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INTEGRATED SCIENCE DIGITAL MODULE BASED ON SCIENTIFIC LITERACY: ANALYZING TECHNOLOGICAL CONTENT KNOWLEDGE (TCK) SKILLS IN INDUSTRY REVOLUTION 4.0 ERA

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Abstract

The Industrial revolution 4.0 era has changed the view of educational model focus, where the old literacy knowledge (reading, writing, and mathematic) is not enough to be modal in a society. Curriculum reorientation is needed as new literacy so it keeps to be existed in that era. This research aims to understand validity and reading level of Integrated Sciences digital module based on scientific literacy students, and to analyze TCK skills of students after using digital module. This research use R & D method with subject of 44 science teacher candidate. Validating was done by expert validator. Reading level uses the result of scale test. TCK analyzed with descriptive percentage. Research showed there is acceptance using of Integrated Sciences digital module with reading level in intermediate level (51,90%) and validity is high (81,25%). TCK was analyzed with likert type scale in a enough criteria due to use of digital module. It is concluded that Integrated Science digital module based on scientific literacy can be used as learning module. Development of other digital module needs supporting from high institution so that it can hold on industry revolution 4.0 era.

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INTRODUCTION

Shahroom & Hussin (2018) stated that The fourth Industrial Revolution (IR) has changed the landscape of educational innovation, where quick revolution in innovation has delivered another model of education for the future, expecially for higher education. The use of communication and technology according to Burhan et al (2016) had an important role, it included in education system, it could be seen from the change of life characteristic in 21 century. Hussin (2018) explains that education 4.0 is a response to the needs of IR 4.0 where human and techology are aligned to enable new possiblities. Thus according to Afrianto (2018) the principle of IR 4.0 can be described as follows Figure 1.

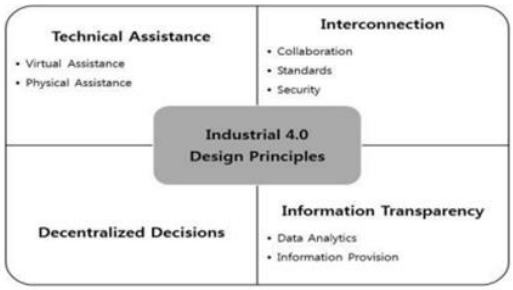

Figure 1. Principles of IR 4.0

Hermann et al (2016) similarly explains that, there is four principle designs of IR 4.0. First, an interconnection, second is information transparency. Third, the availability of various technical assistance, and the fourth, decentralized decicions which are the ability of the virtual physical system. Thus, the four designs of IR 4.0 can be supporting literacy culture.

Indonesia as a big country should be able to develop literacy culture as requirement for life skills in 21 century with integrated education, start from family, school and then society. Thus refers to Subekt et al (2018), in the global competition of information technology development, compete effort of nation can be enhanced by motivating from high institution. The goals of integrated technology in education mainly from curriculum content, learning process, and using technology in applying educating.

The survey result of scientific literacy from OECD, PISA (2015), Indonesia increased the position that at early the second level from bottom, it is now in the sixth level from bottom, but the upgrading this level was under average of OECD countries, it was 493. Fatkhurrohman & Astuti (2016) state that as science teacher candidates, the quality of science students must be prepared from the beginning of lectures to be professional teacher who are excellent in scientific literacy. The result in Integrated Science lectures year 2016/ 2017 showed that the scientific literacy application of students was less. Rusilowati (2013) explain that the lack of scientific literacy application, because there were unbalanced in some aspects of scientific literacy in learning material books. Based on research conducted by Hayati (2017), the result competence of chemical literacy from the science teacher candidate students was far from expectation, it was showed from nominal literacy of 56.64%, functional literacy of 26.40%, conceptual literacy of 61.50%, and multidimensional literacy of 50.20%. We can drawn conclusion from the research conducted by Fathurrohman (2016) and Hayati (2017) that our science teacher candidates is still far from expectation of scientific literacy.

A complex knowledge planning was needed, it is known as *Technological Pedagogical Content Knowledge* refers to Harris (2011); Mishra (2006); Tomshon (2007)—a total package from technologies, pedagogic, contents, and context knowledge skills (TPCK). Suryawati (2014) reveal that TPCK was viewed as conceptual design that showed the relation of three knowledge that must be own for teachers, they were technology, pedagogic and content. Figure 2 showed the relation beetween sub domain of TPCK.

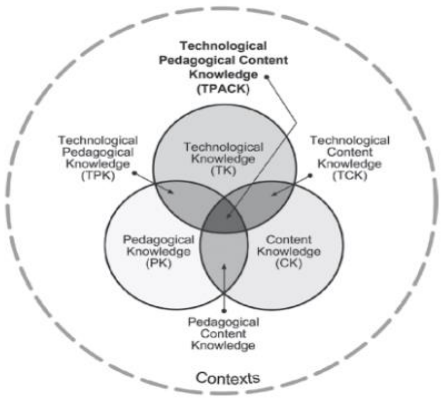

Figure 2. Technological Pedagogical Content Knowledge (Harris (2011; Koehler(2014)

Picture beside shows that there are 7 relation sub domain of TPCK, they are: TK (Technological Knowledge), CK (Content Knowledge), PK (Pedagogical Knowledge), TCK (Technological Content Knowledge), PCK (Pedagogical Content Knowledge), TPK

(Technological Pedagogical Knowledge), dan TPCK (Technological Pedagogical Content Knowledge).

Based on figure 2, there are four important parts that will be discussed in this scope research, they are: PCK (Pedagogical Content Knowledge) or pedagogic knowledge in specific contents of learning, TPK (Technological Pedagogical Knowledge) or how to use kinds of learning media, TCK (Technological Content Knowledge) or relation of feeding back between technology and contents, and TPCK (Technological Pedagogical Content Knowledge). The definition of TCK according to Cox (2009) was the knowledge about how to use technology to find and create contents in all the way without considering in teaching.

Fitriani (2017) explain that TPCK was the knowledge about how to facilitate students learning from certain contents with pedagogic and technology approach. One of the applications of TPCK in lectures is using technology to transfer material in learning process, it is using Integrated Science Digital Module based on scientific literacy.

We know that module is divided to two categories, they are print out module and digital module. The advantage of digital module was able to display some materials with interactive learning media. It is in line with the statements of the research results conducted by Irwandani (2017); Sugianto (2013); Suwindra (2012)).

From the observation that, the problems of this research are: the usage of internet technology hasn't been optimally, hasn't been available digital module in Integrated Science lectures, been less of scientific literacy application, and been less balance of indicators in the scientific literacy material book.. Likewise, there has been no previous research that discussed the Development of Integrated Science digital module based on scientific literacy to enhance Technological, Content, Kowledge (TCK) skills to this Industri Revolution Era 4.0. This research is expected to be the solution of the problems.

METHODS

A research and development (R & D) methods was used as methodology, in Figure 3. The step of research was showed in this Figure 3 below which is begin with necessity analyze, instruments development, making of Integrated Sciences digital module based on scientific literacy, product validity, evaluation and improvement, trying out of product. Digital module trials as a product are carried out on a limited scale.

The Research subject was students of science study program fourth semester year 2017/2018, include 44 students. Research was done in classroom of Universitas Pancasakti. Limited trials of module is for 10 students, and large scale trying out is for 34 students. Data collecting is got from angket and instrument test of TCK are for 34 students semester IV.

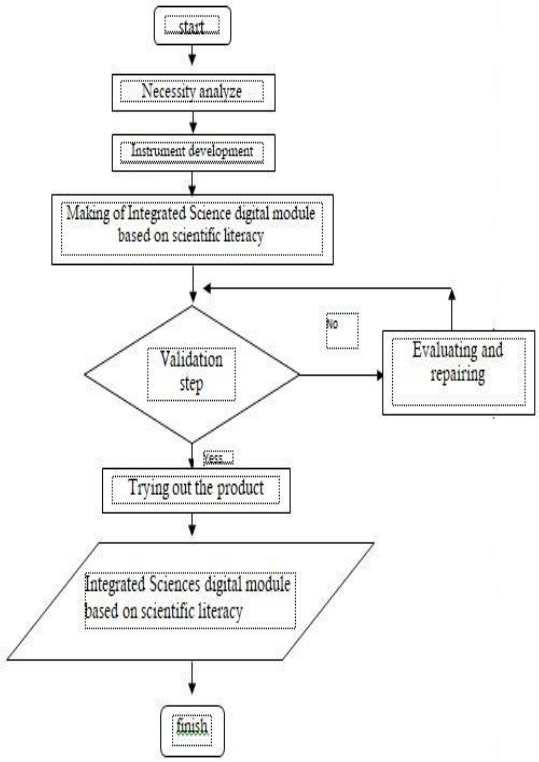

Figure 3. Research design Flowchart desain and Integrated Science digital module based on scientific literacy (modification from Sadiman dkk, 1996).

The first research is begun with necessity analyze based on TPCK instruments, includes: Technological Knowledge (TK) angket, Pedagogical Knowledge (PK), Content Knowledge (CK). Then, being been done with module development with analyzing of validity and reading level. There are eight aspects for validity of this digital module, they are: contents, rational, characteristic, curriculum appropriate, languages, displays, and flexibility. Each aspect given minimal score of 1 and maximal score of 4, the range of evaluation category in validity can be seen in Table 1.

Table 1. Evaluation scale digital module

No	Criteria Table 1	Recommendation	Scores
1	The highest validity	Usable without revisions	V>28
2	High validity	Usable with few revisions	23<V<28
3	Intermediete validity	Usable with many revisions	13<V<23
4	Low validity	unusable	V<13

TCK data analyze uses kuesioner with 5 point likert type scale: 1= no knowledge; 2= little knowledge; 3= moderate knowledge; 4= quite knowledge; and 5= complete knowledge.

The instrument was adopted from TPCK instrument for 21st century skill with the following table below.

Table 2. Criteria interval value

Interval Values	Criteria
>4.20 – 5.00	Very Good
>3.40 – 4.20	Good
>2.60 – 3.40	Enough
>1.80 – 2.60	Less
>1.00 – 1.80	Very Less

[(Riandi (2018) in Suryawati (2014)]

Integrated Science digital module based on scientific literacy is called valid if it is in the minimal range of high validity more than 23. Then, reading level is also analyzed to understand how far this digital module can be used to readers. Reading level technic for digital module can be calculated as Sudijono (2008):

$P=f/N\times100\%$

noted:

P = evaluation percentage

f = score of students

N = all scores

RESULTS AND DISCUSSION

Validation integrated science digital module was conducted by four experts; material experts, media experts, lecturer, and science teacher. This reserach developed Integrated Science digital module based on scientific literacy with themes of Energy, Environment and Pollution. This modul could be accessed at www.ipaterpadu.com.

Module validity result: average score of validity 26, it is include in high validity category so that digital module is acceptable to be used.

The rekapitulation value from module validator showed on the table 2 below.

Table 2. rekapitulation value module validator

No	Aspect	Values			
		I	II	III	IV
1	Objectives	4	3	3	4
2	Rational	3	4	3	3
3	Module contents	3	3	2	4
4	Module Characteristic based on scientific literacy	2	3	3	3
5	curriculum appropriate	3	4	3	4
6	Languages	3	4	3	4
7	Displays	2	4	3	4
8	Flexibility	3	4	2	4
	Total	23	29	22	30
	Average	26			
	Category	High validity			

The contents in this digital modul consisted of four scientific literacy aspects, they are sciences as a body of knowledge, sciences as the way of investigating, sciences as the way of thingking, and sciences as interaction of science, technology, and society. The characteristic of this developing digital module have these four aspects with ratio of 1:1:1:1.

Reading level test uses random test by erasing the tenth word from module, showed table 3.

Table 3. Recapitulation of reading level test result

No	Description	Scores
1	Minimal score	45%
2	Maximal score	62%
3	average	51.9%

Measuring the level of readability module, uses hitch test. According to Bermouth in Widodo (1993), the criteria limit in interpreting the results of the hitch test is for the lower limit of 37%, the upper limit of 57% and the midpoint of 47%. If the students test results score less than 37% then the digital module is difficult to understand or the level of readability is low. If the score obtained is more than or equal to 57% then

the level of redability is high. From the table above (table 3) showed that the average score was 51,9%, which means in intermediate level, or the module was easy to be understood.

Masitoh (2018) stated that many learning terminologies appear to agree with technology development, some of them are *e-learning, online learning, web based training, online courses, web based education* etc. Digital module can be meant material which used in *e-learning*. Module was learning material that consist of arranged contents systematically guide students to learn by themselves and assessment form lectures, besides there were coherent learning experiences explicitly with learning outcome and assignment. According to Matanluk (2013) module usage implementation the learning process could enhance thinking ability and active participating on exploring knowledge, Module can be printing out media or arranged with software. Digital module is known as online learning module, it is usually used in the e-learning model. So, this digital module is only able to be accessed online with certain website.

The integrated digital science module contains scientific literacy content, while, the indicators of scientific literacy (8) that would be developed in this Integrated Science digital module are: (a) identification of sciences concept and its application in daily life; (b) sciences inquiry process; (c) sciences understanding; (d) relation of sciences, technology and society knowledge.

Based on Technological Content Knowledge (TCK) analysis, the score TCK after treatment, showed on the table below.

Table 4. The score of TCK after treatment

No	Items	Mean	Criteria
1	I know the application of digital module can help understanding contents, law, and theory in Integrated Sciences	2.67	enough
2	I know the ICT applications used by in integrated science module material	2.90	enough
3	I know the ICT applications that I can use for a better understanding of the content of the integrated science material	3.00	enough
4	I know the technology I can use in facing the difficult content in integrated science	2.90	enough
5	I know about technologies that I can use for understanding integrated science material	2.90	enough
	Average total	2,87	enough

The mean score of TCK science teacher candidates was on enough criteria. The science teacher candidates need to know not only the material they have, but also the material which related to be changed by technology applications. It means according to Schmidt (2009), not all topics was suitable with the technology.

The science teacher candidates TCK profile, can be showed in this following Table 5.

Table 5. TCK profile Science teacher candidate

No	Items	Percentage (%)	Criteria
1	Application of digital module to help understanding contents, law, and theory in Integrated Sciences	86%	Good
2	Understanding the application of digital module related to Integrated Sciences	80%	Good
3	Developing using technology to do activity and students assignment	84%	Good

The table showed that the Integrated science module help them (science teacher candidates) to improved their Technological Content Knowledge. Based on Celik (2014) statement that TCK hels teachers create examples and cases where technology can be effectively integrated into their teaching.

CONCLUSION

From discussion above, it can be concluded that: module validity result: average score of validity 26, it is include in high validity category so that digital module is acceptable to be used; reading level result: From random test in this research get 51.9 % which has the meaning that module has easy to be understood; and the score of TCK science teacher candidates after treatment was in enough criteria.

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