). Figure 5 shows that out of 32 students, 25 students got N-gain scores in the high category, 5 students in



the medium category, and 2 students in the low category. Using ASICC-based electronic modules can improve students' scientific argumentation skills. Table 8 shows the examples of answers to student pre-test and post-test question.

**Table 8.** Table of examples of answers to student pre-test and post-test question

Category	Test	
	<p><b>Question:</b>                      Toxoplasmosis is an infectious disease caused by the parasite <i>Toxoplasma gondii</i>. <i>Toxoplasma gondii</i> is one of the harmful protozoa in the sporozoa group. This parasite is found in many small animals such as birds, mice, or other rodents that live and feed on debris on the ground. Parasites that enter the bodies of these animals will multiply and can be released through their feces. Not only that, the parasite can also spread to other organisms that eat animal flesh with <i>Toxoplasma</i> in it. Wild cats that are used to hunting small animals or eating crumbs on the ground are one of the potential hosts for this parasite to enter the chain of transmission. Based on this, does every cat have the <i>Toxoplasma</i> parasite? Give your opinion!</p>	
High Scientific Argument	Pre Test	<p><b>20</b>                      Tidak, karena parasit toksoplasma masuk ke tubuh kucing melalui apa yang dimakannya. Misalnya tikus, burung kecil, daging mentah, atau makanan lain yang terkontaminasi tanah dan terdapat toksoplasma di dalamnya, lalu kucing memakannya barulah kucing tersebut akan bisa memiliki parasit toksoplasma.</p> <p>Identity: NND-No.20</p>
	Post Test	<p>Tidak. Karena, parasit toksoplasma masuk ke tubuh kucing melalui apa yang dimakannya, jika makanan yang diberikan kepada kucing terbukti higienis dan bersih maka besar kemungkinan kucing tersebut tidak memiliki parasit toksoplasma. Pada kucing peliharaan yang tidak dibiarkan bebas berkeliaran, makan dari makanan pabrikan yang sifatnya kering, dan rutin divaksinasi, toksoplasma sangat jarang menginfeksi.</p> <p>Identity: JNWGU -No.14</p>
	<p><b>Description:</b>                      Students' answers are categorized as having strong scientific arguments because they contain several sets of supporting data that are in accordance with scientific reasoning.</p>	
Medium Scientific Argument	Pre Test	<p><b>15</b>                      Tidak, karena toksoplasma masuk ke tubuh kucing melalui makanannya jika makanan bersih dr toksoplasma maka kucing tersebut.</p> <p>Identity: JSS -No.15</p>
	Post Test	<p>setiap kucing belum tentu memiliki parasit toksoplasma, karena ada beberapa kucing yang benar-benar dipelihara dan diperhatikan makanan dan gaya hidupnya. parasit toksoplasma masuk ke tubuh kucing melalui apa yang dimakannya.</p> <p>Identity: KGA -No.16</p>
	<p><b>Description:</b></p>	

Students' answers are categorized as having moderate scientific arguments because they contain a series of data or supporting documents that are in accordance with scientific reasoning.

Low Scientific Argument	Pre Test	18	Tidak, karena ada banyak kucing yang tidak liar atau terawat
	Identity: MHKMA -No.18		
	Post Test		Tidak, karena tidak semua kucing liar.
Identity: SAL -No.29			

**Description:**

Students' answers are categorized as having low scientific arguments because the arguments only contain doubters with one simple claim.

**5. Conclusions**

Based on the results and discussion, the ASICC-based electronic module on protist material is valid and effective for improving the scientific argumentation skills of class X MIPA students at SMAN 1 Kediri.

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