

## THE DEVELOPMENT OF ELECTRONIC-WORKSHEETS (E-WORKSHEETS) BASED ON CROSSWORDS GAMES WITH SUB-MATERIALS OF THE EXCRETORY SYSTEM TO IMPROVE THE MOTIVATION OF HIGH SCHOOL STUDENTS

### *Pengembangan e-LKPD Berbasis Permainan Teka-Teki Silang Untuk Meningkatkan Motivasi Belajar Materi Sistem Ekskresi SMA*

**Indiarti Dwi Fina**

Undergraduate Program in Biology Education, Faculty of Mathematics and Natural Sciences, State University Of Surabaya

[indiarti.18063@mhs.unesa.ac.id](mailto:indiarti.18063@mhs.unesa.ac.id)

**Raharjo**

Undergraduate Program in Biology Education, Faculty of Mathematics and Natural Sciences, State University Of Surabaya

[raharjo@unesa.ac.id](mailto:raharjo@unesa.ac.id)

**Erlix Rakhmad Purnama**

Undergraduate Program in Biology Education, Faculty of Mathematics and Natural Sciences, State University Of Surabaya

[erlixpurnama@unesa.ac.id](mailto:erlixpurnama@unesa.ac.id)

#### **Abstract**

Education in the 4.0 industrial revolution era has a curriculum that utilizes the internet of things (IoT) as a source or media in the learning process. Learning media that support is e-worksheet with crossword games that will help students be motivated in the learning process. This study aims to develop a valid and practical e-worksheet based on crossword games with sub-materials Excretory System to improve learning motivation of students. This study is development research that uses the ASSURE model with steps: Analyze learners, State objectives, Select method, media, and materials, Utilize materials, Require learners' performance and Evaluate/Revise. The e-worksheet research trial included 20 students of XI grades from Muhammadiyah 10 Gresik. Validity was determined by material experts, media experts, and a biology teacher at SMA Muhammadiyah 10 Gresik. The practicality of the e-worksheet was determined using students' response questionnaire, students' motivation questionnaire before and after using the product, implementation of motivation, and student activities. Validity and practicality data were analyzed using the descriptive quantitative. The result showed that the developed e-worksheet obtained an average validity percentage of 98.14% with very valid criteria. The practical e-worksheet obtained 93.5% of students' responses, the increase in students' motivation improvement from 60.1% to 86.8%, and 91.67% observation motivations implementation. The data that is received shows that e-worksheet based on crossword games are very valid and practical.

**Keywords:** e-Worksheet, Crosswords, Excretory System, Motivation

#### **Abstrak**

Pendidikan era revolusi industri 4.0 memiliki sebuah kurikulum yang memanfaatkan internet of things (IoT) sebagai sumber atau media dalam pembelajaran. Media pembelajaran yang memanfaatkan teknologi salah satunya adalah e-LKPD dengan permainan teka-teki silang yang akan membantu siswa termotivasi dalam melakukan pembelajaran. Penelitian ini bertujuan mengembangkan e-LKPD berbasis teka-teki silang untuk meningkatkan motivasi belajar siswa pada materi Sistem Ekskresi yang valid dan praktis. Penelitian ini merupakan penelitian pengembangan yang menggunakan model ASSURE dengan tahap Analyze learners, State objectives, Select method, media, and materials, Utilize materials, Require learners performance dan Evaluate/Revise. Uji coba penelitian e-LKPD dilakukan pada 20 siswa kelas XI SMA Muhammadiyah 10 GKB. Validitas diperoleh dari hasil validitas ahli materi, ahli media, dan guru biologi SMA Muhammadiyah 10. Kepraktisan e-LKPD diperoleh dari angket respon, angket motivasi sebelum dan sesudah penggunaan media, keterlaksanaan motivasi, dan aktivitas siswa. Data validasi dan kepraktisan kemudian dianalisis menggunakan deskriptif kuantitatif. Hasil penelitian menunjukkan bahwa e-LKPD yang dikembangkan memperoleh persentase validitas rata-rata 98,14% dengan kriteria sangat valid. Kepraktisan e-LKPD memperoleh 93,5% respon siswa, kenaikan dari motivasi siswa 60,1% ke

86,8%, dan observasi keterlaksanaan motivasi dengan 91,67%. Hasil data yang diterima menunjukkan bahwa e-LKPD berbasis teka-teki silang memiliki kriteria valid dan praktis.

**Kata Kunci:** e-LKPD, Teka-teki silang, Sistem Ekskresi, Motivasi

## INTRODUCTION

Education in the 4.0 industrial revolution era is a phenomenon in which there is a need for the industrial revolution assistance by providing an appropriate curriculum. The changing times also affect changing simple technology into complicated and increasingly complex technology, so a technology-based curriculum is needed. The curriculum required is a curriculum that utilizes the internet of things (IoT) as a source or media in learning. The 2013 curriculum was created as a government effort for the community to achieve excellence in mastering technology. Due to the ongoing COVID-19, technological developments are urgently needed at this moment. Pandemic has made students' motivation decrease because students are required to study online. It is the same with the result of demands in the form of online learning with the occurrence of digital transformation from learning that does not require electronics to learning that relies on electronics (Iivari, 2020). The teacher must be capable of motivating students to learn with technology. Innovation in developing a media that combines text, sound, images, animation, audio, and video through links or websites in biology learning is carried out to meet the needs of students (Sadikin, 2019).

Interviews conducted with one of the biology teachers at SMA Muhammadiyah 10 Gresik revealed that online learning of sub-materials Excretory System was carried out by some applications such as Moodle, Zoom meeting, and Powerpoint for giving the materials. Students tend to be passive and unmotivated because of limited learning materials and media while online learning on Excretory System. This indicates a lack of learning resources, learning materials, and media (Asma, 2020).

Excretory System materials for high school students have descriptive knowledge that includes structure, function, procedural process, and disorders of organs related to the Excretory System (Aini, 2017). Excretory System also has a few bioprocesses that need to be learned and understood by students. The excretory system that has happened inside the body can be seen by students, this is one of the problems because they got difficulty learning. The difficulty while students learn makes their motivation decrease. The teacher needs to use media learning to help students learn better in Excretory System material. This is accurate with Qumillaila's (2017) statement a series of processes that occur in the body

makes it difficult for students to understand that a supporting tool such as technology is needed. Supporting tools that have the advantage of being able to help students motivated with pictures and videos for describing the bioprocess of the Excretory System. Learning with e-worksheet media is one of the innovations of online learning. The changing innovation or learning will help students be motivated in the learning process. The Excretory System material has several bioprocesses to be detailed or explained in easy grammar to help students understand the materials. Easy grammar tends to help students on understanding and remembering concepts of the material that are given by the teacher. The pictures and videos on the e-worksheet will help students in the process of describing the bioprocesses that occur. A good presentation of learning media is media that is systematically arranged, has an attractive visual, efficient timing is right in the learning process, and provides concepts that are easily accepted by students (Wulandari, 2018).

Crossword games as an e-worksheet innovation in evaluation activities will help students to be interested in giving the right and correct answers. The sense of satisfaction that students feel after correctly answering the question helps to improve their intrinsic motivation. Crossword games are a learning technique based on the game that has the charm that can give a sense of pleasure and can do with various variations (Ningsih, 2020). Crossword games may be utilized as educational games to help students with material stability. Stabilization means that there are repeating materials that can make an easy way for students to remember and understand the materials. It fits the characteristics of crossword games, which are easy to be remembered because they present relatively short messages (Ratnasari, 2017).

The combination of the electronic worksheet and crossword games aims to assist teachers in providing a pleasant learning atmosphere with conducive conditions. Using e-worksheet based on crossword games is rather simple using HTML5, where students can do it anywhere using a cellphone or laptop. This study was conducted to help students become motivated in learning, especially in the Excretory System sub-material, by implementing an e-worksheet based on crossword games.

**METHOD**

This study is development research using the ASSURE method that has 6 steps, there is: step Analyze learners, State objectives, Select method, media, and materials, Utilize materials, Require learner’s performance, and Evaluate/Revise.

The e-worksheet based on crossword games was tested on 20 students of XI grade Science from SMA Muhammadiyah 10 Gresik who have the same level of knowledge regarding the Excretory System material. The object of this study is an e-worksheet based on crossword games. The subjects of this study are 20 high school students in XI grade.

The development data in the form of validity and practicality of the media were reviewed with the results of validation, the results of student responses, the results of learning motivation, and the implementation of student learning motivation.

The results of the validity of the media are known by being given a validation sheet which includes aspects of presentation, content, and linguistics assessed by two expert lecturers (material experts and media experts), and a biology teacher at SMA Muhammadiyah 10 Gresik. The assessment is carried out using a Likert scale on each aspect with a score from 1 to 4 scale rubric.

Validation analysis is known by using the following formula:

$$\text{Average Score} = \frac{\text{Total score each aspect of validator}}{\text{Total validator}}$$

The media was identified as valid if the average score has  $\geq 2,51$  ( Sugiyono, 2013).

The practicality of the e-worksheet based on the crossword games was measured by the students’ response questionnaires, student motivation questionnaire, and observation sheets from learning based on motivation. The motivation questionnaire was given to 20 students before and after learning with an e-worksheet based on crossword games. Students assess each aspect with a Likert scale rating from a score of 1-5.

Practical analysis based on motivation questionnaires can be measured by the following formula:

$$\text{Percentage} = \frac{\text{Total score}}{\text{Maximum score}} \times 100\%$$

The results of the percentage of motivation questionnaire are interpreted based on **Table 1**. The e-worksheet media is identified as practical if the percentage of student motivation is  $\geq 61\%$  (Riduwan, 2016).

**Table 1.** Interpretation of students learning motivation

Percentage (%)	Criteria
0% - 20%	Very Weak
21%-40%	Weak
41%-60%	Enough
61%-80%	Strong
81%-100%	Very Strong

Students’ response questionnaires and observation sheets on the implementation of student learning motivation were carried out based on the Guttman scale. Guttman scale assessment used the criteria of “Yes” and “No” and the analysis was carried out using the following formula:

$$\text{Percentage} = \frac{\text{Total Positive score}}{\text{Maximum score}} \times 100\%$$

The response questionnaire was assessed by 20 students after learning with an e-worksheet based on crossword games learning media. The response questionnaire is identified as practical if the resulting percentage reaches  $\geq 70\%$  (Sugiyono, 2013).

The assessment of the practicality of the e-worksheet was measured based on **Table 2**.

**Table 2.** Interpretation of practical students’ response

Percentage (%)	Criteria
30-50	Less Practical
51-69	Enough Practical
70-85	Practical
86-100	Very Practical

The observation questionnaire on the implementation of students’ learning motivation was assessed by 3 observes who were assessed during the research. The media is identified as practical with a motivation implementation observation questionnaire if the percentage generated is  $\geq 70\%$  (Sugiyono, 2013). The assessment is interpreted based on **Table 3**.

**Table 3.** Interpretation of practical motivation learning

Percentage (%)	Criteria
30-50	Less Practical
51-69	Enough Practical
70-85	Practical
86-100	Very Practical

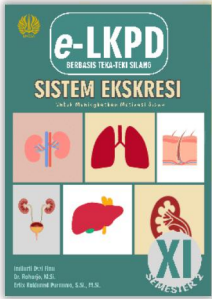

**RESULT AND DISCUSSION**




This development research aims to produce a valid and practical e-worksheet based on crossword games to increase students’ learning motivation on Excretory System material.

Learning activity with e-worksheet was innovated with crossword games intended to help motivate students in learning. The e-worksheet based on crossword games contains the main cover of the e-worksheet, sub-cover e-worksheet (*Activity I* and *Activity II*), forewords, instruction to use, indicator and purpose of learning Excretory System material, sections of e-worksheet (materials concept, *did you know* feature, and *crosswords* section), *discussion* section, and references.

The steps of making an e-worksheet have to do with an application called *Photoshop* for the design process, then save on PNG format and managed to become an electronic worksheet with the flipbook builder application. In the *Flipbook build application*, several interactive features are provided, such as attached videos, pictures, included hyperlinks to the crossword games, hyperlinks of google form that are needed for students to answer crosswords in JPG format, and hyperlinks for the answer of the discussion section. This application can make e-worksheet become a website that will help students to get easier on using them. Visuals and features of the e-worksheet are presented in **Table 4.** and also have different meanings behind it. The visual of the e-worksheet can help students' interest feelings. The features can help students to get curiosity feelings while they are in the learning process. The activities that concluded on the e-worksheet can help students to easy to learn.

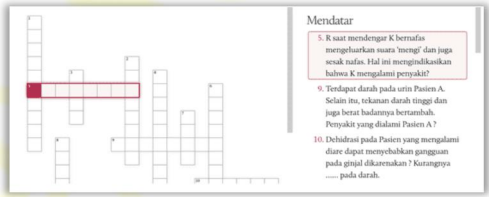

**Table 4.** The visuals and features of the e-worksheet based on crosswords

No	Visuals and Features	Description
1.		The visuals of the e-worksheet main cover were made by adding excretory system organs in the box. The square shape did represent the innovation of e-worksheet in crossword games.
2.		Materials features were written with easy language and grammar that can help students to understand the concept.

3.		The crosswords section has a link that is attached with crossword games, this aims to evaluate students about the sub-materials Excretory System.
4.		<i>Did You Know</i> feature has videos as an extra knowledge about the excretory system? Videos that were added are experiments and problems on the organ of the excretory system that can be played directly on an e-worksheet without opening another window.
5.		The discussion section has a feature that gives 3 organ excretory system problems that were common in society. A group of students was made to analyze the problems.

The crosswords of the electronic worksheet were made by an application called Eclipse crossword then managed to become a link and then added to the e-worksheet. Visuals of the crosswords have a simple and clear design that is present in **Table 5.**

**Table 5.** Visuals and features of crosswords

No	Visuals and Description	
1.		Crosswords have clear presents of numbers and questions, so it is easy for students to do work.
2.		'CEK JAWABAN' features can help students to know which answer is correct or wrong.

**Validity of e-Worksheet Based on Crosswords**

The validity of the e-worksheet was evaluated by 3 validators there is 2 validator professors and 1 biology teacher of high school. Validity of it is done to get a valid learning media for trial. Validity results from the validator also have some suggestions that the researcher can do some revisions about it.

**Table 6.** Recapitulation of revision results on e-worksheet based on crosswords

No	Suggestion	Revision Results
1.	There are a few questions of crosswords that are not enough to reach the basic competencies of the sub-materials Excretory System	The question already changed into questions that are equal to sub-materials Excretory System basic competencies.
2.	Concepts of human bioprocess of urine need to be more specific	Concepts have been written more specific, detailed, and clear than before.
3.	The number needed on the crossword games.	The number has already been added to crossword games.
4.	Needed an answer key and discussion for students	The answer key was shared with google doc after the learning process

The suggestion was given by three validators on the different aspects. The question that was not achieving basic competence or indicators of sub-materials Excretory System already changed by the researcher. The bioprocess of excretory already changed into a clear and detailed explanation. This can help students to understand the concept of the materials. The materials contain fact, concept, principle, and relevant procedures which has a systematically learning purpose regarding materials sequence that will affect learning media or products validity (Putra, 2018). Furthermore, the question with HOTS (Higher-order Thinking) or C4 cognitive level can also help students to think and resolve problems in their lives with related problems. This same as Ariyana's (2018) statement, that learning a HOTS level in it can motivate students to study the problems until they got the solution after reading the materials from pictures, videos, short descriptions, and others. The results of validity data have 9 aspects that are present in **Table 7.** as recapitulation results of validity media.

**Table 7.** Recapitulation of Media Validity

No	Evaluate Aspects	Score			Average
		V1	V2	V3	
1.	Cover Visual	4	4	4	4
2.	The Suitability Learning Purpose	4	4	4	4
3.	Understanding Writing	4	4	4	4

4.	The Presentable Instruction to Use	4	4	4	4
5.	The Suitability Pictures	4	4	4	4
6.	The Suitability Materials	3	4	4	3.7
7.	Crosswords	3	4	4	3.7
8.	Indicators matched Analyze Activity	4	4	4	4
9.	Grammar	4	4	4	4
Average					<b>3.93</b>
Category					<b>Very Valid</b>

Description:

V1: Biology Professor of UNESA

V2: Biology Professor of UNESA

V3: Biology Teacher of Highschool

The average of whole validation aspects has 3.93 which means the e-worksheet based on crossword games is very valid. This means that researchers can do trials. The validity of every aspect of the e-worksheet will helps in the trial of the research. Systematically presence of the e-worksheet must be consistent, conceptualized in the right order, and have the appropriate material concept (Khafida, 2021). In addition, several supporters of the feasibility of presenting an e-worksheet such as images, colors, layouts, and attractive designs as well as structuring the writing language were carried out to assist in increasing student interest and motivation during learning. Moreover, several supported for appropriateness of e-worksheet such as pictures, colors, layout, and attractive design also arranged writing can do as help increase students' motivation while they did learning.

The function of using an e-worksheet based on crossword games can help students to get enthusiastic about learning. The raising of students' competence will happen because there is an innovation in the game's form of crosswords (Susanti, 2020).

**Practicality of e-Worksheet Based on Crosswords**

Practical e-worksheet was reviewed by students' motivation questionnaire, students' response questionnaire, and observation from the learning motivation sheet.

**a. Learning Motivation Students**

The results of the motivation questionnaire that was given to students can be indicated as practical if the percentage measured  $\geq 61\%$ . Recapitulation results of motivation before and after students did learning with e-worksheet based on crosswords in **Table 8.** increased.

**Table 8.** Recapitulation of Motivation Students

Students	M1	Criteria	M2	Criteria
1	46	EM	84	VSM

2	84	VSM	78	SM
3	46	EM	82	VSM
4	46	EM	96	VSM
5	80	SM	100	VSM
6	60	EM	84	VSM
7	74	SM	96	VSM
8	82	VSM	82	VSM
9	40	WM	78	SM
10	72	SM	96	VSM
11	58	EM	82	VSM
12	46	EM	82	VSM
13	54	EM	86	VSM
14	70	SM	96	VSM
15	96	VSM	100	VSM
16	70	SM	96	VSM
17	46	EM	86	VSM
18	50	EM	82	VSM
19	40	WM	72	SM
20	42	EM	78	SM
<b>Average</b>	<b>60,1</b>	<b>EM</b>	<b>86,8</b>	<b>VSM</b>

Description:

- VWM : Very Weak Motivation
- WM : Weak Motivation
- EM : Enough Motivation
- SM : Strong Motivation
- VSM : Very Strong Motivation

The results motivation average before using an e-worksheet based on crosswords has 60.1% indicating that students have enough motivation to do learning. The increase did happen after learning that using an e-worksheet based on crosswords within 86.8% was a very strong motivation criterion. The improvement of students' motivation makes the media practical to be learning media to students learning with Excretory System material.

Crossword games as an innovation of e-worksheet were made to assist students in learning to be motivated. This accordance with supported statements that crosswords can give stimulation to students for being competitive to be a winner which they need to fill all squares within the right answer (Adan, 2020). Competitive feelings to be a winner can also help by motivating students to get the right answer so they can be the winner. The squares of the crossword games also can be wrong. So that, teachers can observe how many correct and wrong students answer on crosswords. The scores also can give students stimulation for being competitive in games.

### b. Students Response

The response that was given by students has a positive response. Students actively asking during the learning process using the media can be meant that they did start to get interested in the media. The results

recapitulation is displayed in **Table 9**. Which shows that an e-worksheet based on crosswords is practical.

**Table 9.** Recapitulation of Students' Response Questionnaire

No.	Aspects	Positive Response (%)	Criteria
1.	Presentment of e-Worksheet Based On Crosswords	90	Very Practical
2.	Grammar That Was Use	97.5	Very Practical
3.	Visuals of e-Worksheet	95	Very Practical
4.	Presentable Sub-materials Concept	95	Very Practical
5.	Crosswords	90	Very Practical
<b>Averages</b>		<b>93.5</b>	<b>Very Practical</b>

Based on **Table 9**. It can be indicated that the e-worksheet based on crosswords is included in the very practical within 93.5%. Students gave a few responses about how easy the e-worksheet is to use and how attractive the visual is. Media e-worksheet can help increase students learning motivation due to how e-worksheet was made; which are interesting, interactive, and easy to use (Nuzulia, 2016). The visual of the e-worksheet is cool and unique they said. It is really different from the other e-worksheet were just looking odd in the color, text style, and pictures. The text that was written about the material also helps students to get the answer to play crossword games.

The presentation of e-worksheet based on crossword games is the lowest because the times that were given when playing the crossword games do need more. Crosswords have a higher level of HOTS, which is students must give the right solution to problems and the square of crosswords can be filled in.

### c. Learning Motivation Observation

The media can be practical in learning motivation. The observation was evaluated by 3 observers, who did it during the research. **Table 10.** is presenting a recapitulation of observation results.

**Table 10.** Recapitulation of Motivation Learning Observation

No	Activity	Average	Category
1.	Students read the instruction e-worksheet based on crossword games before doing <i>Activity I</i> and <i>Activity II</i>	100	Very Practical
2.	Students were not giving up whenever there is a problem while learning	66.67	Enough Practical

3.	Students read materials concepts actively from e-worksheet based on crossword games	100	Very Practical
4.	Students pay attention to the teacher about e-worksheet based on crossword games	100	Very Practical
5.	Students study hard with e-worksheet based on crossword games	100	Very Practical
6.	Students starting to get enthusiastic about using e-worksheet based on crossword games while learning	66.67	Enough Practical
7.	Students are interested in using worksheets based on crossword games while learning	100	Very Practical
8.	The learning atmosphere is calm and structured so students can concentrate	100	Very Practical
Averages		<b>91.67</b>	<b>Very Practical</b>

The average of motivation learning observation as motivation's Uno (2010) has 91.67% with the very practical category. Motivation indicators include: the desire and urge to succeed, encouragement and need for learning, hopes and aspirations, interesting activities in learning, and a conducive learning environment (Uno, 2010). The students were doing the e-worksheet all activity which means that e-worksheet based on crossword games is very practical. The activities which got very practical are because the visual was on point, the text was written clearly, the pictures are related, and the videos that were added are new to them so they get interested in them. This meant students get helped by the visuals and features of the e-worksheet based crossword games. The characteristic of an e-worksheet can visualize the human excretory system that considered difficult because much of the theoretical and conceptual material needed to be thoroughly understood (Nisa, 2021).

There is some point where the activity got enough motivation. It might happen because the level of crossword games question needed more time to solve, but the time is limited. Recapitulation of motivation learning observation based on motivation indicators by Uno was displayed detailed in Table 11.

**Table 11.** Recapitulation Based on Motivation Indicators

No	Indicators	Question Number	Average	Category
1.	Desire and urge	1	83.33	Very

	to succeed	2		Practical
2.	Encouragement and need for learning	3 4	100	Enough Practical
3.	Hopes and aspirations	5	100	Very Practical
4.	Interesting activities in learning	6 7	83.33	Very Practical
5.	A conducive learning environment	8	100	Very Practical

The practical category indicated that students did motivate while learning. The innovation in the media within the correct learning model and students learning interests can increase students' motivation (Sugihartini, 2017). An independent urge to achieve the goal of learning makes students can do all the activities of the e-worksheet.

Innovation with crosswords inside the e-worksheet can increase motivation with features like the sub-materials concept, pictures, and videos. Crosswords can increase thinking ability, and concentration, and provide a pleasant learning atmosphere (Irma, 2020). There is an effect to increase student interest that can make ambition to have a high score. The increase in student interest is due to the student's attention to the learning.

## CLOSING

### Conclusion

This development research on e-worksheet based on crossword games obtained valid and practical based on the research's data. The results of the study conclude that e-worksheet based on crossword games can increase students' motivation while learning Excretory System material. This study concludes that e-worksheet based crossword games can be used as a learning media for Excretory System material for high school students.

### Suggestion

The use of an e-worksheet based on crossword games requires more time to work due to the cognitive level of analytical crossword questions.

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