Chapter 5 Results and Analysis

In this study, we organized the content of this chapter into several parts based on the research question. First, we presented the result of the learning achievement between two groups, followed by exploring the difference analysis between assignment 1 and 2 for Experimental Group, and the correlation analysis between assignment, assessment, and learning achievement. We also conduct lag sequential analysis, and the usability test analysis to know whether the user can easily use the system, how efficient and effective the system can help the user achieve the students' goal and user satisfaction to the system.

5.1 Analysis of Learning Achievement between Two Groups

We separated both pre-test and post-test in four parts: understanding fraction (UF), fraction representation (FR), problem-solving (PS), and pre-test / post-test result (PR). A one-way ANOVA analysis was utilized using both the pre-test and post-test result. We conducted the pre-test analysis to know the prior knowledge difference between two groups. The mean and standard deviation for the control group (CG) pre-test results are 37.259 and 17.340, and 37.851 and 15.924 for the experimental group (EG). This result has followed by UF, FR, and PS in both groups pre-test. The mean of CG for UF, FR, and PS are 2.814, 14.814, and 19.629 and .483, 7.903, and 12.551 for the standard deviations. Meanwhile, the mean of EG for UF, FR, and PS are 2.667, 15.556, and 19.629 and .480, 9.640, and 1.554 for the standard deviations (Table 4). A t-test also conducted to the pre-test result of the two groups. The t-test result of both groups indicated that there is no significant difference ($p = .896 > 0.050$) in the average of students' prior knowledge between CG and EG (Table 5).

For the post-test result, we did the same way. At first, we analyzed the result using a one-way ANOVA then followed by a t-test. The mean and standard deviation for the CG post-test result are 33.370 and 18.943, and 43.370 and 16.957 for the EG. The result has also followed by UF, FR, and PS in both-group post-test. The mean of CG for UF, FR, and PS, are 2.444, 12.778, and 18.148 and .640, 1.860, and 12.720 for standard deviations. Meanwhile, the mean of EG for UF, FR, and PS are 2.814, 19.074, and 21.481 and .395, 9.306, and 1.267 for the standard deviations (Table 4). Same with the pre-test, we also conduct a t-test to the post-result of the two groups. T-test analysis to the post-result of the two groups indicated that there is a significant difference ($p = .046 < .05$) in the average of the overall post-test result between CG and EG. More specifically, the significant difference exists in UF and fraction representation FR (Table 5). From the descriptive statistics and T-test analysis, we can conclude that EG performs better than CG.

Table 4. Descriptive Data of the Pre-test and the Post-test Results

	Group	Variable	N	Mean	S.D.	Std. Error
Pre-Test	CG	Understanding Fraction	27	2.814	.483	.930
		Fraction Representation	27	14.814	7.903	1.521
		Problem Solving	27	19.629	12.551	2.415
		Total	27	37.259	17.339	3.337
	EG	Understanding Fraction	27	2.667	.480	.924
		Fraction Representation	27	15.556	9.640	1.855
		Problem Solving	27	19.629	1.554	2.031
		Total	27	37.851	15.924	3.064
Post-Test	CG	Understanding Fraction	27	2.444	.640	.123
		Fraction Representation	27	12.777	1.860	2.090
		Problem Solving	27	18.148	12.720	2.448
		Total	27	33.370	18.943	3.645
	EG	Understanding Fraction	27	2.814	.395	.761
		Fraction Representation	27	19.074	9.306	1.791
		Problem Solving	27	21.481	1.267	1.975
		Total	27	43.370	16.957	3.263

Table 5. Multiple Comparison Data of the Pre-Test and Post-test Result between two groups

	Variable	Mean Difference	Std. Error	Sig.
Pre-Test	Understanding Fraction	.148	.131	.264
	Fraction Representation	-.740	2.399	.759
	Problem Solving	.000	3.156	1.000
	Total	-.592	4.530	.896
Post-Test	Understanding Fraction	-.370	.144	.014
	Fraction Representation	-6.296	2.752	.026
	Problem Solving	-3.333	3.146	2.94
	Total	-1.000	4.896	.046

From the result, we can conclude that in general, EG performs better, especially in understanding fraction (UF) and Fraction Representation (FR). Between the two groups had different treatment. In the CG only had traditional way learning activity (traditional lecture and paper-based practice), different from the experimental group that they used the Authentic U-fraction to learn and apply fraction concept and operation in an authentic context, while control group has paper-based practice.

From the result, we also know that EG performs better in Fraction Representation because they had different treatment from the CG. In the CG, we provide the paper-based assignment for the student, but in the EG, we used the Authentic U-Fraction to provide assignment. To accomplish an assignment in The Authentic U-Fraction, a student in the EG needs to make fraction representation by using the picture they take from the environment around them. So, the EG students always tried to implement their understanding of fractions in authentic contexts to make fraction representation. By implementing their understanding fraction in an authentic context, they will have a deep image about fraction, so when they encounter authentic context, it will remind them, and the students will recall their memory. Even more, the students in the experimental group could learn from another students' work in a location-based peer sharing feature provided in the Authentic U-Fraction. By using this feature, the students can go to the location where other students' make the record and observe and learn the fraction concepts. However, the result in problem-solving is not significantly different between CG and EG. It caused by, during their learning activity even use the app (EG) or not (CG) they have assignments and needs problem-solving skills to accomplish. So that is why the result is not significantly different in problem-solving between two groups.

5.2 Analysis of Assignment, Assessment and Learning Achievement

In this part, we analyze all variables in the assignment, assessment, and learning achievement. We conduct independent t-test to find out the difference between two assignments, conduct a Pearson correlation analysis to find out whether a correlation between assignments, assessments, and learning achievements and regression analysis to find out what variables can predict the students learning achievements.

Two different assignment for the EG conducted during the research activity. The first assignment has done inside the classroom and the second around campus in an authentic context. In this part, an independent t-test was conducted to analyze the difference between the two assignments quantity. Overall, there is a difference in quantity of the record created by the students with mean 9.749 for assignment one and 14.000 for assignment two. The reason is that the assignment two conducted in the 4 (four) authentic location, so it gives a chance to the student to accomplish the assignment in assignment two by exploring the location.

5.2.1 Correlation Analysis between Assignment, Assessment, and Learning Achievement

In this part, we conduct a Pearson Correlation Analysis to find out whether a correlation between assignment, assessment, and learning achievement. In the assignment, it divided into two parts: the quantity of assignment and the students' annotation. The quantity of assignment is defined as how many students can solve problems that are in the assignment, and the students' annotation can define as on how many annotations students made in the advanced multimedia whiteboard and record description.

In the assessment, we also divide it into two parts; the first is student peer assessment using three scaffoldings and authentic context, and the second is teacher score. The three scaffoldings in the peer assessment consist of "linguistic" which involves the ability of students to describe the results of their work in the form of sentences, "logic mathematics" which involves the ability of students to describe the results of their work in the form of mathematical symbols", and "visual representation" which involves the ability of students to describe the results of their work in a graph.

However, in the peer assessments, we also conduct a five-scales rating based peer assessment. We want to know whether the five scales rating is still effective or not to measure the students' record quality. The difference between three scaffoldings and five scales rating lies in the assessment technique. In the three scaffoldings, the students give a score to the peer by three guidance: "Is the explanation correct or not?", "Is the mathematic symbol correct or not?", and "Is the graph representation correct or not." Using these three guidances, students assess their peer record by giving the score one or zero. One if the answer is correct, zero if the answer is incorrect. So the students more clear for what should they assess to their peer record.

In the other hand, utilize five scales rating to assess peer record means the students must give a score with a score range from one to five which one is the lowest and five is the highest to their peer record. Unlike three scaffoldings, in five scales rating, there is no guidance to students when they assess their peer record. They will look to their peer record generally without paying attention to the detail like explanation correctness, mathematical symbol correctness, or graph representation correctness.

So, in the peer assessments, we have two assessment: peer assessment using three scaffoldings and five scales rating. We analyze between two peer assessments to find out whether five scales rating assessment is effective or not to measure students' record quality. The difference between the two peer assessment analyzed using the Pearson Correlation to the teacher score and learning achievement.

In teacher assessment, we also use three scaffoldings without authentic context. The differences between the three scaffoldings used in peer assessment and teacher assessment are the score range. In the peer assessment, each scaffolding gave a score range of one or zero. If the students answer for each scaffolding is correct, then it gave a score of one. Otherwise, it is given a zero value. In the teacher assessment, the teacher will give a score for each scaffolding with a range of values 0, 2.5, and 5. If the students' answer in scaffolding is perfect, then the teacher gives the score 5, if it is not perfect but still acceptable, then the teacher gives the score 2.5, and if it is entirely unacceptable, then the teacher gives the score to the students' record zero points. The result of the teacher assessment is a teacher score, which is part of the expert judgment for the students' record.

Finally, we conduct a Pearson correlation to all variables in the assignments, assessments, and also learning achievements to find out the correlation between variables. After we know the correlation between variables, then we conduct a multiple linear regression to find out what variables can predict the students learning achievements.

5.2.2 Correlation Analysis between Quantity of Assignment and Annotation

From the results in Table 6, we know that there is a correlation between the quantity of assignment and annotation ($r = .579$, $p = .002$). Overall, The annotations on whiteboard ($r = .582$, $p = .001$), the annotations on description ($r = .564$, $p = .002$), and the total of annotations ($r = .579$, $p = .002$) has a correlation with the quantity of assignment. From all correlation results, it can be concluded as more students create more record in the assignment, the more annotation they make.

5.2.3 Correlation Analysis between Assignment and Assessment

Also, from the results in Table 6, it shows there is a correlation between the quantity of assignment and annotations to the assessment. Overall the quantity of assignment ($r = .662$, $p < .001$) & total of annotations ($r = .715$, $p < .001$) correlates to peer assessment score using three scaffolding and authentic contexts. Moreover, all components in the annotations correlate to all scaffoldings. However, there is no correlation between the quantity of assignment & the total of annotations to the five scales rating.

It is proven that the three scaffoldings and peer assessment score using three scaffolding and authentic contexts better than utilize five scales rating. It is mean, while the students assess their peer record, they will pay attention more deeply to their peer record based on each scaffolding. The students are more apparent to what should they assess from their peer record by using these three scaffoldings. So, the more students make a meaningful annotation in their records, or more students make records, the higher the score they get from the peer assessment using three scaffolding and authentic contexts.

This result also strengthened by an interview with four students in the experimental group. Students stated, "Because the scaffolding can help me whether another student assignment is drawn correctly or not." Another student also stated, "I can give judgment correct

Table 6. The Pearson Correlation between Assignment, Assessment, and Learning Achievement in EG

	1	2	3	4	5	6	7	8	9	10	11	12
1. Quantity of Assignment	1											
2. Annotations on Assignment	.579**	1										
3. Peer Assessment: Linguistics	.656**	.721**	1									
4. Peer Assessment: Logical Mathematics	.676**	.705**	.996**	1								
5. Peer Assessment: Visual Representation	.650**	.714**	.993**	.990**	1							
6. Total Peer Assessment Score	.662**	.715**	.999**	.998**	.997**	1						
7. Peer Assessment: 5 scales Rating	.286	.321	.535**	.509**	.505**	.517**	1					
8. Teacher Assessment Score	.096	.759**	.384*	.347	.390*	.375	.281	1				
9. Posttest: Understanding Fractions	-.121	.092	.043	.010	.024	.026	-.108	.124	1			
10. Posttest: Fraction Representation	.204	.532**	.341	.347	.339	.343	.062	.529**	.160	1		
11. Posttest: Problem Solving	.167	.540**	.401*	.368	.401*	.391*	.222	.612**	.354	.478*	1	.
12. Posttest Score	.210	.621**	.431*	.414*	.429*	.426*	.166	.664**	.326	.842**	.876**	1

**. Correlation is significant at the .01 level (2-tailed)
*. Correlation is significant at the .05 level (2-tailed)

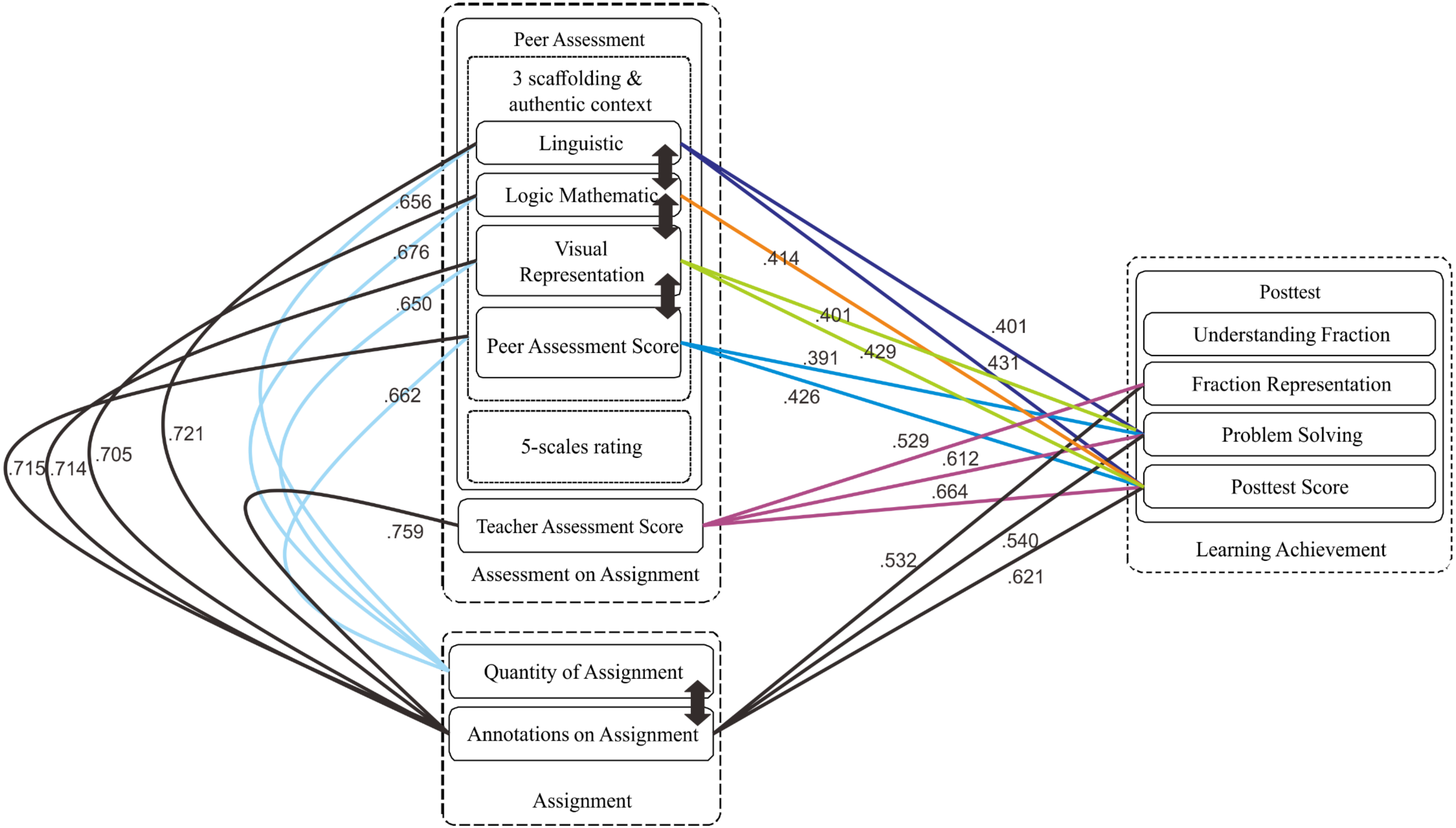


Figure 16. Summary of Pearson Correlation Analysis between Assignment, Assessment on Assignment and Learning Achievement

or not," that indicated the students like with the scaffoldings. One student also revealed that with scaffolding, "I can learn how to grade other, and you can know whether the answer is right or wrong."

The second, the annotations correlates to the teacher assessment score utilize three scaffoldings ($r = .759$, $p < .001$). Moreover it is correlates to all component of annotations: annotations on whiteboard ($r = .760$, $p < .001$) and annotations on description ($r = .750$, $p < .001$). So, as mentioned before, the more students make a meaningful annotation in their records, the higher the score they get from the teacher assessment using three scaffoldings.

5.2.4 Comparison between Peer Assessment and Teacher Assessment

From the results in Table 6, we get the comparison between students' peer assessment using three scaffoldings, five-scales rating, and the teacher assessment score to the post-test. The results show that teacher assessment score has higher correlation to the posttest ($r = .664$, $p < .001$) than students' peer assessment using three scaffolding ($r = .426$, $p < .027$). However, there is no correlation between five-scales rating to the posttest score. The teacher assessment score has a higher correlation because the teacher has the expertise to give a score to the students' record. The teacher has a better understanding of which students' record is good and which is not good or just ordinary than the students. However, at least, the three scaffolding and authentic context we apply can help students to give meaningful assessment which ends in the correlation with posttest score.

5.2.5 Correlation Analysis between Assignment, Assessment, and Learning Achievement

In this part, we analyze the correlation between assignment and assessment to the learning achievement. At first, In the assignment, only students' annotations of assignment has correlation to the learning achievement ($r = .621$, $p = .001$) more specifically all components of students' annotations has correlations to the learning learning achievements: annotations on whiteboard ($r = .624$, $p = .001$) and annotations on description ($r = .604$, $p = .001$). In another hand, there is no significant correlation between the quantity of assignment to the learning achievement. So it can be concluded that the number of records made by students does not affect the student's learning achievement. However, the more complete student records, affect the posttest value. It is because some students' record does not have a complete annotation, so the annotation score is not perfect.

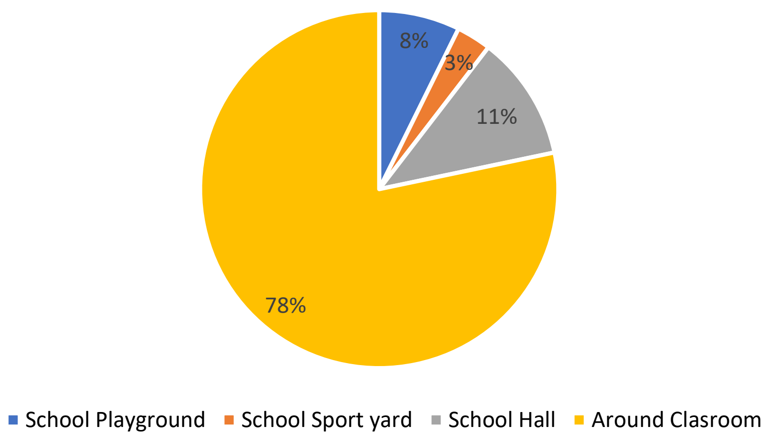
The importance of annotations also revealed from interview with students. A student stated that annotation was important because "it let us to remember what we did". Other students also stated "It is important because the notes are helpful to review". More students also stated "it is important, because if you only have pictures, you won't understand them". So, it can be concluded that the completeness of annotations is very important. Besides it can affect to the learning achievement, it also needed by other students to review.

The correlation in the assignment strengthened by the result of the correlation between the assessment to the posttest score. The results in Table 6 shows that there is a correlation for both assessment to the posttest score: peer assessment using the three scaffoldings and authentic context ($r = .426$, $p = .027$) and teacher assessment score ($r = .664$, $p < .001$) to the posttest score. It is means the students records quality is very influential on student learning achievement. The more meaningful the annotations made by students, the higher their learning achievements.

5.2.6 Analysis of Location-based Peer Sharing

As mentioned in chapter four, we provide location-based peer sharing to make student easier to make a confirmation and give an assessment to other students works. From total 479 peer assessment in four authentic locations, 78% (375 assessment) were carried out in students works done in locations around the classroom (Graph 1).

It means that most of the students prefer other students' work to be done in the locations around the classroom because they are more familiar with the location. It is easier to find and explore an authentic object around the classroom than around the school playground, school sports yard, or school hall.



Graph 1. Preferred location statistics in peer assessment in location-based peer sharing

5.2.7 Regression Analysis for The Predicted Variables for Students Learning Achievements.

In this part, we try to analyze all research variables to find out what variables can predict the students learning achievements. We run the multiple linear regression, and the results show that teacher score is the variable that most predict the students' learning achievement (Table 7 and 8).

Table 7. Multiple Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. The error of the Estimate
1	.664[a]	.441	.418	12.932

a. Predictors: (Constant), Teacher Score

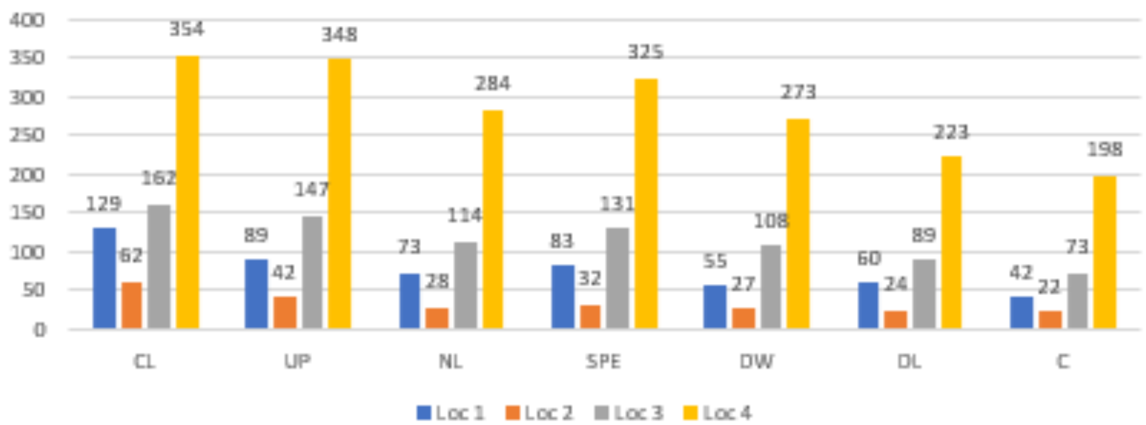
Table 8. Multiple Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Err	Beta		
1	(Constant)	23.485	5.125		4.582	.000
	Teacher Assessment Score	2.851	.642	.664	4.438	.000

5.3 Lag Sequential Analysis Toward the Students Behavior

To analyze the students' behavior when they solve fraction problem in authentic context through assignment two, we conduct a lag sequential analysis. First, we extract students' activity when they use the app from the app activity log. In assignment two, the app provides seven learning steps that must be followed by students, but it does not rule out the possibility that students will repeat some step because the system does allow it.

At first, we show the frequencies of code behaviors (graph 2) during authentic learning activities with the app in four different authentic locations.



Note: Step1: Choosing Location (CL), Step2: Understanding Problem (UP), Step3: Navigate to Location (NL), Step4: Solving Problem by Exploration (SPE), Step5: Describing Work (DW), Step6: Describing Location (DL), Step7: Confirmation (C). Loc 1: playground, Loc 2: sports yard, Loc 3: hall, Loc 4: around the class.

Graph 2. The Frequencies of code behavior during authentic learning activities with the app in four different authentic locations

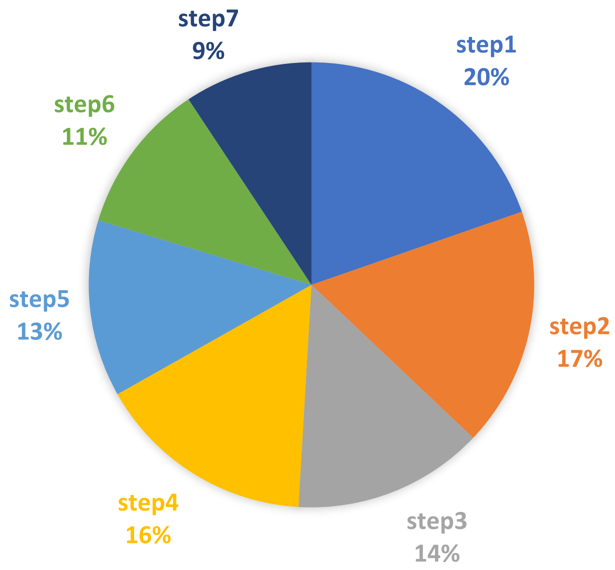
In total, there are 3599 activities done in four different authentic locations during the activities outside the classroom. Graph. 2 shows that around the class (n = 2005) is the favorite location to do the authentic tasks followed by the hall (n = 824), playground (n = 531), and sports yard (n = 237) because students could more readily found the fraction objects around the classroom (e.g., the wall with a tile pattern, floor, windows) than the other locations.

The most common activity from four different authentic locations is Choosing Location (n = 708, 20%) followed by Understanding Problem (n = 626, 17%), Solving Problem by Exploration (n = 572, 16%), Navigate to Location (n = 499, 14%), Describing Work (n = 463, 13%), Describing Location (396, 11%), and Confirmation (n = 335, 9%).

Table 9. Frequencies of Activities

	Step 1	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**	**Step 7**	**Totals**
Step 1	96	581	14	5	2	10	0	708
Step 2	120	0	478	25	0	2	1	626
Step 3	32	18	2	447	0	0	0	499
Step 4	101	3	0	3	459	6	0	572
Step 5	8	1	0	78	0	376	0	463
Step 6	19	22	4	14	2	1	334	396
Step 7	331	1	1	1	0	1	0	335
Totals	707	626	499	573	463	396	335	3599

Note: Step1: Choosing Location (CL), Step2: Understanding Problem (UP), Step3: Navigate to Location (NL), Step4: Solving Problem by Exploration (SPE), Step5: Describing Work (DW), Step6: Describing Location (DL), Step7: Confirmation (C)



Note: Step1: Choosing Location (CL), Step2: Understanding Problem (UP), Step3: Navigate to Location (NL), Step4: Solving Problem by Exploration (SPE), Step5: Describing Work (DW), Step6: Describing Location (DL), Step7: Confirmation (C)

Graph 3. Frequency of Activities in Four Different Authentic Locations

Table 10 shows the transition probabilities matrix between the different learning steps. A chi-square test confirmed a significant relation between the rows and columns in transitional frequency matrix, $\chi^2 = 9901.9372$, df = 36, $p < .001$. The most probable cases are those where one step follows the next step (e.g., CL→UP→NL→SPE→DW→DL→C→CL). This is indicated that students tend to do the next activity after finished the previous activity.

Table 10. Transitional Probabilities Matric between the Different Learning Steps

	Step 1	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**	**Step 7**	**Totals**
Step 1	0.1356	0.8206	0.0198	0.0071	0.0028	0.0141	0	0.1356
Step 2	0.1917	0	0.7636	0.0399	0	0.0032	0.0016	0.1917
Step 3	0.0641	0.0361	0.004	0.8958	0	0	0	0.0641
Step 4	0.1766	0.0052	0	0.0052	0.8024	0.0105	0	0.1766
Step 5	0.0173	0.0022	0	0.1685	0	0.8121	0	0.0173
Step 6	0.048	0.0556	0.0101	0.0354	0.0051	0.0025	0.8434	0.048
Step 7	0.9881	0.003	0.003	0.003	0	0.003	0	0.9881
Totals	0.1356	0.8206	0.0198	0.0071	0.0028	0.0141	0	0.1356

Note: Step1: Choosing Location (CL), Step2: Understanding Problem (UP), Step3: Navigate to Location (NL), Step4: Solving Problem by Exploration (SPE), Step5: Describing Work (DW), Step6: Describing Location (DL), Step7: Confirmation (C)

Finally, the sequences of activities reach significance levels depending on the computation of z-values (that is > z 1.96) and Yule's Q (that is > Q 0.30) (Bakeman and Gottman, 1997; Pohl, Wallner, & Kriglstein, 2016). Based on Table 12 and Table 13, the following sequences were significant: CL→UP (z = 50.649, Q = 0.993), UP→NL (z = 49.781, Q = 0.996), NL→SPE (z = 48.456, Q = 0.990), SPE→DW (z= 52.483, Q = 0.999), DW→DL (z =51.716, Q = 0.997), DL→C (z = 54.477, Q = 1.000), C→CL (z = 38.294, Q = 0.997).

Table 11. Adjusted Residual (z-values) between the Different Learning Steps

	Step 1	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**	**Step 7**	**Totals**
Step 1	-4.547	50.649	-10.21	-12.35	-11.16	-9.099	-9.511	-4.547
Step 2	-0.329	-12.63	49.781	-8.974	-10.58	-9.398	-8.668	-0.329
Step 3	-8.016	-8.754	-9.378	48.456	-9.248	-8.463	-7.711	-8.016
Step 4	-1.304	-11.61	-10.46	-10.97	52.483	-8.295	-8.355	-1.304
Step 5	-10.39	-10.45	-9.248	0.583	-8.857	51.716	-7.385	-10.39
Step 6	-7.882	-6.588	-7.847	-7.141	-7.787	-7.247	54.477	-7.882
Step 7	38.294	-8.668	-7.545	-8.207	-7.385	-6.574	-6.157	38.294
Totals	-4.547	50.649	-10.21	-12.35	-11.16	-9.099	-9.511	-4.547

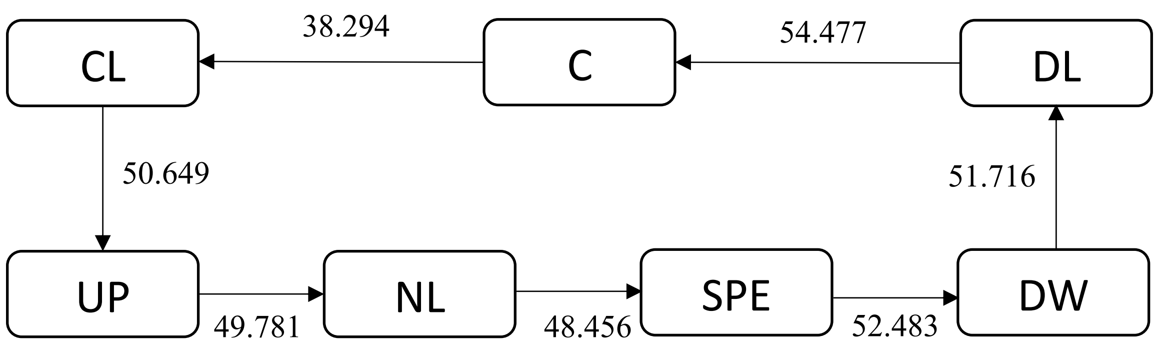
Note: Step1: Choosing Location (CL), Step2: Understanding Problem (UP), Step3: Navigate to Location (NL), Step4: Solving Problem by Exploration (SPE), Step5: Describing Work (DW), Step6: Describing Location (DL), Step7: Confirmation (C)

From the result of the analysis, we get the behavioral transition of conducting tasks in four different authentic locations.

Table 12. Yule's Q Values between the Different Learning Steps

	Step 1	**Step 2**	**Step 3**	**Step 4**	**Step 5**	**Step 6**	**Step 7**	**Totals**
Step 1	-0.262	0.993	-0.818	-0.943	-0.971	-0.83	-1	-0.262
Step 2	-0.018	-1	0.996	-0.689	-1	-0.959	-0.975	-0.018
Step 3	-0.605	-0.734	-0.959	0.99	-1	-1	-1	-0.605
Step 4	-0.077	-0.96	-1	-0.956	0.999	-0.866	-1	-0.077
Step 5	-0.884	-0.983	-1	0.039	-1	0.997	-1	-0.884
Step 6	-0.689	-0.596	-0.894	-0.705	-0.941	-0.965	1	-0.689
Step 7	0.997	-0.975	-0.967	-0.972	-1	-0.957	-1	0.997
Totals	-0.262	0.993	-0.818	-0.943	-0.971	-0.83	-1	-0.262

Note: Step1: Choosing Location (CL), Step2: Understanding Problem (UP), Step3: Navigate to Location (NL), Step4: Solving Problem by Exploration (SPE), Step5: Describing Work (DW), Step6: Describing Location (DL), Step7: Confirmation (C)



Note: Step1: Choosing Location (CL), Step2: Understanding Problem (UP), Step3: Navigate to Location (NL), Step4: Solving Problem by Exploration (SPE), Step5: Describing Work (DW), Step6: Describing Location (DL), Step7: Confirmation (C)

Figure 17. Students' behavioral transition of conducting assignment in four different authentic location

5.4 The Analysis of The System's Usability, Ease of Use, Ease of Learning and User Satisfaction

To find out whether the user can easily use the application, how efficient and effective an application can help the user achieve his goal, and whether the user is satisfied with the application, we conducted a test use USE Questionnaire by Lund. A.M (2001). It is thirty items questionnaire that divided into four dimensions: Usefulness (8 items), Ease of Use (11 items), Ease of Learning (4 items), and Satisfaction (7 items). The questionnaire detail showed in Table 14.

Students were asked to give a level of agreement for each question on a one to five scales (strongly disagree, disagree, neutral, agree, and strongly disagree). Cronbach's alpha coefficient was employed for 30 items questionnaire to examine the internal consistency and content validity of the survey.

Table 13. USE Questionnaire item

Question	Dimension
31. It helps me be more effective	Usefulness
32. It helps me be more productive	
33. It is useful	
34. It gives me more control over the activities in my life	
35. It makes the things I want to accomplish easier to get done	
36. It saves me time when I use it	
37. It meets my needs	
38. It does everything I would expect it to do	
39. It is easy to use	Ease of Use
40. It is simple to use	
41. It is user-friendly	

Question	Dimension
42. It requires the fewest steps possible to accomplish what I want to do with it	
43. It is flexible	
44. Using it is effortless	
45. I can use it without written instructions	
46. I do not notice any inconsistencies as I use it	
47. Both occasional and regular users would like it	
48. I can recover from mistakes quickly and easily	
49. I can use it successfully every time	
50. I learned to use it quickly	Ease of Learning
51. I easily remember how to use it	
52. It is easy to learn to use it	
53. I quickly became skillful with it	
54. I am satisfied with it	Satisfaction
55. I would recommend it to a friend	
56. It is fun to use	
57. It works the I want it to work	
58. It is wonderful	
59. I feel I need to have it	
60. It is pleasant to use	

The total alpha coefficient was 0.960, and for each dimension exceed more than 0.800, which is higher than 0.6. It means the items of the questionnaire were sufficiently reliable for representing the usability of the system.

Table 14. Statistical Results of Questionnaire

Dimension	Mean	Std. Deviation
Usefulness	31.629	5.1
Ease of Use	44.481	6.1
Ease of Learning	16.333	2.8
Satisfaction	27.703	4.6

Table 14 shows the summarized statistical analysis for each dimension of the USE Questionnaire. All 27 students from the EG completed the survey. From the results, we can conclude that:

a) 79% of the students revealed that the app is useful to facilitate them study fraction in an authentic context.
b) 80% of the students agreed that Authentic U-fraction is easy to use because it has an excellent user interface and user experience design.
c) 80% of the students agreed that features in Authentic U-fraction are easy to learn, so they not easy to make a mistake when they operate the app.

d) 77% of the students revealed that they enjoyed the feature on Authentic U-fraction, and it satisfied them.

5.5 Analysis of The Authentic Learning Questionnaire

To find out the students' perception on authentic learning, creativity, happy learning, healthy learning, meaningful learning, and system sustainability and scalability, we conducted a test using 19 items of the Authentic Learning Questionnaire. Students were asked to give a level of agreement for each question on a one to five scales (strongly disagree, disagree, neutral, agree, and strongly disagree). Cronbach's alpha coefficient was employed for 19 items questionnaire to examine the internal consistency and content validity of the survey.

Table 15. The Authentic Learning Questionnaire Item

Questions	Mean	Std. Deviation
1. I relate the concepts of fractions with my surrounding using Authentic U-fraction app.	3.81	1.178
2. I use Authentic U-fraction app to get more understanding of the concepts of fractions.	3.78	1.188
3. Using Authentic U-fraction app can help me to identify fraction objects in my surrounding.	4.15	.989
4. Using Authentic U-fraction app to explore the concepts of fractions in my surrounding can give me a happy learning experience.	3.89	1.251
5. Using Authentic U-fraction app to apply the concepts of fraction in my surroundings can help me to get more useful knowledge.	3.89	1.155
6. Walking regularly to identify the concepts of fractions in my surroundings using Authentic U-fraction app can strengthen my bones and muscles.	3.44	1.086
7. Sensing the fresh air when I explore different fraction objects in my surroundings using Authentic U-fraction app makes me feel better.	3.63	.926
8. I think to walk to explore different objects of fractions in my surroundings using Authentic U-fraction app can make me healthier.	3.81	1.001
9. I always have a cheerful effect on others when I explore the objects of fractions in my surrounding using Authentic U-fraction app.	3.89	.974
10. I can enhance my knowledge in the discussions learning activity by using Authentic U-fraction app.	4.11	.974
11. My peers can share their experiences and knowledge with me by using Authentic U-fraction app.	3.89	1.188
12. I can manipulate the fraction objects to solve the problems in Authentic U-fraction app.	3.78	1.155
13. My imagination of fraction objects can be realized by solving the problems in Authentic U-fraction app.	3.70	1.203

Questions	Mean	Std. Deviation
14. Applying the concepts of fractions in my surrounding can motivate me to learn more.	3.89	.974
15. I like to identify fraction objects in many different topics by using Authentic U-fraction app.	4.00	1.177
16. Using Authentic U-fraction app to solve fraction problems in my surroundings can help me to remember related previous knowledge.	3.70	1.031
17. I will suggest my relatives and friends to use Authentic U-fraction app to explore fraction objects in their surroundings.	3.85	1.099
18. I will do more tasks in Authentic U-fraction app to improve my understanding of fraction concepts in my surrounding.	3.70	1.031
19. I will do more tasks in Authentic U-fraction app to get familiar with fraction objects in my surrounding.	3.85	1.167

Table 15. Shows the items statistics analysis for 19 items of the Authentic Learning questioner. Overall, the means of all items in the questionnaire was more than 3.0.