Students' learning performance and communication skill using REACT-based tutorial worksheet on Statistics

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Abstract. Universitas Terbuka (UT) students are expected to show good learning performance and good communication skill. Good learning performance can be shown if students were able to construct their understanding comprehensively, while good communication skill can be achieved if students were fostered to communicate their thought whether verbally or through writings. This research was aimed to describe the learning performance and communication skill of UT students on the Statistic Education subject through REACT (Relating, Experiencing, Applying, Cooperating, and Transferring) worksheet based tutorial. Subjects of the research were 71 Statistic Education students in UT which 15 students were from Purwodadi Study Group of UT Malang, 39 students from Bondowoso Study Group of UT Surabaya and 17 students were from Mojokerjo Study Group of UT Surabaya. The instruments used were I, II, III assignment; final exams; REACT-based worksheet; observation sheet; and questionnaire response. The result of the research showed that students got 89.0 average scores, and the percentage of students which got A, B, and C were 39.5%; 38.0%; and 22.5% respectively. Students were also shown the ability to communicate their thought well whether verbally or through writings.

1. Introduction

One subject which students are obligated to take in Primary Teacher Education Program (PGSD) in Universitas Terbuka (UT) is Statistic Education. Statistic Education subject discusses basics of statistic, data presentation in the form of tables and diagrams, measurement of centralization, location, and dispersion, also slopes and spikes measurement, normal distribution and its implementation, hypothesis examination, regression analysis and correlation.

It can be seen from the materials that learning Statistic Education demands the students to achieve certain specification, which is knowledge about data that have been seen daily, algebra and logarithm operations. Those specifications are found to be hard for PGSD-UT students which are also primary teachers. A subject which is considered hard to learn could lower the students' motivation to study. The low motivation to study could make the student become lazy to learn the module, do the assignments in the module and finish the tutorial assignments independently. This attitude can impact to low learning performances in the subject.

The problem mentioned above need to be solved so that students will have better learning performance and systematic mathematic communication. One of the solutions is for tutor to use learning instruments which can help them to better understand the materials in Statistic Education principal materials books. The learning instruments could be in the form of REACT (Relating, Experiencing, Applying, Cooperating, and Transferring) based worksheets. The strategy was firstly discovered by the Center of Occupational Research and Development [1]. There are some benefits in using this strategy for learning, which are (a) it could motivate students in learning, (b) improve students learning performance, (c) foster students to have comprehensive understanding and the reason to learn, (d) develop positive attitude of the students, (e) develop appreciation attitude whether to themselves or others, (f) improve learning effectiveness, (g) develop the sense of belonging, (h)

develop their ability for the future, (i) develop the attitude in loving the environment and environment oriented, and (j) able to describe the importance of the materials and its direct application in the daily activity [1],[2].

Researchers have developed REACT-based worksheet draft [3]. The subjects of the research were PGSD program students from UT Jember who took Statistic Education subject (PEMA4210) on the 2016.2 registration period, and the result showed that REACT-based worksheet draft has fulfilled the validity, practical and effectivity criteria. The draft needs to be field tested further on wider location [4]. The aim of this research was to develop the REACT-based worksheet on Statistic Education tutorial which fulfils the validity, practical and effectivity criteria. The implementation of the worksheet was also intended to improve the learning performances and the ability of mathematical communication of UT students.

2. Method

This research was a development research. The subjects were students from UT Malang, Jember, and Surabaya. The overall subjects were 71 UT students who took Statistic Education subject, which 15 students from UT Malang, 39 students from UT Jember and 17 students from UT Surabaya. The development of REACT-based worksheet used development steps for education product for field test which can be seen in Figure 1 [4].

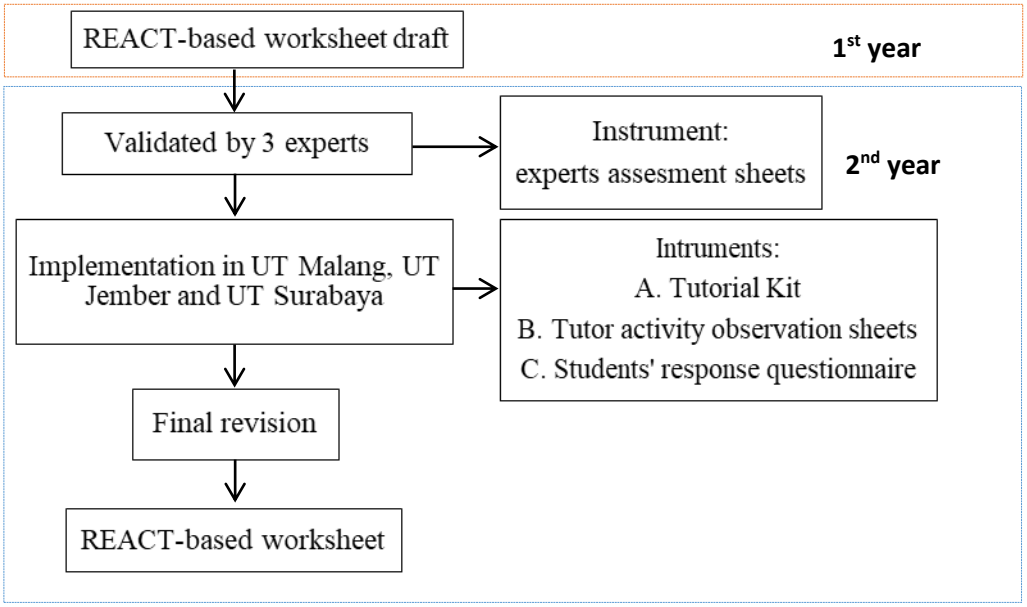

Figure 1. Procedure of REACT-based worksheet development

The data was then analyzed descriptively and by comparing the obtained data with validity, practical and effectivity criteria. The criteria, data and analysis method can be seen in Table 1.

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Table 1. Criteria, data and analysis method

Criteria	Required Data	Data Collection Instruments	Data Analysis Method
Validity			
(a) Worksheet materials based on the Statistic Education theories. (b) Materials presentation on REACT-based worksheet strategy.	*Experts assesment: 1=SD, 2=NA, 3=A, and 4=SA	Experts assessment sheets	1. Data presented as table and graph. 2. Data compared with worksheet quality criteria
Practical			
(a) Tutor could at least do 80% of the SAT activity in each tutorial (b) All modules in the worksheet can be finished on 8 times face to face tutorial.	Data obtained from observer: 0 = not done 1 = done	Tutor activity observation sheets	1. Data presented as table and graph. 2. Data presented as averages or percentages. 3. Data compared with worksheet quality criteria.
Effectivity			
(a) Students could answer at least 80% of questions/ tasks/ assignments in the worksheet.	Students' answer on the worksheet	REACT-based worksheet	1. Students' answerers were scanned and shown, then interpreted. 2. Data presented as averages or percentages. 3. Data compared with worksheet quality criteria.
(b) Students' average score at least reached 70.	Students' score	Task 1, 2, 3 and final exam	1. Data presented as averages or percentages. 2. Data compared with worksheet quality criteria.
(c) At least 70% of students agreed or strongly agreed that worksheet could help them to understand the concepts in Statistic Education subject.	*Data Angket: 1=SD, 2=NA, 3=A, and 4=SA	Task 1, 2, 3 and final exam Students Questionnaire	1. Data presented as table and graph. 2. Data presented as averages or percentages. 3. Data compared with worksheet quality criteria.

*SD = Strongly disagree; NA = Not agree; A = Agree; SA = Strongly agree

3. Results and Discussion

3.1 Results

The REACT-based worksheet draft which previously made was revalidated by three experts. The experts were UT tutor on mathematic, an expert on the mathematic education and expert on the education product development. The validation was done using expert assessment sheets. The results showed that three experts were strongly agreed that the materials from worksheet were in accordance

with the Statistic Education theories and the presentation of the material on the worksheet was based on the REACT strategy. Thus, the REACT-based worksheet has fulfilled the validity criteria.

On the next step, REACT-based worksheet was implemented to the research subjects which located on three different locations, on UT Malang, UT Jember, and UT Surabaya. At each worksheet implementation, in the first, second, fourth, sixth and eighth tutorial, activities of each tutors were observed by two observers using Tutor Activity Observation Sheets. The determined time of tutorial observation was decided since on the third, fifth, and seventh tutorial students were asked to finish Task I, II, and III respectively. The observation results showed that the average implementation of the worksheet on UT Malang, Jember and Surabaya were 94%, 95%, and 97% (more than 80%). The results indicate that the REACT-based worksheet has fulfilled the practical criteria.

The implementation of REACT-based worksheet was done through student groups to finish the tasks, assignments or problems on each worksheet. Each group consisted of students with different mathematic ability. The aim was to create positive dependency on each group members. The dependency could happen if students with high mathematical ability help other students in learning and finishing tasks on each worksheet, while other students also felt the need to learn to students with the higher mathematical ability [5],[6].

Implementation results showed that the average finished questions/tasks/assignments percentage by students in UT Malang was 97%.6; in UT Jember was 98.4%, and in UT Surabaya was 99.4%. On each tutorial, the percentages were over 90%. The example of student's answer on worksheet 4 question about normal curve and its implementation could be seen in Figure 2.

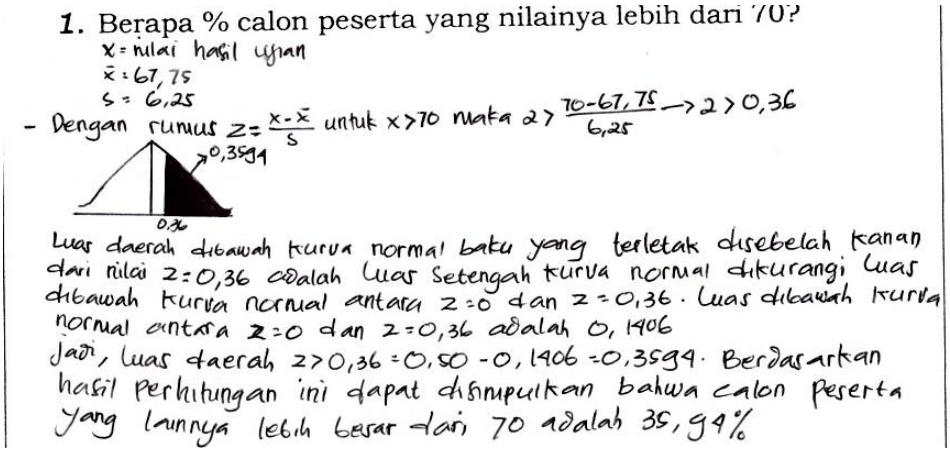

Figure 2. The example of student's answer on the Worksheet 4 question

Furthermore, students were able to answer questions about conceptual understanding (Figure 3). The conceptual understanding is an understanding with rich meaning which correlated to "what" questions [7],[8], e.g what is the meaning of statistic hypothesis?

Hipotesis Statistik

Pelajari contoh 3 halaman 8.6, dari contoh diatas ayo kita simpulkan:

a. Hipotesis Statistik adalah.. Suatu anggapan atau pernyataan yang mungkin benar atau tidak, mengenai satu populasi atau lebih

b. H_0 adalah.. Hipotesis yang dirumuskan dengan harapan untuk ditolak (Hipotesis nol)

c. H_1 adalah.. Hipotesis yang dirumuskan dengan harapan untuk diterima (Hipotesis tandingan).

d. Kesalahan jenis I adalah.. Penolakan terhadap hipotesis nol (Ho) padahal hipotesis tersebut besar

e. Kesalahan jenis II adalah.. Penerimaan terhadap hipotesis nol (Ho) padahal hipotesis tersebut salah.

Figure 3. The example of conceptual understanding answer

Students could also answer questions about procedural understanding (Figure 4). The procedural understanding is an understanding of "how to do something", the example was about how to make circle diagrams.

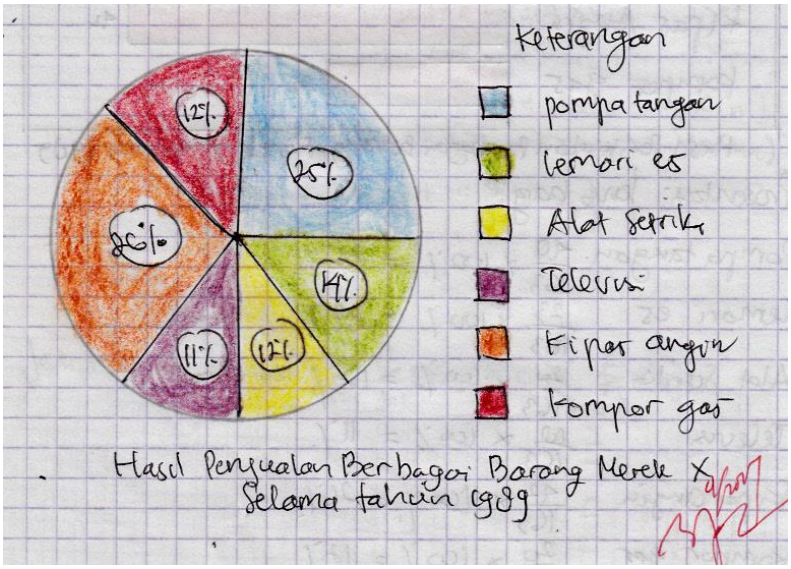

Figure 4. The example of procedural understanding answer

The students' ability to answer problems/questions/tasks on the worksheet can be seen on the students' assignment score. Overall, students' average score was 89.0, where the minimum score for students were 8, which means that student achieved more than 80 (Table 2).

Table 2. Students' assignment score

UT	Averages	Minimum	Maximum
Malang	86,0	83	90
Jember	88,6	85	94
Surabaya	90,0	86	94
Overall	89	83	94

On the eighth tutorial, researchers gave questionnaire on each student to get their responses to the implementation of REACT-based worksheet in the Statistic Education. The results showed that more than 75% of the students gave positive responses to the implementation of REACT-based worksheet on Statistic Education subject.

The final exam results were in accordance with the students' assignment score, where 39.5% of students got A, 38.0% of students got B, while 22.5% got C (Figure 5). The results showed that REACT-based worksheet has fulfilled the effectivity criteria.

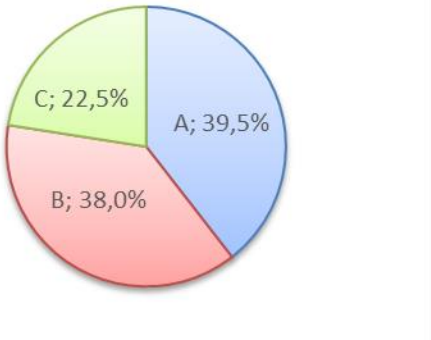

Figure 5. Results of final exam in percentage

3.2 Discussion

The results showed that REACT-based worksheet could foster students to have a good understanding to concepts and procedures in Statistic Education subject, which can be shown by the students' average score which was 89.0 and 74% of students achieved A or B score. This was in accordance to [9] who stated that the implementation of REACT strategy could improve the mathematic conceptual understanding of 10th grade SMAN 1 Batang Anai students. The similar was also stated by [10] who showed that the implementation of REACT strategy was effective to improve students' ability on the Fuzzy Logic material.

Furthermore, a meaningful knowledge could help students to have mathematic connecting and representation ability. The mathematic connecting ability could be achieved because mathematic knowledge was connected to the other knowledge and context on daily life. Representation itself is a representative of mathematic concepts in the form of figures and symbols. The implementation of representation by students could make mathematical concepts more concrete and help students to solve complex mathematical problems by made it into a simpler form. Research by [11],[12],[13],[14], showed that learning by REACT strategy could help students to have mathematical connecting and representation ability.

Students with meaningful knowledge would show more capability to finish mathematical tasks, assignments, or problems [5]. Besides, REACT strategy would push students to implement their knowledge on meaningful tasks so students would have good thinking habit. That thinking habit is the critical and creative thinking [15].

REACT-based worksheet could also build fun learning environment to the students, so they would be more motivated to finish the tasks, questions, or problems on the worksheet independently, whether it was during or outside the class. The result was also in accordance to research done by [16] which showed that implementation of REACT strategy significantly affects students' motivation thus resulting in better learning performance.

Implementation of REACT-based worksheet on the Statistic Education subject could help students to develop mathematical communication ability both verbally or in writings. The ability to communicate verbally can be shown in students' ability to deliver their ideas during group discussion, and their ability to deliver their solution to the problem during class discussion. The implementation of REACT-based worksheet with the heterogeneous group discussion framework could push students to develop their communication ability. The students' communication ability through writing could be shown from their solutions to the problem in REACT-based worksheet and from their assignments. For the example, students could communicate how they decide on the answer to question number 4 (Figure 2), so as the meaning of statistic hypothesis (Figure 3).

4. Conclusion and Recommendation

4.1 Conclusion

The results of REACT-based worksheet showed that the worksheet has fulfilled the validity, practical and effectivity criteria. Furthermore, the implementation of REACT-based worksheet could help students to achieve better learning score, which is showed by the average score on students' assignment that achieved 89.0, while the percentage of students who achieved A, B, and C was 39.5%; 38.0%; and 22.5% respectively.

The implementation of REACT-based worksheet on the Statistic Education tutorial could also help students to develop mathematical communication ability whether verbally or through writing. The students' verbal mathematical communication could be seen during the group and class discussion when they deliver their ideas and solutions to the problem. The REACT-based worksheet implementation on heterogenuous group discussion framework could push students to develop their communication ability. The students' communication ability through writing could be seen on their solution to their assignments on REACT-based worksheet.

4.2 Suggestion

This research showed that the implementation of REACT-based worksheet on the Statistic Education tutorial could help students to have meaningful understanding, to make the mathematic connection, and improve their ability to solve and communicate the mathematical problem. REACT-based worksheet could also implement on other tutorials, with the attention to the subject's characteristics. Furthermore, the tutorial should use learning media based on heterogeneous group and class discussion. Time scheduling on each tutorial should also be a concern when tutor implements the worksheet

5. Reference

[1] CORD 2001 *The REACT strategy* Retrieved from http://www.cord.org/the-react-strategy

[2] Crawford M L 1999 *Teaching and contextually*: *research, rationale, and techniques for improving student motivation and achievement in mathematics and science* (Texas: CCI publishing, Inc)

[3] Prastiti T D 2016 Implementasi strategi REACT (relating, experiencing, applying, cooperating, transferring) pada tutorial statistika pendidikan di Universitas Terbuka *Proc.Sem. Nas. Pend. Mat* (Surabaya: Universitas Neger Surabaya) p 379

[4] Karyadi E A 2007 *Pengembangan inovasi pembelajaran* (Jakarta: Direktorat Ketenagaan Dirjen Dikti)

[5] Hudojo H 2005 *Kapita selekta pembelajaran matematika* (Malang: Universitas Negeri Malang)
[6] Sutawidjaja A and Afgani J 2011 *Pembelajaran matematika* (Jakarta: Universitas Terbuka)
[7] Goldstein E B 2011 *Cognitive psychology: Connecting mind, research, and everyday experience* (3rd ed.) (Belmont: Wadsworth)
[8] Matlin M W 1994 *Cognition* (4 ed.) (Orlando: Harcourt Brace & Company)
[9] Husna F E, Dwina F and Murni D 2014 Penerapan strategi REACT dalam meningkatkan kemampuan pemahaman konsep matematika siswa kelas X SMAN 1 Batang Anai *J. Pend. Mat* **3** pp 226-30
[10] Leftrida R 2016 *Efektifitas penerapan pembelajaran kontekstual dengan strategi REACT (relating, experiencing, applying, cooperating, transferring) untuk meningkatkan pemahaman pada materi logika fuzzy* Retrieved from http://jurnal.untad.ac.id/jurnal/index.php/Kreatif/article/view/2398/1562
[11] Yuniawatika 2011 Penerapan pembelajaran matematik dengan strategi REACT untuk meningkatkan kemampuan koneksi dan representasi matematik siswa sekolah dasar *Proc Sem Nas Pend Mat* (Bandung: STKIP Siliwangi Bandung)
[12] Siahaan F B, Saragih S and Siagian P 2012 Pengaruh strategi REACT dan sikap siswa terhadap matematika dalam peningkatan kemampuan koneksi matematika siswa SMA *J Pend Mat Paradikma* **5** pp 128-36
[13] Arifin A T, Kartono and Sutarto H 2014 Keefektifan strategi pembelajaran REACT pada kemampuan siswa kelas VII aspek komunikasi matematis *J Kreano* **5** pp 91-8
[14] Sulistyaningsih D and Prihaswati M 2015 Pembelajaran matematika dengan REACT untuk meningkatkan kemampuan koneksi matematik materi dimensi tiga kelas X *JKPM* **2** pp 8-13
[15] Marzano R J, Pickering D and McTighe J 1993 *Assessing student outcomes* (Alexandria: Association for Supervision and Curriculum Development)
[16] Fortuna I K A D, Dantes and Sariyasa 2014 Pengaruh strategi REACT terhadap hasil belajar matematika ditinjau dari aktivitas belajar siswa kelas V SD *J Prog Pasca Univ Pend Ganesha* **4** pp 1-11