DEVELOPMENT OF PROTEIN SYNTHESIS TOPIC WEBTOON "SYNPRORY!" LEARNING MEDIA TO IMPROVE UNDERSTANDING OF 12th GRADE HIGH SCHOOL STUDENT

Pengembangan Media Pembelajaran Web-comic Berbasis Webtoon "Synprory!" untuk Meningkatkan Pemahaman pada Sub-materi Sintesis Protein Kelas XII

Tyas Cricilia
Undergraduate Program in Biology Education, Faculty of Mathematics and Natural Sciences
State University of Surabaya
E-mail: tyas.18007@mhs.unesa.ac.id

Evie Ratnasari
Undergraduate Program in Biology Education, Faculty of Mathematics and Natural Sciences
State University of Surabaya
E-mail: evieratnasari@unesa.ac.id

Abstract

The development of science and technology is increasingly rapid in the world, especially for the educational sector, the teachers should keep up with the times and adapt to the current technology. This can be utilized by teachers to start innovating by creating a learning media that students may access through their smartphones anytime and anywhere. One of the topics considered difficult to learn is protein synthesis, because it is not sensory and complex. This research aims to develop webtoon-based web-comic learning media to improve understanding of the 12th grade student in protein synthesis sub-topic. This research used ASSURE method (Analyze Learner, State Objective, Select Media and Materials, Utilize Media and Materials, Require Learner Participant, and Evaluate and Revise). Data collection methods through validation methods, response questionnaires, pre-test and post-test which were carried out 20 grade 12th students of SMA Negeri 14 Surabaya. The data obtained were analyzed using descriptive-quantitative techniques. The results of this study is a learning media "*Synprory!*" webtoon-based web-comic with validity value 3,88 considered as a valid category and gain a positive responses from student with a practicality value of 95,5%. The results of the study were also effective in improving student understanding with an N-gain of 0,77 in the high category. Thus the development of "*Synprory!*" webtoon-based web-comic learning media to improve understanding of the 12th grade protein synthesis sub-topic is feasible in terms of validity, practicality, and effectiveness.
Keywords: webtoon, web-comic, protein synthesis, understanding, learning media.

Abstrak

Perkembangan ilmu pengetahuan dan teknologi semakin pesat di dunia terutama pada bidang pendidikan, para pendidik sudah sepatutnya mengikuti perkembangan jaman dan beradaptasi dengan teknologi yang ada saat ini. Hal ini dapat dimanfaatkan guru untuk memulai inovasi dengan membuat sebuah media pembelajaran yang dapat diakses siswa melalui smartphone mereka kapan saja dan dimana saja. Salah satunya materi yang sulit untuk dipelajari karena tidak bisa diindra dan kompleks adalah sub-materi sintesis protein. Penelitian ini bertujuan untuk mengembangkan media pembelajaran web-comic berbasis webtoon untuk meningkatkan pemahaman siswa pada sub-materi sintesis protein kelas 12. Penelitian ini menggunakan metode ASSURE (Analyze Learner, State Objective, Select Media and Materials, Utilize Media and Materials, Require Learner Participant, dan Evaluate and Revise). Metode pengumpulan data melalui metode validasi, angket respon, tes pre-test dan post-test yang dilaksanakan pada 20 siswa kelas 12 SMA Negeri 14 Surabaya. Data yang diperoleh dianalisis dengan teknik deskriptif-kuantitatif. Hasil penelitian ini menghasilkan nilai validitas media sebesar 3,88 dengan kategori valid dan respon positif siswa dengan nilai kepraktisan 95,5%. Hasil penelitian juga efektif meningkatkan pemahaman siswa dengan N-gain sebesar 0,77 pada kategori tinggi. Dengan demikian pengembangan media pembelajaran web-comic berbasis webtoon untuk meningkatkan pemahaman pada sub-materi sintesis protein kelas 12 layak ditinjau dari validitas, kepraktisan, dan keefektifan.
Kata Kunci: webtoon, web-comic, sintesis protein, pemahaman, media pembelajaran.

INTRODUCTION

High school students often have difficulties in understanding certain materials, especially related to learning materials that can't be sensed or observed directly. Protein synthesis is one of the materials in Biology that is considered complex because this material studies the mechanisms and complex processes of the body in the formation of proteins. In addition, the teaching materials used by students are inadequate and are unable to keep up with the times and advanced digital technology (Nusantari, 2011).

Based on the results of Suhermiati's research (2015), one of the materials that students often found difficult to understand is protein synthesis. Because of the difficulties they had, students often experienced conceptual errors and were not motivated to learn. In the learning of protein synthesis material, students are lacking in understanding the processes that occur, especially in the transcription and translation phases. Students remain confused about the role and differences between RNA and DNA. This caused by poor delivery of information from the teacher to the students. The teacher only delivered the material in outline and did not provide a detailed explanation of the processes that occur at the steps of protein synthesis.

The same problem also occurs up to the college level. Fadliyah (2019), stated that college students also had problems understanding protein synthesis material due to learning methods that only proceed in one way, causing students to become passive and lose motivation to learn. In addition, student learning media is still less diverse and not interesting so that the level of understanding material is still relatively low.

Through the two studies conducted at the high school and college levels, it can be seen that both experienced difficulties in learning protein synthesis sub-topics. The discussion of protein synthesis sub-topic itself is important because the material is a basis for various other biology materials, which are related to genetic material, biochemistry, and nutrition since protein is one of the macronutrients needed by the body. The relation between protein synthesis sub-topic with other materials indicates that protein synthesis material is one of the important materials and must be understood in depth.

With these obstacles, a learning media is needed to facilitates students in learning and understanding the topic of protein synthesis. Learning media must be packaged attractively but still in accordance with the material to be delivered. One aspect that can be utilized as a reference for media development is the visual aspect. This is in accordance with the opinion of Beegel (2014), which states that humans are visual creatures who have a tendency to easily process information packaged in the form of images than through text or sound. One of the visual media that has recently been in demand by teenagers is webtoon.

Webtoon is a digital comic application that contains a variety of comics from around the world. Comic writers can freely create and share their artwork on the webtoon application. By the year 2020, webtoon users in Indonesia have reached 6 million users with an average age of 18-25 years. Webtoon can be classified as an appealing media because it presents diverse visuals due to the many interesting genres as well as art styles on webtoon, so its users will gradually increase (Annisa, 2020).

Webtoon has certain uniqueness that makes it different from comics in general. Since it is digital-based, this application is very practical and can be accessed anytime and anywhere through electronic devices such as cellphones, laptops, computers, and other communication devices that connected with internet connection. Webtoon also has special characteristics that distinguish it from other comics. These special characteristics include vertical scrolling, presenting sequences, non-linear story-telling, and interactive motion and sound (Jang & Song, 2017).

Many studies have been conducted using webtoon as a media in the learning process. One of them is research by Hidayat (2019) who developed webtoon-based learning media on human nervous system material for grade 12 high school. The research conducted showed that the development of webtoon-based learning media on human nervous system material was stated to be valid and effective in improving student learning outcomes. In addition, the response questionnaire given to students received a positive response with a result of 83.3%. Research by Hidayat (2019) shows that webtoon has a positive impact on students in the learning process.

There are several uniqueness and benefits of webtoon as a learning media, therefore, it is necessary to develop learning media to improve understanding of class 12 sub-topic. A new breakthrough is required in learning protein synthesis sub-topic so that students would no longer experience difficulties in the learning process both at the high school level and at the college level. Webtoon is a media that is considered good to use as a learning media.

Based on the description above, researchers considered that the development of webtoon-based web-comic learning media as teaching materials to improve

Cricilia, Tyas & Ratnasari, Evie: Development of Protein Synthesis

the understanding of 12th grade students in learning protein synthesis sub-topic is worth to be carried out.

METHODS

This research was developed with ASSURE model. ASSURE is a research model proposed by Heinich which was later developed by Smaldino through his book "Instructional Technology & Media for Learning". The ASSURE research development model has 6 stages as proposed by Heinich in Smaldino (2011), Analyze Learner, State Objective, Select Media and Materials, Utilize Media and Materials, Require Learner Participant, and Evaluate and Revise. The purpose of ASSURE model is to accommodate teachers in the learning process by integrating the use of technological advances and media for students.

The research target of developing webtoon-based web-comic learning media on the K-13 curriculum was carried out on 20 grade 12 students of SMA Negeri 14 Surabaya in October 2023. Data collection techniques carried out through validation data, student response questionnaires, student pre-tests, and post-tests.

The validation method was used to determine the validity of webtoon-based web-comic learning media on the protein synthesis sub-topic. The validation process is carried out by validators who are material expert lecturers, media expert lecturers, and grade 12 school biology teachers. The validation carried out by experts includes an assessment in the aspects of media, material, and linguistic.

Through the validation stage, material experts, media experts, and grade 12 school biology teachers can provide suggestions that can be used for researchers in making revisions to the products produced so that the final product produced is a valid product to use. Media can be categorized as valid if it gets a score above 2,50.

Questionnaires will be given to students after completing both learning tests and have finished using the previous webtoon-based web-comic media to determine the improvement of student understanding. This questionnaire contains several statements regarding the webtoon-based web-comic learning media that they have used. In this questionnaire, students must provide an attitude response according to what are their thoughts on the product that has been used.

Students can respond by choosing the answer "YES" to give a positive response to the statements stated in the questionnaire and choosing the answer "NO" in the questionnaire to give a negative response to the statements given by the researcher. Learning media can be declared practical if it gets a score above 60%.

The test method is given before (pre-test) and after (post-test) the learning media is used. This is done to determine the comparison of student understanding before and after being given learning media as a tool to improve student understanding of protein synthesis material. The test contains of 10 questions about the protein synthesis sub-topic that has been presented through the learning media. Students were declared complete if they scored >75 and obtained N-gain >0,030 or included in the medium and high categories.

RESULT AND DISCUSSION

The results of the development work resulted "*Synprory!*" (Synthesis Protein Story) *a* webtoon-based web-comic learning media on protein synthesis sub-topic that can be seen on Figure 1. This learning media is a digital comic of protein synthesis published in the webtoon application that can be accessed directly through the application or using the web using electronic media connected to the internet network that can be seen on Figure 2. Besides the application or web, "*Synprory!*" learning media is also accessible by scanning the QR code on the Figure 3.
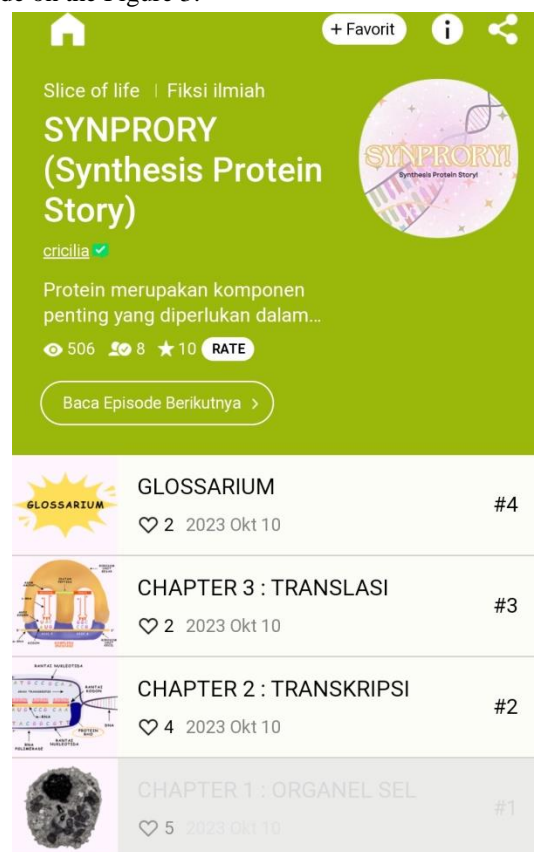

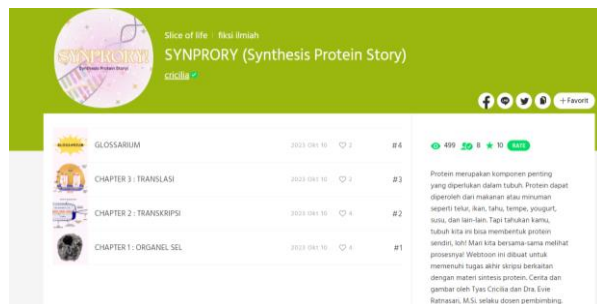Figure 1. Webtoon Aplication on Smartphone

279

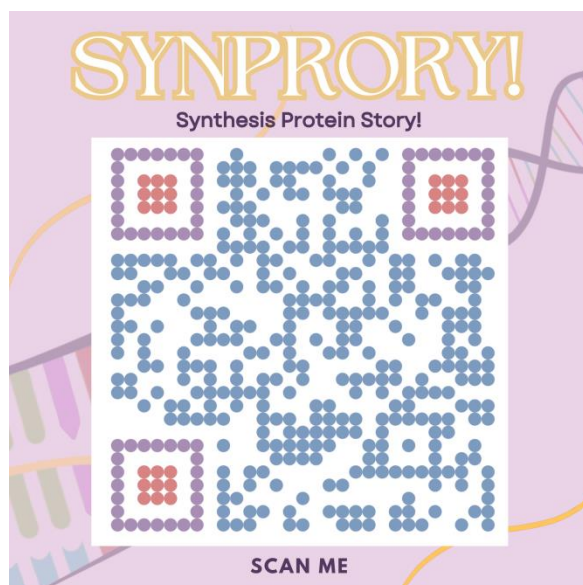Figure 2. Display Screen Access Through Webtoon website on PC

Figure 3. Accessible QR Code

Based on the validation result of "*Synprory!*", webtoon-based web-comic learning media on grade 12 protein synthesis sub-topic, the results of 3 main aspects were obtained, which are media aspects, material aspects, and linguistic aspects. The average validity obtained in the media aspect is 3,9, the average validity obtained in the material aspect is 3,84, and the average validity obtained in the linguistic aspect is 3,9. The total average validity obtained for "*Synprory!*" webtoon-based web-comic learning media on protein synthesis sub-topic in grade 12 is 3,88. The results obtained indicate that the validity of "*Synprory!*" web-based web-comic learning media on protein synthesis sub-topic in grade 12 is classified in the very valid category to be tested. These results can be seen in Table 1.

Table 1. Validity of Learning Media Based on Webtoon "*Synprory!*"

No.	Aspect	Score			Total Score	Avg.
		V1	V2	V3		
Media						
1	Ease of access	4	4	4	12	4
2	Character attractiveness	4	4	4	12	4
3	Ease of character recognition	3	4	4	11	3,6
4	The use of various colors	4	4	4	12	4
5	Contains appropriate background	4	4	4	12	4
6	Contains clear image	4	4	4	12	4
7	Contains images that are in line with protein synthesis topic	4	4	4	12	4
Average/Criteria		3,9 / Very Valid				
Materials						
1	The suitability of Chapter 1 with basic competencies and protein synthesis material	4	4	4	12	4
2	The suitability of Chapter 2 with basic competencies and protein synthesis material	4	4	4	12	4
3	The suitability of Chapter 3 with basic competencies and protein synthesis material	4	4	4	12	4
4	There is an explanation of peptide bonds and amino acids	4	3	4	11	3,6
5	There is a picture caption on each organelle presented	4	3	4	11	3,6
Average/Criteria		3,8 / Very Valid				
Linguistic						
1	There is a Q&A conversation about the differences between DNA and RNA between teachers and students	4	3	4	11	3,6
2	Explanations on each picture are clear and not complicated.	4	3	4	11	3,6
3	Explanation is	4	4	4	12	4

280

No.	Aspect	Score			Total Score	Avg.
		V1	V2	V3		
	related with protein synthesis material					
4	The mention of organelle names uses appropriate names	4	4	4	12	4
5	The mention of organelle names is consistent	4	4	4	12	4
6	Explanation does not contain double /ambiguous meaning	4	4	4	12	4
7	Font selection is easy to read and attractive	4	4	4	12	4
8	Using interesting font colors and easy to read	4	4	4	12	4
Average/Criteria		3,9 / Very Valid				
Average All Aspect		3,88				
Criteria		Very Valid				

Notes:

V1 : 1st validator (media expert)

V2 : 2nd validator (material expert)

V3 : 3rd validator (high school biology teacher)

Avg : Average score

Related to the results of the media validation developed, the first component to be assessed is the media component. This component consists of aspects regarding ease of access, character attractiveness, media display, and the quality of the images displayed. In its assessment, this component received an average total assessment of 3,9.

In the first statement, ease of access, the average score is 4. The media developed is media that is easy to access anywhere and anytime. Not only through the webtoon application, but the media developed can also be accessed through a web browser on each student's cellphone. In accordance with the opinion of Gonzalez (2015), the utilization of easy access in technology is very good when utilized, one of which is to create innovative learning media for students.

The average media validation results get a good score and can be stated as a feasible and valid media. However, in media development, there is one thing that is considered by media expert validators, namely about the character of the teacher in the comic.

In the initial draft, the teacher character was felt to look too young so it was necessary to revise so that the character could look older and different from the student characters in the comic.

The practicality of "*Synprory!*" webtoon-based web-comic learning media on the 12th grade protein synthesis sub-matter was obtained by distributing response questionnaires to students after first conducting tests and using the learning media. The student response questionnaire consists of 20 aspects of closed questions with answers in the form of "YES" and "NO" statements on each aspect. A recapitulation of the student response questionnaire on "*Synprory!*" webtoon-based web-comic learning media on grade 12 protein synthesis sub-topic can be seen in Table 2.

Table 2. Recapitulation of Students Responses

No.	Aspect	Possitive Responses	%
1	Easy to use	20	100
2	Easy to access via webtoon	19	95
3	Media in accordance with protein synthesis material	20	100
4	Can develop learning motivation	20	100
5	Images are clear and not blurry	20	100
6	Teacher and students characters in the media are interesting	18	90
7	Teacher and student characters are in accordance with the story	18	90
8	Teacher's character in the story makes it easier for students to understand the material	16	80
9	Images of organelles in comics are easy for students to understand	17	85
10	Interesting color	20	100
11	Interesting story setting	17	85
12	Easy to read media	19	95
13	The storyline is in accordance with the protein synthesis process	20	100
14	The language used is easy to understand	20	100
15	Language does not contain racism	20	100
16	Does not cause double/ambiguous perception	19	95
17	The story does not contain racism	20	100
18	Using the right font selection	20	100
19	Media can be used or accessed at any time	20	100
20	Media can make it easier for students to learn protein synthesis	19	95
Average of All Aspect		95,5	
Criteria		Very Practical	

281

Based on the results of the recapitulation of questionnaire data on the practicality of "*Synprory!*" webtoon-based web-comic learning media on grade 12 protein synthesis sub-topic, students gave a positive response. This can be observed based on the average results of students who gave a positive response to each aspect of 95,5% which can be classified into the very practical category.

In the response questionnaire given, students were also asked to write their reasons for giving an assessment of "*Synprory!*" webtoon-based web-comic learning media on grade 12 protein synthesis sub-topic. Most students consider that the media they use is an interesting media compared to the books they usually use in learning protein synthesis. In addition, students also think that the media they use is interesting and can motivate them in learning protein synthesis material. Most students feel helped and happy with the development of "*Synprory!*" webtoon-based web-comic learning media on grade 12 protein synthesis sub-topic.

In order to determine the effectiveness of "*Synprory!*" web-based web-comic learning media in the 12th grade protein synthesis sub-topic, a test was conducted in the form of a pre-test and post-test. The pre-test is assigned before students learn using "*Synprory!*" web-based web-comic learning media, while the post-test is assigned after students learn and access "*Synprory!*" web-based web-comic learning media. This test was conducted to determine the increase in students' understanding of protein synthesis sub-topic before and after using learning media.

This test was given to 20 students and consisted of 10 questions related to protein synthesis sub-topic. The results of the recapitulation of student scores during the pre-test and post-test can be seen in Table 3.

Table 3. Recapitulation of Students Score Test

No	Name	Score		N-gain	
		Pre-test	Post-test	Score	Criteria
1	ADS	23	83	0,78	High
2	APA	59	88	0,71	High
3	AFF	61	98	0,95	High
4	AAL	48	80	0,62	High
5	AMR	36	90	0,84	High
6	DCR	58	90	0,76	High
7	DAR	53	90	0,79	High
8	DNAR	45	80	0,64	Medium
9	DJI	65	100	1,00	High
10	LNS	68	100	1,00	High

No	Name	Score		N-gain	
		Pre-test	Post-test	Score	Criteria
11	ONS	25	80	0,73	High
12	PTD	45	80	0,64	Medium
13	RS	56	90	0,77	High
14	RRP	38	90	0,84	High
15	RHA	27	80	0,73	High
16	RNW	38	80	0,68	Medium
17	RAM	35	80	0,69	Medium
18	SPB	25	80	0,73	High
19	STE	59	90	0,76	High
20	SIR	40	80	0,67	Medium
Average Score		45,2	86,45	0,77	High

Notes:
N-gain Criteria
0,70 < 1,00 : High
0,030 < 0,70 : Medium
0,00 < 0,30 : Low

Table 4. Students Level of Understanding Based on Learning Indicators of Protein Synthesis Sub-topic

Indicator Number	Indicator	Pre-test Average Score	Post-test Average Score
4.3.1	Identify cell parts associated with the process of protein synthesis.	4,5	10
4.3.2	Explain the differences between DNA and RNA and explain the types of RNA that participate in the process of protein synthesis.	4,5	8,83
4.3.3	Analyze the correlation between amino acids and proteins in the process of protein synthesis.	6	2
4.3.4	Explain the purpose of the protein synthesis process and its impact on the body.	5,7	9,9
4.3.5	Explain the process of protein synthesis in the body and the products that are produced.	4,08	9,92
Student Average Score		3,8	8,13
N-gain		0,7 (High)	

Based on the results of the pre-test and post-test in Table 3, it can be seen that the percentage of student completeness after the pre-test was only 0% with an average score of 45,2 which is still below the minimum completion criteria determined by the school which is ≥ 75 and all students were declared incomplete.

After the post-test, there was an increase in student test results with an average score of 86,45 which value has met the minimum completeness criteria determined by the school. The N-gain obtained is 0,77 and it can be

stated that the results obtained are included in the high category. Students' pre-test scores range from 23-68, while students' post-test scores range from 80-100.

During the pre-test, all students were declared incomplete. Most students did not complete the pre-test because they had not learned the protein synthesis material correctly. Previously students had received protein synthesis material but with the role-playing method and learned it through student textbooks. In accordance with interviews conducted with the 12th grade Biology teacher, role playing is still not effective in making students understand the protein synthesis material given, so when students are faced with test questions, most of the students still have difficulty while answering each of the questions given. Protein synthesis material is considered as one of the biology materials that is difficult for students to understand and comprehend (Suhermiati, 2015).

Furthermore, this was overcome by using "*Synprory!*" webtoon-based web-comic learning media on protein synthesis sub-topic. Students then learned the media that can be accessed through their personal smartphones. By using learning media on smartphones, students can have in-depth learning opportunities and experiences. This is because the search for information and knowledge obtained by students through internet sources will be more numerous. The use of this media will also develop and improve students' understanding of the material they learn (Rogozin, 2012).

The use of web-comic learning media based on *Synprory!* webtoon got a positive response from students. Students considered that the media used was interesting and made it easier for them to understand the material provided. In addition, students feel that access to the media is relatively easy since webtoon is an open application that can be accessed by anyone and anytime (Fitriyah, 2021).

After using the learning media and doing the post-test, the total student completeness reached 100%. All students were declared complete because they received a test score ≥ 75 in accordance with the minimum completion criteria determined by the school. Based on Table 3, the average student post-test score is 86,45 which has increased by 41,25 from the previous one which only got an average score of 45,2. This shows that students' understanding of protein synthesis material has increased after learning using "*Synprory!*" webtoon-based web-comic learning media. The results of n-gain also showed high criteria with a value of 0,77.

Based on the recapitulation of the average student score data reviewed through the indicators in Table 4, there are indicators that have a not so high level of understanding. The indicator is indicator 4.3.3, which is analyzing the relation between amino acids and proteins and their impact on the body.

In the indicator regarding the relationship between amino acids and proteins, students experience difficulties and confusion when answering questions, so that in this indicator many students give incorrect answers. Students must initially understand the meaning of proteins and amino acids so that they will not be confused when being asked some questions about the correlation between the two.

The low achievement on indicators related to amino acids, proteins, and peptide bonds can be caused by the lack of explanation of these components in chapter 1 which should contain various organelles and matters related to the process of protein synthesis.

This research is in accordance with the opinion of Arsyad (2014), which states that learning media can help students in clarifying the presentation of information conveyed so that it can facilitate and improve student learning outcomes. In addition, learning media can be used to improve and direct students' focus on the material they are learning so that it can generate learning motivation in students.

In teaching protein synthesis material, an attractive and good media plays a very important role because protein synthesis is a material that is difficult to perceive and imagine. This is also in accordance with the opinion of Arsyad (2014), that learning media plays an important role in helping teachers and students in overcoming the limitations of the senses, space, and time in learning a particular material concept.

This is also in line with the Dual Coding learning theory by Pavio (2006), which states that learners will be able to more easily associate the material obtained when using a combination of verbal (reading text) and non-verbal (images). One of the learning media that combines these two things is comic media.

Overall, based on the results of validity, practicality based on student response questionnaires, and effectiveness based on student pre-test and post-test results, "*Synprory!*" webtoon-based web-comic learning media for grade 12 can be categorized as valid, practical, and effective media used in learning activities on protein synthesis material.

CLOSING
Conclusion
The results of this study is a learning media "*Synprory!*" webtoon-based web-comic with validity value 3,88

283

considered as a valid category and gain a positive responses from student with a practicality value of 95,5%. The results of the study were also effective in improving student understanding with an N-gain of 0,77 in the high category. Thus the development of "*Synprory!*" webtoon-based web-comic learning media to improve understanding of the 12th grade protein synthesis sub-topic is feasible in terms of validity, practicality, and effectiveness.

Suggestion

Comic learning media needs to be developed with other more interesting story background so that students are more interested and excited in learning certain material. In the process of making comics, it is necessary to provide many conversation scenes in the middle of the material so that students can develop a feeling of being carried away by the atmosphere and comic stories. It will make the students' learning experiences more diverse. This webtoon-based digital comic learning media requires further development for other Biology materials so that student learning media becomes more diverse and varied.

ACKNOWLEDGMENT

REFERENCES

Annisa, Irwansyah. 2020. *LINE WEBTOON* Sebagai Industri Komik Digital. *Jurnal Ilmu Komunikasi. Vol.6. No.2 Hal 134-148.*

Arsyad, Azhar. 2014. *Media Pembelajaran*. Jakarta: PT. RajaGrafindo Persada

Beegel, J. 2014. Infographics for Dummies. New Jersey: John Wiley & Sons, Inc.

Fadliyah, Malihatul. 2019. Minat dan Hasil Belajar Mahasiswa Prodi Pendidikan Biologi Universitas Muhammadiyah Surabaya dalam Penerapan Metode Bermain Peran *(Role Playing)* pada Perkuliahan Biokimia Materi Sintesis Protein. *Jurnal Online Universitas Muhammadiyah Surabaya.*

Fitriyah, Lailatul. 2021. Spasialisasi Dalam Industri Komik Digital:Integrasi Horizontal dan Vertikal Dalam Line Webtoon. *Jurnal Ilmu Komunikasi, Masyarakat, dan Keamanan.* Vol. 3 (No.2).

Gonzalez, M.A., Martin, M.E., Liamas, C. 2015. Teaching and learning Physics with Smartphones. *Journal of Cases on Information Technology*

Hidayat, Nandang. 2019. Pengembangan Bahan Ajar Komik *Webtoon* untuk Meningkatkan Hasil Belajar Biologi Siswa SMA Kelas XI. *Prosiding Seminar Nasional Simbiosis. Vol.4*

Jang & Song. 2017. Webtoon As A New Korean Wave In The Process Of Glocalization. *Kritika Kultura. No.2. Hal 168-187.*

Nusantari, E. 2011. Analisis dan Penyebab Miskonsepsi pada Materi Genetika Buku SMA Kelas XII. *Jurnal Nasional. Gorontalo: Universitas Negeri Gorontalo*

Paivio, Allan. 2006. *Dual Coding Theory And Education*. USA: The University of Michigan School of Education

Rogozin. 2012. Physics Learning Instruments of XXI Century. *Proceedings of The World Conference on Physics Education 2012.*

Smaldino, Sharon E. 2012. *Instructional Technology & Media For Learning*. Pearson Education. Inc.

Suhermiati, Ita. 2015. Analisis Miskonsepsi Siswa Pada Materi Pokok Sintesis Protein Ditinjau Dari Hasil Belajar Biologi Siswa. *Jurnal Berkala Ilmiah Pendidikan Biologi Vol.4 No.3.*