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The development of interactive learning media for biology based on telegram bots on digestive system materials in class VIII Junior High School to train students' critical thinking skills

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Abstract

The industrial revolution era of 4.0 requires every graduate to have thinking skills, but in reality, these skills are still low in schools. Interactive media is an alternative solution that can be used to train students' critical thinking skills. This study develops a telegram bot to train the students' critical thinking skills on the material of the digestive system. The research method uses the modified Borg & Gall model and is limited to five steps, namely: 1) preliminary research; 2) develop the initial product; 3) expert validation and revision; 4) small field trials and revisions; e) large-scale field trials and final products. The research instruments used were validation questionnaires, response questionnaires, media implementation and learning achievement tests which were then analyzed descriptively. The results show that the telegram bot is very valid with very good legibility. The practicality of the telegram bot is shown by the implementation of the media, with a score of 94.3 and student responses of 93.93. The results of increasing the student's critical thinking skills show an N-Gain of 0.65, categorized as moderate. Therefore, the telegram bot on the digestive system effectively trains students' critical thinking skills.

Abstrak

Era revolusi industri 4.0 mengharuskan setiap lulusan memiliki keterampilan berpikir, namun realitanya keterampilan ini masih rendah di sekolah. Media interaktif menjadi salah satu solusi alternatif yang dapat digunakan untuk melatihkan keterampilan berpikir kritis siswa. Penelitian ini mengembangkan *bot telegram* untuk melatihkan keterampilan berpikir kritis siswa pada materi sistem pencernaan. Metode penelitian menggunakan model Borg & Gall yang telah dimodifikasi dan dibatasi hingga lima langkah yakni: 1) penelitian pendahuluan; 2) mengembangkan produk awal; 3) validasi ahli dan revisi; 4) uji coba lapangan kecil dan revisi; e) uji coba lapangan skala besar dan produk akhir. Instrumen penelitian yang digunakan berupa angket validasi, angket respon siswa, keterlaksanaan media dan tes hasil belajar yang dianalisa secara deskriptif. Hasil penelitian menunjukkan *bot telegram* tergolong sangat valid dengan keterbacaan sangat baik. Kepraktisan ditunjukkan dari keterlaksanaan media dengan skor 94,3 dan respon siswa sebesar 93,93. Hasil peningkatan keterampilan berpikir kritis siswa menunjukkan *N-Gain* sebesar 0.65 yang terkategori sedang. Oleh karena itu *bot telegram* materi sistem pencernaan efektif digunakan untuk melatihkan keterampilan berpikir kritis siswa.

A. Introduction

The era of the industrial revolution 4.0 demands quality human resources and has various abilities. Therefore, the teacher's role is not solely to direct the mastery and understanding of scientific concepts, but also to improve students' thinking skills. This is as stated in the Regulation of Kemendikbud (2022), the Minister of Education, Culture, Research and Technology of the Republic of Indonesia number 5 of 2022 concerning competency standards for graduates of primary and secondary education which requires that every graduate has the ability to interpret texts, produce inferences, reasoning and other abilities that are part of higher order thinking skills.

One of the high-order thinking skills that the millennial generation needs to have in the industrial revolution 4.0 era is critical thinking skills. Critical thinking is a systematic mental activity carried out by tolerant people with an open mind to broaden their understanding (Johnson, 2007). Critical thinking is also the basis for analyzing arguments and can develop a logical mindset (Hasibuan & Surya, 2016).

Biology is a branch of Natural Sciences (IPA) which has a lot of complex material that demands critical thinking skills.The digestive system is a wrong concept with complex discussions and cannot be observed directly by students so that it requires thinking skills, especially thinking critically (Mardiah et al., 2018). However, based on the results of the 2018 Program for International Student Assessment (PISA), Indonesia occupies a low position in the science performance category (IPA), which is ranked 62nd, with an average score of 369 (OECD, 2019). This below average score indicates that students' critical thinking skills in science including biology are still low. Ulfah et al. (2020) in Kotabaru and Sari (2020) in Tabalong district also showed that the critical thinking skills of junior high school students in these subjects were still relatively low.

The selection of learning media turns out to be one of the factors that determine the success of developing student skills. Mayer (2009) describes one of the media that can offer learning technology that has strong potential to improve the quality of learning, namely interactive media. Interactive media is a combination of several media whose use is manipulated by the user in terms of commands or behavior (Majid, 2007).

Several studies have shown that the use of interactive media in learning gets a positive response and is able to improve critical thinking skills. Sastrakusumah et al. (*2*018) suggests that the use of interactive learning media assisted by the I-Spring Presenter application has a significant effect on students' critical thinking skills in class XI Civics lessons. Firdaus et al. (2020) explained that the use of interactive media based on the SETS approach can improve the critical thinking skills of elementary school students. Aminuddin et al. (2020) in their research has developed interactive multimedia, Macromedia Flash, to effectively improve students' critical thinking skills.

However, the Covid-19 pandemic in early 2020 which resulted in closing schools required the world of education to transform into an online system (in a network) by utilizing internet technology (Adisel & Prananosa, 2020). This makes teachers and students use social media to support learning achievements (Fitriyani et al., 2020). One of the interactive media that utilizes technology and can be used in online learning is the telegram bot in the telegram social media application. Telegram bots can be developed into a type of interactive media by displaying menus containing subject matter as was done by Ramadhan (2018). This research shows that student responses strongly agree if telegram media is used as a learning support with a score of 86.47%. Study Hidayat et al. (2021) also shows that one of the features in telegram, namely the telegram quiz bot, can *be used as a medium to improve listening skills.*

Telegram bot is a third-party application that can be run on Telegram. The Telegram application itself is capable of enabling users to send or receive data in the form of text, images, audio, video and other stickers in various formats (pdf, doc, zip, mp3 and others) ("Telegram", nd). It is this ability to send various files and commands that will be utilized further in developing interactive media.

Based on the explanation above, researchers are encouraged to develop telegram bot media as a learning medium in learning Biology of the digestive system material to train students' critical thinking skills.

B. Material and Method

The development of this learning media uses research and development methods according to Borg & Gall (1983) which has been simplified by the Tim Puslitjaknov (2008) into 5 steps, namely: 1) preliminary research, (2) developing initial products, (3) expert validation and revision, (4) small-scale field trials and product revisions, (5) large-scale field trials and final products. The critical thinking skills used are adapted from Facione (1990) which are limited to four indicators namely, interpretation, analysis, evaluation and inference. The instrument used is the results of the

LKPD assessment and the evaluation was carried out three times in meetings.

The stages of this research and development are described as follows:

1) The stage of conducting preliminary research

This stage consists of an analysis of media needs and a review of basic competencies. Needs analysis was carried out by means of literature studies and interviews with teachers and students at MTsN 12 Tabalong.

2) Initial product development stage

Initial product development is done by creating a product design. Product design includes interface design and content design which was divided into 3 meetings.

3) Validation Stage

The telegram bot media product that has been developed together with learning tools in the form of a syllabus, lesson plan, worksheet and evaluation questions will be validated by 3 experts, namely ULM Biology Education Postgraduate Lecturer. The data obtained from the validation results are then categorizedaccording to the validity criteria presented in Table 1.

Table 1 Media validity criteria

No.	Score	Validity Criteria	Information
1	> 85- 100	Very Valid	Can be used without revision
2	> 70-85	Valid	Usable but needs minor revision
3	> 55-70	Quite valid	It can be used but needs quite a large revision
4	> 40-55	Less valid	It is recommended not to use it because it needs major revisions
5	≤ 40	Invalid	Cannot be used

(Source: Adapted from Akbar, 2013)

4) Small Scale Field Trials

In small-scale field trials students were given questionnaires in the form of implementation and student response questionnaires. Data from student responses are then categorized based on the average score presented in Table 2.

Table 2 student response criteria

Score	Statement/Practicability Level
>80 - 100	SS/ Strongly agree
>60 - 80	S/ Agree
>40 - 60	KS/ Disagree
>20- 40	TS/ Disagree

(Source: Adapted from Fatmawati, 2014)

5) Large Scale Field Trials

Effectiveness data analysis was carried out descriptively from the results of students' critical thinking skills through student worksheets and evaluation results in large-scale field trials. The average value obtained is then categorized according to Table 3.

Table 3 Categories of critical thinking skills

Score	Information
>90,5-100	Very high
>75,5-90,5	Tall
>60,5-75,5	Currently
>40,5-60,5	Low
0-40,5	Very low

(Source: Adapted from Sugiyono, 2013)

The magnitude of the increase in critical thinking is calculated using the formula for the normalized gain value (N-Gain). The results of the N-Gain score obtained are then converted with the criteria in Table 4.

Table 4 Classification of N-gain

g Value	Criteria
$g \geq 0.7$	Tall
$0.7 > g \geq 0.3$	Currently
$g < 0.3$	Low

(Source: Adapted from Hake, 1999)

C. Results and Discussion

The resulting product development results are divided into four menus consisting of learning materials, worksheets, evaluation questions, and criticisms and suggestions. The process of developing telegram bot media products on digestive system material is adjusted to indicators of students' critical thinking skills based on needs analysis, namely students who do not fully understand material and pictures from textbooks during learning and the use of learning media that is not optimal and the designs that have been made. Analysis The development of the telegram bot must be in accordance with the design and flow that has been made so that the resulting telegram bot media is good and coherent so that it is easy to use and can achieve learning objectives. This is in line with the research of Febrianto et al. (2021) that making interactive learning media requires an orderly and systematic production workflow so that production time can run more effectively and is also on target, according to the target.

Cover is designed using pictures of the digestive system to give students an idea of the contents of the material (See Figure 1). The menu display is arranged based on a design which is

divided into sub-menus that make it easier for students to operate. Even though students use media independently, it is still structured according to the arrangement of material that has been made in the telegram bot (See Figure 2, Figure 3, Figure 4, Figure 5, and Figure 6).

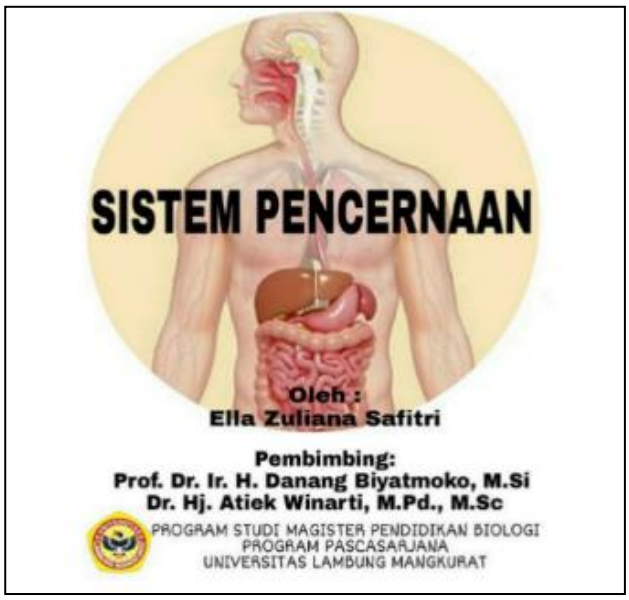

Figure 1 Telegram bot media cover (in Indonesia)

Figure 2 Digestive system material menu displays (in Indonesia)

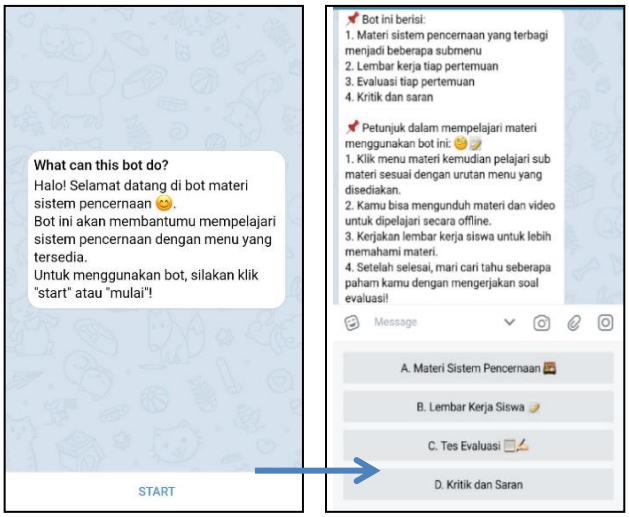

Figure 2 Display menu and main menu page (in Indonesia)

Figure 4 Digestive system sub material page (in Indonesia)

The contents of the telegram bot are equipped with a combination of text, images, videos and Gform links. Pictures and videos are used to support the material on the digestive system. Videos are equipped with sound and some are self-recorded so that it is more interesting and easier for students to learn independently. This is in line with research by Aminuddin et al. (2020) which combines writing and pictures in interactive multimedia to train students' critical thinking skills. Kuswanto & Radiansah (2018) in their research

stated that all learning media products were very interesting and interactive because they consisted of text, images, animation and sound.

Figure 5 Material video displays (in Indonesia)

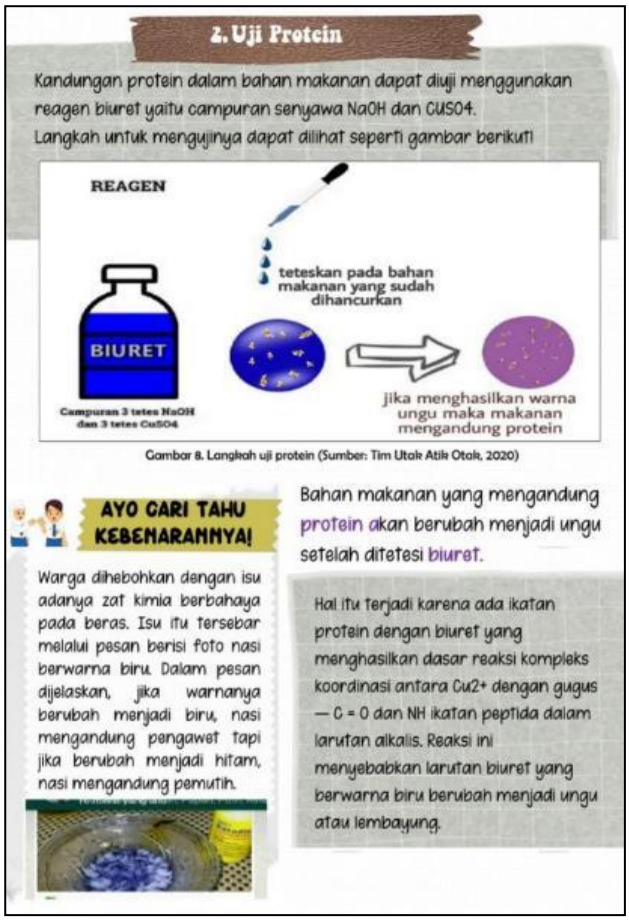

Figure 6 Material content pages (in Indonesia)

Products that have been developed are then validated and scores are obtained which are presented in Table 5.

Table 5 telegram bot media validation results

No.	Aspect	Average
1.	Media aspects (display and technical)	87,11
2.	Material aspect	92
Total		**179,11**
Score average		**89.56**

The validation results show that the telegram bot media developed is included in the very valid category both in terms of appearance, technical (media operation) and material. Display menus that are well-organized and neat and text that has high legibility will make it easier for students to operate the media. This is supported by Vaughan (2010) who argues that text is a very important element in the media because it is a powerful information provider. Easy operation without any errors or unresponsive commands provides comfort for the user. In line with what was stated by Agustina et al. (2020) thatthe absence of distractions in the multimedia program will make the learning process run smoothly.

This very valid result shows that the telegram bot media is theoretically and practically feasible to use for small-scale trials. Research conducted by Aminuddin et al. (2020) also showed that valid media can be tested on small groups. In line with Muchtar et al. (2021) in his research that the valid I-Spring interactive media was tested in a limited group test.

The small-scale trial aims to find out the practicality of the media through a media implementation questionnaire and the student responses given. The results of student responses are shown in Table 6.

Table 6 show a positive student response to the use of telegram bot interactive media. This means thatstudents are interested and motivated in participating in learning and are able to increase the desire to learn because of the attractive appearance of the media and the sequential material. This is supported by Oktavia (2020) that interactive media can influence students' enthusiasm in understanding learning. Ramadhan (2018) suggests thatstudents strongly agree if telegram media is used as a learning support.

The sentences contained make learning directed so that it encourages critical thinking. Students can also learn at their own pace because the media is operated and controlled by each individual. The positive response results show that the Telegram bot is practical and easy to use. The

handy telegram bot can be used for large-scale field trials. The effectiveness of telegram bots is obtained from the average results of student worksheets and evaluations carried out on large-scale tests. Results obtained. The results obtained show that students' critical thinking skills increase at each meeting as shown in Table 7.

The improvement of students' critical thinking skills is then normalized using N-Gain based on Table 8. The results showed that the critical thinking skills of the students who were trained were in a very high category both in interpreting, analyzing, evaluating and making inferences after using the telegram bot interactive media for 3 meetings. At each meeting there was an increase in students' critical thinking skills as the telegram bot media was used more and more often.This shows that the use of telegram bot-based interactive media is able to make students understand the material better so that they can solve existing critical thinking skills problems. This statement is in line with research conducted by Aminuddin et al. (2020); Agustina et al. (2020); Firdaus et al. (2020); Haka et al. (2021) that interactive media can improve students' critical thinking skills.

Table 6 Student response questionnaire results

No.	Statement	Average
1.	Contains sentences that encourage me to think critically	92.75
2.	Presentation of the material encourages me to discuss with other friends.	92.75
3.	The material drives my curiosity.	96.5
4.	Increase my understanding of the digestive system.	100
5.	Interesting view.	92.75
6.	I can learn at my own pace	92.75
7.	Increase the desire to learn.	96.5
8.	Makes my learning more focused and coherent.	85.75
9.	Provide motivation to study the material.	96.5
10.	Make studying biology not boring.	92.75
Total		**939**
Average		**93.9**

Table 7 Results of critical thinking skills

No.	Indicator	Before	After using the media		
			P1	P2	P3
1.	Interpretation	54.25	67.25	81.5	91.5
2.	Analysis	58.83	66.83	77.58	85.08
3.	Evaluation	49.16	63.25	79.16	85.91
4.	Inference	44	68.5	79	90
	Average	51.56	66.46	79.31	88.13
	Category	**Low**	**Currently**	**High**	**Very high**

Table 8 N-gain results for critical thinking skills

No.	Indicator	N-Gain	Criteria	Average	Criteria
1.	Interpretation	0,74	Tall	0,65	Currently
2.	Analysis	0,55	Currently		
3.	Evaluation	0,62	Currently		
4.	Inference	0,68	Currently		

Telegram *bots* as an interactive media has the advantage of being attractive because it combines several media such as text, images, videos, animations, as well as links such as gform links so that the display is fun and attracts student learning interest. High student interest in learning will make students' ability to understand the material higher so that they are able to think more critically. Rahayu et al. (2021) mention interactive mediabased on Adobe flash makes learning fun because it is equipped with videos, pictures, animations and text, there are practice questions. This statement is supported by Purwati (2021) that images, audio, video, and animation used in digital media can stimulate students' interest in learning about a material. The application of Prezi media which has a program that can display visuals, audio and animation by Kasim et al. (2021) is also able to increase students' learning motivation and critical thinking skills.

The existence of images, audio and video besides being able to convey material more clearly,

especially in the digestive system which has complex material and abstract parts will make students not bored while doing independent learning. In line with the opinion of Hidayat et al. (2021) that with the text, image, questions and audio features on the telegram quiz bot, it can be utilized in material listening skills. This means that students will be more focused and focused in understanding the processes and explanations of the digestive system material. Oktavia (2020) in her research also shows that interactive multimedia influences student activity and enthusiasm in understanding learning.

Another advantage is that telegram bots are not bound by space and time in the learning process so they can be learned anytime and anywhere. This is as revealed by Abimanto & Mahendro (2021) that the telegram application has the advantage of not requiring space in the learning process and can be implemented at any time. Materials in the telegram bot can be downloaded and saved. Material that has been downloaded will be stored in the cloud so it will not take up a lot of memory space and can be studied again without the need for an internet network again. This allows students to learn flexibly so as to motivate students to learn. This statement is supported by the research of Sadikin et al. (2020) which suggests that appart for being accessible anytime and anywhere, interactive multimedia is also able to increase student motivation.

There is a reciprocal relationship between users (students) and the program, namely when students interact with menus that have telegram bots that are responded to by presenting information that can provide new experiences for students. Students can control the media and study the material themselves but remain focused because the material is arranged according to the indicators to be achieved. This is in line with Anggraini & Sartono (2019) that interactive multimedia can be controlled by users so as to provide direct experience for students. This new experience will provide motivation for students which can affect learning outcomes and the value of students' critical thinking skills. This is reinforced by Arsyad (2017) that the teaching and learning process will run effectively and efficiently if it is supported by the availability of media that supports the interaction process that is being carried out.

The next advantage, this telegram bot media contains critical thinking indicators. This indicator is in the form of question sentences, information/presentation of problems, as well as instructions to students to train students' critical thinking skills. This critical thinking indicator is contained in the column or box at the end of the submaterial page. For example, in the first sub-matter about food substances, it is prepared by starting with simple questions related to the material discussed in the form of a breakfast menu that is eaten to stimulate students to start lessons. Next, given a presentation of problems such as why if you don't eat your body feels weak? What is contained in food substances so that after eating you can move with enthusiasm?

Students will be asked to find out the content of food substances in the menu they eat by studying the material presented and its functions. Finally, after students have studied the information obtained, students will be asked to evaluate the food that will be consumed next. This is supported by Latifah (2019), that the definition and explanation of indicators of critical thinking skills must be clear so that there are no misunderstandings in meaning. Ishthifaiyah et al. (2020) also wrote indicators of critical thinking skills in each subchapter, to train students' critical thinking skills.

The last advantage is the existence of a third application feature, namely the gform link on the evaluation menu, making it easier for the teacher to check student learning outcomes which are directly recorded. Teachers can get student learning outcomes immediately after students finish working, without the need to make manual corrections, so that they can be used as evaluation material at the next meeting. Students will also be more enthusiastic because they immediately get a score of learning outcomes and can correct parts that are wrong and have not been understood during learning because new material has been studied. This is supported by Aziz & Shalihah (2020) that the Google form is effective and easy to use in learning evaluation. However, the drawback of using the three gform applications is that they must always be connected to the internet for evaluation.

Based on the overall N-Gain, interpretation indicators are in the high category, while analysis, evaluation and inference indicators are in the medium category. The high increase in interpretation ability is because the problems presented in the worksheet are problems related to everyday life where students have been trained repeatedly to be able to formulate problems. This is as stated by Putra & Nikmah (2017) that the factors that influence students' critical thinking include mastery of problem concepts and prerequisite material (initial concepts), and their application. This means that students who are able to formulate

problems well have a good understanding of the concept of the digestive system.

The existence of problems that are displayed with pictures and videos will make students get a clearer picture of a problem so that they can formulate the problem correctly. Previous research conducted by Aminuddin et al. (2020) using macromedia flash containing images also showed a high increase in students' interpretation skills. Agustina et al. (2020) in his research also mMention that students go throughaudio-visual is able to capture the problems reported. The existence of indicators of interpretation skills in each sub-material also makes students accustomed to identifying problems.

The analysis indicators at the third meeting were in the high category even though the results of the increase from the first to the third meeting were only moderate. This shows a significant increase in students' analytical skills. This increase in analytical skills is because in telegram bot learning students are trained continuously to carry out argument analysis related to questions on worksheets. This activity is supported by videos combined with telegram bots that make it easier for students to do analysis, especially on process material. This is in line with the research of Amsar et al. (2020); Jumriani (2018) that video media can improve students' analytical thinking skills and effectively improve learning outcomes.

The results of student evaluation skills showed an increase in the moderate category. The low level of student evaluation skills at the initial meeting is because students have not fully mastered the material so they still have difficulty connecting the concept of completion. This is in line with the opinion of Rahmawati, Masyukri, & Sarwanto (2010) that evaluation activities require correct understanding of knowledge so that credibility can be accounted for.

The results of the increase were only moderate because at the third meeting the material studied was the digestive process in humans so more videos are needed to explain every process that occurs in each organ. This is in line with the research by Nurhidayah, Malahayati, & Devita Sulistiana thatlearning media DORA (Interactive Video) is able to facilitate students in learning and understanding the coordination system material.However, in the telegram bot the researcher only included one video due to quota limitations for students. This was also revealed in Surahman et al. (2020) that internet quota is one of the obstacles in online learning.

The fourth indicator, namely inference, is the ability to draw conclusions from a problem. The use of telegram bots can improve students' inference skills which were initially low to high after repeated exercises. This low inference skill is because students have not been able to identify the important parts of a problem solution needed to draw conclusions. This is in line with Maslakhatunni'mah et al. (2019) that the low inference indicator is because students have not been able to identify problems and solve problems to make conclusions.

The use of telegram bot media shows a moderate increase in inference skills because students have been trained to identify problems, carry out analysis and evaluation related to the problems presented. This is in line with the research of Sukardi et al. (2019) that learning to think critically and solve problems is better if done with practice as in research. Agustina et al. (2020) in the development of multimedia on the concept of peat swamp forest also showed the results of an increase in students' critical thinking skills.

Based on the description above, it can be said that the critical thinking skills of the students who are trained are in a very high category both from interpretation, analysis, evaluation and inference. Telegram bot interactive media is effective in training students' critical thinking skills on digestive system material. This is due to the advantages of the telegram bot media used. This statement is in line with research conducted by Sastrakusumah et al. (2018); Firdaus et al. (2020); Aminuddin et al. (2020); Haka et al. (2021). that various interactive multimedia are effective in improving students' critical thinking skills.

Based on the research results and comments provided by the telegam bot being developed it still has drawbacks including 1) the product can only be accessed using a smart phone or computer; 2) Must download the telegram application because the product must be accessed using the application; 3) for initial operation, you must use the internet before being downloaded and studied offline; 4) The availability of student quotas is insufficient so that media content is limited; 5) the media is only in the form of one material which is still sourced from printed books and the internet.

D. Conclusion

The digestive system material telegram bot that was developed was effectively used to train students' critical thinking skills with a score of 88.13 and an N-gain of 0.65 or in the moderate category. Even though it is considered very valid and effective, the researcher suggests developing media with a more attractive and interactive design, namely by including more material learning

videos, especially on process material and including more original photos and examples of problems in everyday life.

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