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Research Article

Developing Media Based on the Information and Communications Technology to Improve The Effectiveness of The Direct Instruction Method in Mathematics Learning[1]

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Abstract
The research aims to develop learning media based on Information and Communications Technology (ICT) to improve the effectiveness of applying the Direct Instruction method in learning Mathematics in senior high schools in Indonesia. The designed media were modified from the Borg & Gall's Research and Development consisting of 5 steps, namely: (1) exploration studies, (2) initial product development, (3) expert validation and product revision, (4) limited field trials and product revisions, and (5) main field and final product trials. The research was started from a needs analysis of mathematics teachers to determine the subject matter, the material scope, the depth of material, the most familiar software used by teachers, and the availability of cameras. The validation was done by senior high school math teachers. The designed media covered three mathematics units, i.e. Functions, Polynomials, and Quadratic Inequality by combining the handouts and Microsoft powerpoint software. The research found that the Interactive Learning Media was validly used in learning mathematics among the senior high school involved in the recent study. There is improvement on effectiveness of applying the Interactive Learning Media in learning Mathematics. The media allowed the teachers to combine with the handouts and the powerpoint application to obtain result optimally.
Keywords:
direct instruction, handouts, interactive media.

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Introduction

Some research has shown that Information and Communications Technology (ICT) leads to the improvement of student learning and makes the teaching methods better. A report made by the National Institute of Education Multimedia in Japan (Elmo, 2017) proved that the use of ICT in the field of education through curriculum integration had significant and positive impacts on the student learning achievement, especially in terms of "understanding of knowledge", "practical skills "and "presentation skills". Teacher's performance can be improved through the leadership of principals and a conducive work environment (Hartinah et al., 2019). However, teachers in Indonesia sometimes have different perspectives on using ICT. Many mathematics teachers, for example, are reluctant to use ICT-based media in their teaching and learning process. The main reasons are because of facing troubles in preparing ICT devices, too expensive to buy, and lack of experience in using ICT tools. In addition, some observations indicate that most mathematics teachers in Indonesia use the Direct Instruction method in their teaching practices. Unfortunately, this common method used in Indonesia brings inefficient teaching such as monotone without ICT assistance, and unstructured teaching techniques and procedures.

A Direct Instruction Method refers to a teaching strategy in delivering learning materials directly and explicitly through lectures or demonstration (Howard, 2017; The Online Teacher Resource, 2017; Great Schools Partnership, 2014). Commonly, the teacher stands and presents information in front of the class. Another characteristic is that the teacher describes very clearly the teaching and learning sequences. Carnine et al (2013) asserted that the Direct Instruction method requires the teachers to carefully break down the cognitive skills into small units, which are arranged into stages and taught explicitly. This means that both teachers and students follow the well-prepared teaching and learning procedures set structurally.

According to Muijs & Reynolds (2001), the Direct Instruction method is suitable for various subjects. This is often applied in mathematics or literacy teaching (Zahriani, 2014). The use of technology in the era of 4.0 is a difficult task due to lack of resources (Syazali et al., 2019). However, this method has weaknesses, i.e. not all students have the ability to listening well to the teacher's explanation, and many students immediately feel bored and lose their concentration if the teacher talks a lot. Besides, the teachers often have any encouragement for coping the students' weaknesses.

To overcome these weaknesses, many media have been invented to make the classroom more alive. The finding of research from Ramadhani, Umam, Abdurrahman, and Syazali (2019) shown that the using of Digital-based learning with the model of Flipped-Problem Based Learning be able to improve the process of learning mathematics. The present research also takes part in developing a media used in the Mathematics classrooms in which the teachers face the weaknesses in applying the Direct Instruction Method. The media developed in the current research is a combination of ICT and handout. The use of both creates different learning and teaching environment. The students, for instance, are easily involved in the classroom discussions as they are engaged to be more active by supporting ICT and handouts in their learning process. Lestari et al. (2019) conclude that media which combine with cooperative learning application be able to increase students' interest and thinking power.

The handouts are written materials prepared by the teachers, used to facilitate the learning process and elaborate on the students' knowledge. Handouts are usually taken from various sources which are related to the materials that must be mastered by the students. The handouts, in this case, provide learning materials and information as guidance for the students (Prastowo, 2011). Steffen and Ballstaedt (in the Ministry of National Education, 2008) described that the functions of handouts include: (1) helping students not to take notes, and (2) accompanying the teacher's explanation. In some cases, the teachers prefer to distribute the handout before the teaching presentation begins so that students can take notes the handout during the lessons (The Total Communicator, 2006). Handouts can be produced by the teachers or the educational institutions. The forms and contents of the handouts are very flexible and vary from the simple to the complicated designs. However; the content of the handout commonly consist of the course descriptions, images and charts if any, assignments, and references. Thus, handouts are essential in supporting the teaching-learning process in the classrooms, especially where the Direct Instruction Method is applied.

One of the Direct Instruction method characteristics is that the learning process is carried out step by step. The process will also be well guided if the handouts are used. Unfortunately, printed handouts are sometimes boring. There should be a new environment created in the classroom. One of the ways is by attaching the ICT in the classroom, for example the use of a PowerPoint. PowerPoint is one of Microsoft Office software programs for supporting presentations. PowerPoint uses a graphical approach in slides accompanying the oral presentation (Russel, 2017). Supported by this kind of software, the teachers may transform their printed handouts into slides forms. In doing so, a phone camera is useful in capturing objects needed for the slide handouts. The current study aims to develop and validates an interactive ICT-based learning media for Mathematics senior high school classes in Indonesia.

Method

The research applied a development method research aiming to develop and validate products used in education and learning. The product developed in this research is ICT-based media.

Participants

The present research trials took place in two senior high schools in Yogyakarta, Indonesia. The schools are Minggir Senior High Schools and Taman Madya Senior High Schools. This study is collaborative research involving three mathematics undergraduate thesis. The topics are Functions (Saputri, 2017), Polynomials (Febriantari, 2017), and Quadratic Equations (Endarwati, 2017). From the three research, the researcher did a needs analysis which includes interviews to gain information about the teachers, the use of computer-based media, the most familiar computer applications used, the habit of making handouts, the availability of LCDs in class, and the ownership of phones camera.

Data Collection

The current research follows the development research design of Borg & Gall (2003) which consists of 5 steps.

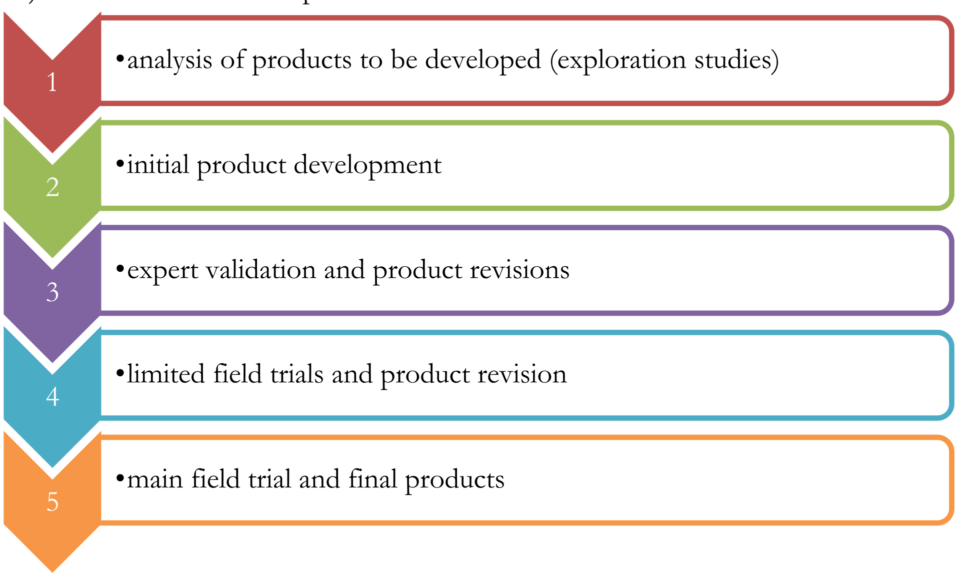


Figure 1.
Research Steps

During these stages, the qualitative and quantitative data were taken from the product validation questionnaire, product trials questionnaire, and interviews. The validation questionnaire and the trial questionnaire were filled by the product validators and the students respectively. The questionnaires were using the 1-4

Likert scales with scale 1 was the lowest. Meanwhile, the interview with the students was set as a short interview.

Data Analysis

The gained data were analyzed descriptive quantitatively using the Ideal Mean formula and Ideal Deviation Standard.

$$\text{Ideal Mean (M)} = \frac{highest\ score + lowest\ score}{2}$$

$$\text{Ideal SD (SD)} = \frac{highest\ score - lowest\ score}{6}$$

The highest score achieved by the research was 4, and the lowest score was 1. The criteria and value limits are presented in Table 1

Table 1.
Criteria and Score Limit

Very valid	$\bar{X} > M + 1,8SD$
Valid	$M + 0,6SD < \bar{X} \leq M + 1,8SD$
Less Valid	$M - 0,6SD < \bar{X} \leq M + 0,6SD$
Not Valid	$M - 1,8SD < \bar{X} \leq M - 0,6SD$
Not Valid at All	$\bar{X} \leq M - 1,8SD$

$\bar{X}$ **: Average score, SD: Ideal Deviation Standard, M: ideal score.**

Results

The current collaborative research on ICT-based learning media involved three mini research on ICT media of Functions, Polynomials, and Quadratic Inequality. Here are the examples are taken from the three research with the topics of Function, Polynomial, and Quadratic Equations.

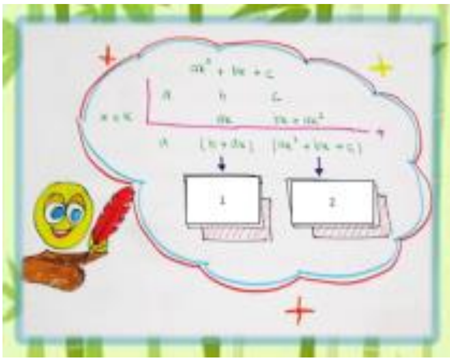
The examples of interface media on the topic of Function is presented in Picture 1 and Picture 2.

Picture 1. The interface of Function material (function score) with the question marks boxes.

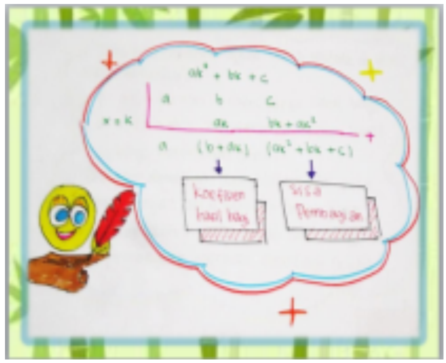
Picture 2. The interface of Function material (function score) without the question marks boxes.

Both pictures were similar. In Picture 1, there were four question marks (?) boxes. These marks disappeared and displayed numbers or words as the answers of the questions as seen in Picture 2 when the mouse was clicked. Procedurally, the teacher showed the second picture after the students did the exercises. For knowing the answer to the first question box, the teacher clicked once. Then, the second answer appeared after the first question was shown. This means that the teacher clicked twice for reading the answer to the second question. This process shows that the media are interactive.

The examples of interface media for the topic of Polynomials is presented in Picture 3 and Picture 4.



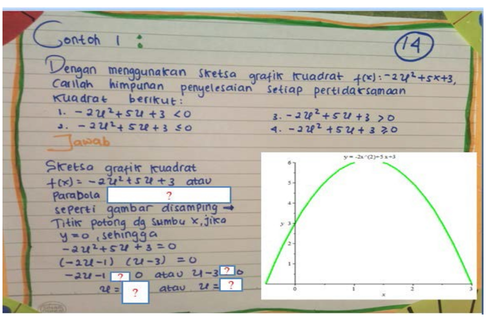
Picture 3. The interface of Polynomials case with the questions marks boxes



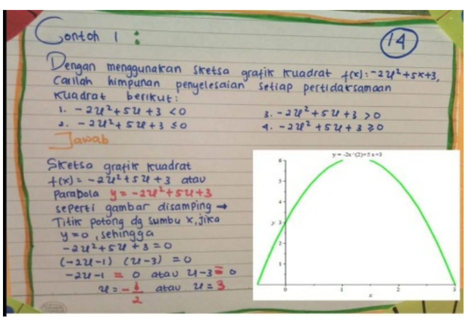
Picture 4. The interface of Polynomials with the information boxes

Similarly to the Function pictures, picture 3 displayed question marks boxes while picture 4 showed the information required in Picture 3 by clicking the mouse twice.

The examples of interface media for the Quadratic Inequality Functions are shown in Picture 5 and 6.



Picture 5. The interface of Quadratic Inequality Function with the question marks boxes.



Picture 6. The interface of Quadratic Inequality Function without the question marks boxes.

The procedure used in the Quadratic Inequality Functions teaching was also the same as the two previous ones. Picture 5 consisted of 5 five rectangles with questions marks boxes showing five questions that the students should answer. Meanwhile, Picture 6 showed complete answers from Picture 5.

The three created media above have been validated by two experts each. The validators were the Mathematics teachers from the schools where the research trials were conducted. A summary of the validation results was presented in Table 2.

Table 2.
The Summary of Validation Results

Media Aspect	**Average Score**		
	The topic of Functions	The topic of Polynomials	The topic of Quadratic Inequality
Content Feasibility	3,75 (VV)	3,8 (VV)	3,7 (VV)
Presentation Feasibility	3,75 (VV)	3,69 (VV)	3,5 (VV)
Instructional Feasibility	4 (VV)	3,75 (VV)	4 (VV)
Media General Design	3,8 (VV)	3,6 (VV)	3,6 (VV)
Media Content Design	4 (VV)	3,5 (VV)	3,25 (V)
Notes: **VV: Very Valid, V: Valid.**			

From the table above, it can be seen that there were five aspects used for validating the media namely content feasibility, presentation feasibility, instructional feasibility, media general design, and media content design. The validation results among media of the three Mathematics topics showed that all aspects were very valid except the media content design aspect of the Quadratic Inequality with 3.25 points depicted as valid. This means that the designed media were very feasible because the VV (Very Valid) value was obtained. Table 2 also shows that the designed media were also very feasible to use because the VG (Very Good) value is obtained. In terms of good media aspects, the media are feasible because they have fulfilled all five validity aspects required.

Besides validating the media, the experts in this research also did evaluation and revision before the media trials. The three media were preliminarily tried out to 10 students consisting of 3 students with high academic abilities, 4 students with moderate academic abilities, and 3 students with low academic ability. The aim was to get inputs from various levels of academic abilities. These inputs have been used to revise the product before the main trial was carried out. The summary of the trials was presented in Table 3.

Table 3.
The Summary of the Trials

No	Topic	Average Score	Category	Items with score 2 (two) (poor category)
1	Function	3,55	Very good	1. The writing on the media is clearly read (item 5) 2. The media facilitate understanding (item 6) 3. Simple sentence (item 9) 4. The words used are easy to understand (item 10)
2	Polynomials	3,66	Very good	1. The writing on the media is clearly read (item 5) 2. The media facilitate understanding (item 6) 3. The words used are easy to understand (item 10)
3	Quadratic Inequality	3,71	Very good	1. The media facilitate understanding (item 6) 2. The words used are easy to understand (item 10)

Based on Table 2, it is concluded that the media are categorized as very good. The three media designed were categorized very good with the average score of 3.55 (Functions), 3.66 (Polynomials), and 3.71 (Quadratic Inequality). However, there are a number of statements that need to be considered because the score was two (poor category) as shown in column 5.

Discussions

The Direct Instruction method is often used in Mathematics (Muijs & Reynolds (2001). According to Carnine et al (2013), a Direct Instruction is teaching which emphasizes on the face to face meeting between the teacher and students. During the teaching process, the materials are broken down into small units arranged into stages and taught explicitly. The developed media in the present study covered all aspects above. First, the media contained teaching and learning materials into small units. Second, the media allowed both teacher and students follow the sequence teaching and learning materials. In explaining the Quadratic Inequality Functions case, for instance, the teacher showed how to execute a mathematics case into five steps which were recognized from the number of question mark boxes as shown in Picture 5. These five steps were set in sequence. This means that the later boxes were clicked after the formers. Third, as a result of the sequence material displayed, the teacher delivered the materials explicitly. For example, in explaining one of the Polynomials formulas as seen in Picture 3, the teacher summarized and stressed the points on the boxes shown. In this case, the teacher did not need to write on the board again but fully focused on engaging and teaching the students explicitly. The most appropriate way if we want students to learn something is to convey it to them explicitly and directly (Kuhn, 2007; Nyutu, Cobern, & Pleasants, 2018).

Direct Instruction in mathematics is also designed to develop and maintain knowledge, and application of skills and concepts (Przychodzin et al, 2004). The designed interactive learning media in this current study have fulfilled the validity aspects i.e. content feasibility, presentation feasibility, and instructional feasibility.

Regarding the content feasibility, the teaching and learning materials included in the designed media have fulfilled the core competencies, and basic competencies derived from the senior high school curriculum in Indonesia. From Picture 5, for example, the media showed the example of a quadratic inequality existed in the grade X of the senior high schools. By displaying the content of the mathematics handouts into powerpoint slides, the students gave more attention to the teaching and learning process in the classroom. They were pushed to follow each step in understanding and executing the mathematics cases through the media shown by the teachers. In other words, the existence of ICT in the classroom supports the students in improving their understanding. This is in line with the study of Yumusak, Maras, & Sahin (2015) that ICT can cause improvement in the students' learning processes and make teaching methods more effective. The effectiveness of the teaching and learning process using Direct Instruction cannot be separated from the students' academic achievement (Al-Zoubi & Al-Adawi, 2019). In fact, the Direct Instruction method is not only suitable for the mathematics subject but also appropriate to all subjects (İlik & Sari, 2016). This leads to the understanding that Direct Instruction has proven to be very effective for a variety of content and with diverse students (Watkins & Slocum, 2003;Burden & Byrd, 2003).

The second validity aspect fulfilled in the current study is presentation feasibility. The presentation feasibility can be seen from the existence of the question mark boxes on the powerpoint slides. The number of these boxes vary depending on the teaching and learning materials discussed. In the Functions topic shown in Picture 1, for instance, there were four boxes. While in the Polynomials and the Quadratic Inequality Functions, there were two and five boxes respectively. Each box requires the mathematics case result or information after the teacher click it. Before doing so, the teacher gave descriptions, then invited the students to be active by giving the case result which was discussed or guessing the information requested. Billingsley, Thomas, & Webber (2018) investigated the effects of direct teaching, computer-assisted instruction (CAI), and a combination of both.The study showed the unique contributions of direct teaching and CAI toward the secondary mathematics learning; however, not all the Direct Instruction lessons began with skill descriptions as some the Direct Instruction lessons did not involve skills. Davis' research (2018) on the interpretation of direct instructions revealed a variety of class phenomena. In this case, we should not assume that students will never learn from the extreme models of direct teaching or that no relationship is made in a student's mind unless the teacher explicitly wants it. Therefore, the direct instruction model suggests that important content must be exposed to the students through active information presentations (Huitt, Monetti, & Hummel, 2009).

The third aspect of the present media validity is instructional feasibility. The instructional feasibility of the designed media can be seen from the media ease-of-use. The teachers simply click the mouse to reveal the mathematics case result or information from the former question mark boxes to the later boxes. Direct instruction is also proven to be more effective than multimedia instruction (Azimigaroosi, Zhiean, & Farahmand, 2015). This means that the roles of teachers in delivering the materials are very essential. The teachers monitor the students' understanding and provide necessary feedback to students about their performance (Rüütmann & Kipper, 2011). The students who are treated with the direct learning strategies also show significant performance in cognitive learning outcomes (Buchori et al, 2017).

Though the application of the Direct Instruction Method is used widely in various learning subjects and brings more positive impacts on the students' learning achievement, the characteristics of direct instruction are criticized and discussed to identify implications for teaching and learning mathematics. Ewing (2011) criticizes the mathematics-based direct instruction. In a didactic teaching style, mathematical knowledge is transmitted to the class with minimal or no discussion. The teacher is the owner of authoritative knowledge, and students are passive recipients of the knowledge. Commonly, the knowledge is instilled by exercises provided in the textbooks and worksheets. The use of the textbook is a source of the further reliable knowledge and further inhibits to the active involvement of students in understanding mathematics.

Conclusions

Attaching the interactive learning media in the Mathematics teaching and learning processes require some validity aspects namely content feasibility, presentation feasibility, instructional feasibility, media general design, and media content design in order to fit it to both teacher and students' needs. The present study on the Interactive Learning Media covering Functions, Polynomials, and Quadratic Inequality Functions by combining the handout and ICT fulfilled these all requirements with a very good validity. The media allowed the teachers to combine the handouts and the powerpoint application which are familiar among teachers. Therefore, the ICT-based learning media designed in the current study is validly applied in the Mathematic teaching and learning process among some senior high schools in Indonesia.

Due to the fast development of teaching and learning media, it would be very challenging for another researcher in doing further research with the present research as the bedrock idea. Here are several recommended research topics; creating interactive learning media in other subjects, students' assignments on creating learning media, testing the effectiveness of the developed media, and training the teachers in creating learning media.

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References

Al-Zoubi, S. & Al-Adawi. F. (2019). Effects of instructional activities based on Multiple Intelligences Theory on academic achievement of Omani students with dyscalculia. *Journal for the Education of Gifted Young Scientists*, 7(*1*), 1-25.

Azimigaroosi, S., Zhiean, F., & Farahmand, H. (2015). On the comparison of the effectiveness of direct instruction method and multimedia instruction on students suffering from special learning disorder along with defects in dictation. *International Letters of Social and Humanistic Sciences*, 62, 8-15.

Billingsley, G.M., Cathy N. Thomas, C.N. and Webber, J.A. (2018). Effects of Student Choice of Instructional Method on the Learning Outcomes of Students with Comorbid Learning and Emotional/Behavioral Disabilities. *Learning Disability Quarterly*. 00(0). 1-14.

Borg, W R & Gall, M D. (2003). *Educational Research: an Introduction* (7th ed).New York: Logman Inc.

Buchori, A., Setyosari, P., Dasna, I.W., Ulfa, S., Degeng, I.W.S, & Sa'dijah, C. (2017). Effectiveness of Direct Instruction Learning Strategy Assisted by Mobile Augmented Reality and Achievement Motivation on Students Cognitive Learning Results. *Asian Social Science*. 13 (9). 137-144.

Burden.P.R. and Byrd. D. M.(2003). *Method for Effective Teaching*. Pearson Education, USA

Carnine, J.D.W., Silbert, E.J., Kame'enui, and Tarve, S. G. (2017). *What is Direct Instruction?* Pearson Allyn Bacon Prentice Hall.

Davis, A. (2018). Evidence-based approaches to education: Direct instruction, anyone?. Management in Education. XX(X). 1-4.

Elmo. (2017). *The Global Leader in Visualiser: Let's start ICT in Education with Elmo Class Room.* http://www.elmoglobal.com/en/html/ict/01.aspx.

Endarwati. E. (2017). Pengembangan Perangkat Pembelajaran Model Direct Instruction Berbasis Komputer dan Foto Handbook Pokok Bahasan Pertidaksamaan Kuadrat untuk SMA. *Skripsi*. Yogyakarta: Universitas Sarjanawiyata Tamansiswa.

Ewing, B. (2011). Direct Instruction In Mathematics: Issues For Schools With High Indigenous Enrolments: A Literature Review. *Australian Journal of Teacher Education*, 36(5). 65-92.

Febriantari, A.T. (2017). Pengembangan Perangkat Pembelajaran Model Direct Instruction Berbasis Komputer dan Foto Handbook Pokok Bahasan Suku Banyak untuk SMA. *Skripsi*. Yogyakarta: Universitas Sarjanawiyata Tamansiswa.

Great Schools Partnership. (2014). *Direct Instruction. The Glossary of Education Reform. Commons Attribution-Non-Commercial-Share Alike 4.0 International License.* http://edglossary.org/direct-instruction/ (retrieved 16 Pebruari 2017).

Hartinah, S., Suharso, P., Umam, R., Syazali, M., Lestari, B., Roslina, R & Jermsittiparsert, K. (2019). Teacher's performance management: The role of principal's leadership, work environment and motivation in Tegal City, Indonesia. *Management Science Letters*, 10(1), 235-246.

Howard, M. (2017). *Direct Instruction Teaching Method: Definition, Examples & Strategies.* http://study.com/academy/lesson/direct-instruction-teaching-method. (Retrieved 16 Pebruari 2017).

Huitt, W., Monetti, D., & Hummel, J. (2009). Designing direct instruction. Pre-publication version of chapter published in C. Reigeluth and A. Carr-Chellman, *Instructional-design theories and models: Volume III, Building a common knowledgebase* [73-97].

Kuhn, D. (2007). Is Direct Instruction an Answer to the Right Question?.*Educational Psychologist,* 42(2), 109–113.

Lestari, F., Saryantono, B., Syazali, M., Saregar, A., Madiyo, Durrul Jauhariyah, D., and Umam, R. (2019). Cooperative Learning Application with the Method of" Network Tree Concept Map": Based on Japanese Learning System Approach. *Journal for the Education of Gifted Young Scientists.* 7(1), 15-32

Nyutu, E. N., Cobern, W. W., & Pleasants, B. A. S. (2019). Student engagement indirect instruction, undergraduate microbiology laboratories. *Journal of Biological Education,* 53(3), 250–264.

Muijs, D., and Reynolds. D. (2001). *Effective Teaching: Evidence and Practice*. London: PCP.

Przychodzin, A. M., Marchand-martella, N. E., Martella, R. C., & Azim, D. (2002). Mathematics Program: An Overview and, Research Summary. *Journal of Direct Instruction.* 4(1), 53–84.

Ramadhani, R , Umam, R , Abdurrahman, A , Syazali, M . (2019). The Effect of Flipped-Problem Based Learning Model Integrated With LMS-Google Classroom for Senior High School Students. Journal for the Education of Gifted Young Scientists, 7 (2) , 137-158 . DOI: 10.17478/jegys.548350

Ruseel, Wendy. (2017). *Beginner's Guide to PowerPoint 2010.* https://www. thoughtco.com/how-do-i-use-powerpoint-2767371. (Retrieved 16 Pebruari 2017).

Rüütmann, T., and Kipper, H. (2011). Teaching Strategies for Direct and Indirect Instruction in Teaching Engineering. *iJEP*. 1(3). 37-44.

Saputri, D.H. (2017). Pengembangan Perangkat Pembelajaran Model Direct Instruction Berbasis Komputer dan Foto Handbook Pokok Bahasan Fungsi untuk SMA. *Skripsi.* Yogyakarta: Universitas Sarjanawiyata Tamansiswa.

Syazali, M., Putra, F., Rinaldi, A., Utami, L., Widayanti, W., Umam, R & Jermsittiparsert, K. (2019). Partial correlation analysis using multiple linear regression: Impact on the business environment of digital marketing interest in the era of industrial revolution 4.0. *Management Science Letters*, 9 (11), 1875-1886.

The Online Teacher Resource. (2017). *What is Direct Instruction?* http://www.teach-nology.com/teachers/methods/models/direct/.(Retrieved 16 Pebruari 2017).

Total Communicator. (2006). Volume IV, Issue 1, January. http:// totalcommunicator.com /vol41/handouts.html.

Watkins, C. L., & Slocum, T. A. (2004). The Components of Direct Instruction. *Journal of Direct Instruction*, 3(2), 75–110.

Yumusak, A., Maras, I., & Sahin, M. (2015). Effects of Computer-Assisted Instruction with Conceptual Change Texts on Removing the Misconceptions of Radioactivity. *Journal for the Education of Gifted Young Scientists*, 3(2), 23-50.

Zahriani. (2014).Kontektualisasi Direct Instruction Dalam Pembelajaran Sains. *Lantanida Journal,* 1(1). 95-106