Blended Learning Approach: Effect On Students' Academic Achievement And Practical Skills In Science Laboratories

Rhesa T. Hinampas, Catherine R. Murillo, Denis A. Tan, Roxette U. Layosa

Abstract: A research investigation was conducted to find out the effect of blended learning approach on students' academic achievement and practical skills in science laboratories. Specifically, it aimed to: determine the level of academic achievement of students as exposed to blended learning approach and to those exposed to non-blended learning approach; ascertain the practical skills of students exhibited when exposed to blended learning approach and to those exposed to non-blended learning approach in terms of: questioning, designing, communicating, recording, analyzing, and interpreting; compare the academic achievement of students toward science laboratories when exposed to blended learning approach and non-blended learning approach; and differentiate the practical skills exhibited by students toward science laboratories when exposed to blended learning approach and non-blended learning approach. The study utilized the quasi-experimental design to determine the students' academic achievement and practical skills in science laboratories through blended learning approach. Two intact classes such as third section class exposed to blended learning approach and second section class exposed to non-blended learning approach were administered with a developed teacher-made test questions and adapted questionnaires on practical skills inventory. Descriptive statistics such as mean and percentages, and analysis of covariance were also used. Results showed that those students exposed to blended learning improved their academic achievement from pre-test to posttest and leveled-up their scores with those students non-exposed to blended learning. The practical skills manifested by students were interpreting, communicating, designing, recording, analyzing, and questioning. Further results showed no significant difference existed between academic achievement of students exposed to blended learning approach and to those exposed to non-blended learning approach, both improved their performances, thus failed to reject the stated null hypothesis. There is significant difference in the practical skills manifested between those students exposed to blended learning approach and those non-exposed to blended learning approach, thus rejecting the stated null hypothesis.

Index Terms: Academic Achievement, Blended Learning, Practical Skills, Science Laboratories

1 INTRODUCTION

A pedagogical approach in science education has been dynamic through the years. It is one way of developing how the teachers teach and how the students learn. However, as the world become connected all around the globe and become globally competitive in all aspects, the way of teaching science education has also changed. Students nowadays are very exposed to the online world. They are called the Millennials, they are the new generation of learners, the largest and diverse students, where they prefer variety of active learning. In the Philippines, many universities and laboratory high schools offer pure science curriculum where students are exposed to different subjects, science laboratories and science researches. Yet, it has been observed that students are passive during lectures and discussions because whenever they feel bored with their lessons, their attention quickly shifts elsewhere.

- *Rhesa T. Hinampas is a faculty of the College of Education, Central Mindanao University (CMU), Philippines. She is assigned to teach Science courses in the Laboratory High School. +639068822042, rthinampas@cmu.edu.ph*
- *Catherine R. Murillo is also a faculty of the College of Education, Central Mindanao University (CMU), Philippines. She is currently the Science Division Coordinator of the Laboratory High School and is handling science courses. +6391773110966, catherine.murillo19@yahoo.com*
- *Denis A. Tan is a faculty of the College of Education, Central Mindanao University (CMU), Philippines. She is currently the School Principal of the CMU Laboratory High School and the Director of the Office of Admissions, Scholarships and Placement in the same university. +639177103100, teacher.tansined@gmail.com*
- *Roxette U. Layosa is the research assistant of this scientific investigation. +639168515991, layosaroxette@gmail.com*

As a result, the students' performance in Science National Achievement Test (NAT) in the country continues to be the most difficult field of discipline in basic education, thus students fail to understand basic concepts [19]. To address the poor achievement in Science and to attain the goals of science education, teaching strategy should be developed for science teachers in order to achieve meaningful and retentive learning [18]. Interestingly, many of the components of ideal learning environment such as less lectures, use of multimedia as well as collaborating with peers, are some of the same techniques research has shown to be effective [5]. With the mandate of K to 12 Philippine Education Program, the traditional way of teaching and learning should be converted to electronic learning where ICT skills and technologies were introduced to this said millennials and now commonly known as the 21st century learners. Students were able to become dynamic in learning. They can use the online world as avenue for learning. Their ideas and knowledge are not contained in a four-walled classroom but instead they can learn with the world [20]. One of the most promising strategies in the integration of interactive lessons with the innovative and technological advances of the virtual environment is the blended learning approach [17]. It is an innovative concept that embraces the advantages of both traditional teaching in the classroom and ICT supported learning including both offline learning and online learning [9]. Through this new way of learning, students may be able to improve and develop their practical skills. Practical skill is used to enhance skills that are important to help students understand and develop their abilities especially in science laboratories. These skills include questioning, recording, designing, communicating, analyzing and interpreting [1]. Practical skills clearly include an individual's competency in the manipulation of a particular piece of apparatus/equipment and many other skills which becomes unfeasible to assess a student's competency within the limited time available in school science laboratories. With

the above reasons and concerns, it is significant therefore to teach students, in a way that they will enjoy and have fun while learning, since it has been found that students in this generation has a short span of attention and they find the way of traditional learning as uninteresting, dull and tiresome. Thus, the integration of blended learning approach was investigated to know its effects on students' academic achievement and practical skills in science laboratories.

2 PROCEDURE / METHODOLOGY

2.1 Locale of the Study

The study was conducted at Central Mindanao University Laboratory High School, College of Education, Central Mindanao University, University Town, Musuan, Maramag, Bukidnon, Philippines.

2.2 Selection of the Respondents

The respondents of this study were two (2) intact sections of Grade 10 students in Chemistry class of Central Mindanao University Laboratory High School enrolled for S.Y. 2017-2018. One group came from the third section who served as an experimental group exposed to blended learning approach involving practical skills in science laboratories, while the other group came from the second section who served as the control group exposed to non-blended learning approach involving practical skills in science laboratories.

2.3 Data Collection

This study made use of academic and non-academic assessment. The students were given the pre-test before the experimental period begins while the post-test was administered after the unit topic was discussed involving the blended learning approach through practical skills in science laboratories. The unit topics include Gas Laws, Chemical Reactions and Biomolecules. Then a questionnaire was given to the students to find out what practical skills exhibited in Science and level of laboratory performance involving the blended learning approach toward Chemistry. Data gathered were coded, encoded and analyzed to obtain information in order to answer the questions put forward for this investigation.

2.4 Data Analysis

The descriptive statistics like mean and percentages were used to determine the level of academic achievement of students and analyzed the data obtained from the results of the survey questionnaires. The Analysis of Covariance (ANCOVA) were employed to determine the significant differences of academic achievement and practical skills of students utilizing blended learning approach and those in non-blended learning approach.

3 Results

This section presents the interpretation and analysis of the data gathered from junior students' academic achievement and practical skills upon exposure to blended learning and non-blended learning environment.

2.3.1. Student's Level of Academic Achievement under the Blended Learning

Table 1.Academic achievement of students as exposed to blended learning approach and those exposed to non-blended learning approach.

PERCENT EQUIVALENT	PRETEST				POST TEST				QUALITATIVE INTERPRETATION
	Non Blended		Blended		Non Blended		Blended		
	N	%	N	%	N	%	N	%	
90 – 100	0	0	0	0	0	0	0	0	Outstanding
80 – 89	0	0	0	0	1	2.04	0	0	Very Satisfactory
70 – 79	0	0	0	0	10	20.41	7	15.22	Satisfactory
60 – 69	1	2.04	0	0	14	28.57	14	30.43	Fairly Satisfactory
Below 59	48	97.96	46	100	24	48.98	25	54.35	Did not Meet Expectation

The post-test scores of the students who were exposed to non-blended learning showed an increased academic achievement. It shows 2.04% very "satisfactory", 20.41% "satisfactory", 28.57% "fairly satisfactory", and 48.98% "did not meet expectation" results. On the post-test of students exposed to blended learning approach, it shows that there is also an increase in their academic achievement. They obtained 15.22% "satisfactory", 30.43 "fairly satisfactory", and 54.35 "did not meet expectation" results. This means that the students who were exposed to blended learning shows an improvement in their academic achievement since their performances leveled-up with the second section who were not exposed to blended learning approach. This is consistent with the findings of the study of Migalang [17] that whenever a student is exposed to blended learning approach, they exhibit academic excellence. This may be due to students' cohesive analysis about the lessons when blended learning strategy was introduced. The same research findings with [24] that exposure to educational technology which relates to academic performance allowed the students a high posttest result. The current findings also accord with the study of Eryilmaz [11], according to the result of his study blended learning was found to have positive effects on learners' study achievement and learners cooperate actively. It means that students acquire existing knowledge and actively create new knowledge for given task performance in the process of sharing knowledge with the peers. It is likely that the blended learning improved students study achievement through cognitive activities. Moreover according to the study of Dagaang [8], the students who experienced integration of technology in their instruction obtained better scores after the intervention was given compared to students who underwent the traditional way of instruction only. Thus, blended learning approach is effective in teaching science and helped increase academic performance of the students.

Practical Skills Before and After Exposure Blended

Table 2 presents the practical skills of students before the exposure of the blended learning approach. The practical skills in their order of preferences indicating "always" are the following: interpreting (2.68); questioning (2.50); analyzing (2.41); recording (2.40); communicating (2.35) and designing (2.10), respectively. The skill on interpreting 2. 68 is the most preferred skill used by the students in a Traditional Learning. The student seems to be good in collecting and inferring data and solve problems. It was followed by the questioning skill (2.50), students were interested in the new way of learning

and they are eager to know how and why things work. But this contradicts with the study of Tawana and Yandila [22], it was found to be the least preferred skill by the students. Analyzing skill (2.41) ranks third in students desired skill. Students were able to visualize and solve problems by making decisions with the given information. Since the students were grouped, they were able to share and critique their ideas to their group mates which show effective in this learning environment. The skill in recording (2.40), communicating (2.35) and designing (2.10), were the least favored skills by the students with traditional leaning. In the skill of recording, students were given opportunities to process information from their investigation by recording their results based on measurements and observations [21] to ensure future data reviews. Students on the skill on communicating are not that proficient, and this contradicts with the study of Nevin and Mustafa [38] that students performed specific tasks in the laboratory and they can present their findings in a more profound and accurate result. Designing skill was not considered by the students, they find it difficult to design their own way of doing experiments.

2.3.2. Table 2. *The student's mean scores of the practical skills before exposure to Blended Learning.*

PROCESS SKILLS	Non Blended		Blended Learning	
	MEAN	QUALITATIVE INTERPRETATION	MEAN	QUALITATIVE INTERPRETATION
Interpreting				
1. I can use science terms to share our results.	3.20	High	3.48	High
2. I can use the results of my investigation to answer the question that I asked.	3.14	High	3.60	Very High
Sub Mean	2.90	High	3.54	Very High
Analyzing				
3. I can analyze the results of a scientific investigation.	3.16	High	3.57	Very High
4. I can use models to explain our results.	3.11	High	3.38	High
Sub Mean	3.14	High	3.48	High
Questioning				
5. I can use scientific knowledge to form question.	3.25	High	3.38	High
6. I can ask a question that can be answered by collecting data	3.16	High	3.52	Very High
Sub Mean	3.21	High	3.45	High
Communicating				
7. I can communicate a scientific procedure to others.	3.02	High	3.26	High
8. I can create a display to communicate our data and observations.	3.07	High	3.48	High
Sub Mean	3.05	High	3.37	High
Recording				
9. I can record data accurately	3.05	High	3.31	High
Sub Mean	3.05	High	3.31	High
Designing				
10. I can design a scientific procedure to answer a question.	2.28	Low	3.29	High
11. I can use data to create a graph for presentation to others.	3.07	High	3.33	High
Sub Mean	2.68	High	3.31	High

After the students' exposure to blended learning, the practical skills of students are presented in Table 3. The practical skills in their order of preferences indicating "always" are the following: interpreting (3.54); analyzing (3.48); questioning (3.45); communicating (3.37); designing (3.31); and recording (3.31). The practical skill on interpreting were found the most preferred skills manifested by the students under the blended learning approach since they managed to answer the questions based on the results of the experiments. This finding adheres with the study of Karamustafaoglu [15] that interpreting was found to be developed effectively as a practical skill among preservice teachers in science and technology class. Many educators emphasized that when a student is exposed in the laboratory via exposure from online activities, they are able to figure-out, conceptualize, and easily give meaning on the data collected.

2.3.3 Table 3. *The student's mean scores of the practical skills after exposure to Blended Learning.*

PROCESS SKILLS	Non Blended		Blended Learning	
	MEAN	QUALITATIVE INTERPRETATION	MEAN	QUALITATIVE INTERPRETATION
Interpreting				
1. I can use science terms to share our results.	3.20	High	3.48	High
2. I can use the results of my investigation to answer the question that I asked.	3.14	High	3.60	Very High
Sub Mean	2.90	High	3.54	Very High
Analyzing				
3. I can analyze the results of a scientific investigation.	3.16	High	3.57	Very High
4. I can use models to explain our results.	3.11	High	3.38	High
Sub Mean	3.14	High	3.48	High
Questioning				
5. I can use scientific knowledge to form question.	3.25	High	3.38	High
6. I can ask a question that can be answered by collecting data	3.16	High	3.52	Very High
Sub Mean	3.21	High	3.45	High
Communicating				
7. I can communicate a scientific procedure to others.	3.02	High	3.26	High
8. I can create a display to communicate our data and observations.	3.07	High	3.48	High
Sub Mean	3.05	High	3.37	High
Recording				
9. I can record data accurately	3.05	High	3.31	High
Sub Mean	3.05	High	3.31	High
Designing				
10. I can design a scientific procedure to answer a question.	2.28	Low	3.29	High
11. I can use data to create a graph for presentation to others.	3.07	High	3.33	High
Sub Mean	2.68	High	3.31	High

The analyzing practical skill shows to be at the third during the pretest (2.41) but ranks second during the posttest (3.48). This means that the students improved their skill in analyzing. On questioning practical skill, it ranked second during the pretest (2.50) but third during the posttest (3.45). It seems that students no longer focused on their ability to ask questions since almost all of their questions were readily available in the internet and the simulations they used with their activities. Based on the results, students exposed to blended learning approach developed their communicating and designing skills from the pretest to the post test. They were able to communicate their data through tables, graphs, diagrams and other information presentation including those that are technology based. In designing specific procedures were usually considered but not totally in understanding the activities given, thus they find difficulty when they told to

design their own procedure. However, recording were found the least skills performed by the students. The students failed to analyze fully the results of their investigations. According to the study of Gonzales(2016), scientific process skills had helped the students engaged in learning chemistry as well as in solving problems which created new solutions and thus foster positive results in their performance. From the study of Suryanti et.al [23] there is an increase in students' scientific literacy levels after they engage in lessons using the process skills approach. This happens because in the learning process the students are actively involved in learning both physically and mentally through and minds-on activities, making inquiries, conducting activities as directed, analyzing data, and drawing conclusions. The students' scientific attitude also experiences positive development. As can be gleaned from tables 2 and 3, data reflects an improvement of students' practical skills when exposed to blended learning approach. From the overall mean of 2.41 indicating "low", it increases to 3.41 indicating "high". This shows that the ability of scientific literacy can be increased through learning activities. Based on the research of Siahaan [22], it was concluded that the use of multimedia computer in linear motion concept for junior high school students is able to increase science practical skills with moderate normalized gain score in each sub-concept learnt. The development of science practical skills is also found in each indicator with the highest increase in predicting skill indicator, while the lowest increase is on summarizing skill and communication skill indicator. In practical terms, the use of computer multimedia can be used as an alternative to improve students' science practical skills.

2.3.4. Analysis Of Covariance On Student's Academic Achievement

The post-test mean score of students under the non- blended learning is 60.45 while the post-test mean score of those under the blended learning is 58.04 with an P-value of 0.434 indicating not significantly different at 0.01 level.

Table 4. Analysis of Covariance on student's academic achievement between two groups.

Descriptive Statistics			
Academic Achievement	Mean	Standard Deviation	N
Blended Learning	58.04	9.11	46
Non Blended Learning	60.45	10.93	49
Total	59.28	10.11	95

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	160.612 (a)	2	80.306	.783	.460
Intercept	10631.495	1	10631.495	103.626	.000
PRETEST	23.321	1	23.321	.227	.635
Group	63.286	1	63.286	.617	.434
Error	9438.714	92	102.595		
Total	343488.000	95			
Corrected Total	9599.326	94			

R^2 = .0666 (Adjusted R^2= .043)

The results showed that there is no significant difference between the two groups; this means that the academic achievement of the experimental group equate with the control group. This indicates an improvement of academic performance for the experimental group. These findings adhere with the study of Gambari et.al [12], that those students exposed to blended learning mode of instruction performed better than those in traditional teaching method. This finding agrees with that of Al-Qahtani and Higgins [3] which reported significant difference among the blended learning, e-learning and traditional teaching method in favor of the blended learning mode. Ceylan and Kesici [6] also concluded that blended learning environment had generated a significant difference in students' academic achievement on behalf of experimental group. According to the study of Tseng and Walsh [26] their results revealed that students in blended learning scored higher on their final grades than that in traditional course but with no significant difference. In the research work of Cupida [7], he concluded that the students' scores showed increase in their performances. The situation in his study considers experience on the part of the students when computer application was employed. Similar data findings adhere with the study of Vegafria [27] that after exposure to multimedia learning, coupled with various activities, there was an increase on content knowledge of the students exposed to multimedia learning than those students exposed to non- multimedia learning.

2.3.5. Analysis of Covariance on Student's Practical Skills

Table 5. *Analysis of Covariance on Students Questioning Skills*

Group	Mean	Std. Deviation	N
1.00	3.6429	.48497	42
2.00	3.4091	.49735	44
Total	3.5233	.50239	86

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.407(a)	2	.703	2.912	.60
Intercept	82.302	1	82.302	340.755	.000
Questioning	.232	1	.232	.962	.330
Group	1.183	1	1.183	4.899	.030
Error	20.047	83	.242		
Total	1089.000	86			
Corrected Total	21.453	85			

R^2= .0666 (Adjusted R^2 = .043)

As can be gleaned from the table, there is a significant difference on the questioning skills between the students who were exposed to the blended learning approach and those who are not. It is always believed that only hands-on activities can be helpful to enhance practical skills, but along with hands-on activities questioning strategy is also rather equally useful if integrated with blended learning approach. Effective use of questioning strategy can promote thinking among students and forces them to manipulate simulation activities to get the answers.

Table 6. *Analysis of Covariance on Student's Designing Skills*

Group	Mean	Std. Deviation	N
1.00	3.5476	.63255	42
2.00	3.2045	.55320	44
Total	3.3721	.61446	86

Tests of Between-Subjects Effects					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.529 (a)	1	2.529	7.186	.009
Intercept	979.692	1	979.606	2783.606	.000
Group	2.529	1	2.529	7.186	.009
Error	29.564	84	.352		
Total	1010.000	86			
Corrected Total	32.093	85			

R^2 = .079 (Adjusted R^2= .068)

In designing practical skill, the students exposed to blended learning approach improved in their performance since the

result shows significant difference from those students exposed to non-blended learning approach. Based from the study of Jirana [14] designing an investigation was the most mastered skill of students in her study. But according to the study of Demerbas and Tanreverdi [10] in the level of science practical skills of science students in Turkey on "designing the inquiry" it has been found that there is no significant difference in the students' skill in designing.

Table 7. *Analysis of Covariance on Student's Communicating Skills*

Group	Mean	Std. Deviation	N
1.00	3.5714	.50087	42
2.00	3.2273	.42392	44
Total	3.3953	.49179	86

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3.729 (a)	2	1.864	9.195	.000
Intercept	43.550	1	43.550	214.784	.000
Communicating	1.184	1	1.184	5.838	.018
Group	2.594	1	2.594	12.793	.001
Error	16.829	83	.203		
Total	1012.000	86			
Corrected Total	20.558	85			

R^2 = .0181 (Adjusted R^2= .162)

In communicating practical skill, there is a significant difference, between those students exposed to blended learning approach and to those exposed to non-blended approach. Communication is an essential skill because students will almost always—in any subject or real-life situation—need to explain their reasoning, description, or explanation in a clear and understandable way. Communication can involve presenting information to others in a variety of ways, including written text, oral discussions, symbols, metaphors, and demonstrations. Communication also includes being able to communicate information through charts, graphs, and other models [13]. Communication skill was the most frequent happening in class based from the study of Lyndon et al [16] since most of the students preferred on discussing with pairs when questions arose while doing task or experiments and while presenting their task.

Table 8. *Analysis of Covariance on Student's Recording Skills*

Group	Mean	Std. Deviation	N
1.00	3.3095	.60438	42
2.00	3.0455	.48005	44
Total	3.1744	.55713	86

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.549 (a)	2	.775	2.589	.081
Intercept	46.845	1	46.845	156.562	.000
Recording	.051	1	.051	.170	.682
Group	1.471	1	1.471	4.917	.029
Error	24.835	83	.299		
Total	893.000	86			
Corrected Total	26.384	85			

R^2 = .059 (Adjusted R^2 = .036)

From the results given in table 8, there is significant difference on the recording skills between those students exposed to blended learning approach and to those students exposed to non-blended learning approach. The results of the study conform to Aram and Germann [4] that 61% of the students performed the activity and recorded the data successfully. The same result shown by Acat et.al [2], that the skill of recording shows the most mastered skill of the students. According to this finding, it can be said that the students' recording data skill has been achieved positively, and it is evident that the students' data recording skill is in the highest level.

Table 9. *Analysis of Covariance on Student's Analyzing Skills*

Group	Mean	Std. Deviation	N
1.00	3.7143	.45723	42
2.00	3.3636	.53226	44
Total	3.5349	.52463	86

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2.647 (a)	2	1.323	5.294	.007
Intercept	57.085	1	57.085	228.357	.000
Analyzing	.005	1	.005	.019	.891
Group	2.643	1	2.643	10.573	.002
Error	20.749	83	.250		
Total	1098.000	86			
Corrected Total	23.395	85			

R^2 = .113 (Adjusted R^2= .092)

From the results given in table 9, there is significant difference on the analyzing skills between those students exposed to blended learning approach and to those exposed to non-blended learning approach. Students can become critical and rational in the way they think when they are exposed to problem solving constantly and continuously. Students become skillful in developing models, formulating representations, and making equations to describe scientific problems besides gaining skills in identifying given conditions of a given problem [20]. The findings of this study is also supported by the study of Asparin and Tan (2018) when they found out that students problem solving skills are significantly better when exposed to Enhanced Gradual Release of Responsibility Instructional Model (EGRRIM) than those exposed to the traditional approach.

Table 10. *Analysis of Covariance on Student's Interpreting Skills*

Group	Mean	Std. Deviation	N
1.00	3.6905	.46790	42
2.00	3.4545	.50369	44
Total	3.5698	.49801	86

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.428 (a)	2	.714	3.015	.054
Intercept	31.237	1	31.237	131.918	.000
Interpreting	.232	1	.232	.979	.325
Group	1.199	1	1.199	5.065	.027
Error	19.653	1.199	.237		
Total	1117.000	.237			
Corrected Total	21.081				

R^2 = .68 (Adjusted R^2= .045)

From the table above, there is significant difference on the recording skills between those students exposed to blended learning approach and to those students exposed to non-blended learning approach. According to the study of Lyndon et.al [16] on the Inculcation of Science Process Skills in Science Classroom, the skill of interpreting is the most

demonstrated skill in class it were stating the relationship between variables and making suitable conclusion using the information and data they have. This skill is a continuity of the skill of making inferences and it is one of the integrated science practical skills.

3 CONCLUSION

The blended learning approach, when introduced in chemistry class would enable the learners to perform better performances. Teachers therefore, need to explore more teaching variables and examine a learning environment that enhances academic achievement. The educational approach toward the blended learning environment require the learners to be actively involved, hence science educators with blended learning environment should accommodate instructional strategy and materials and assess student's science practical skills. The implemented blended learning approach need further investigation by looking at the goal structures and other combined learning strategies and assess students' academic learning outcomes. In accordance with the students' science practical skills development, various teaching methods should be adopted. Course contents should be determined with the aim of improving science practical skills of the students.

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