THE DEVELOPMENT OF CHEMISTRY INSTRUCTIONAL HANDBOOK BY BLENDED LEARNING TO ENHANCE ACHIEVEMENT ON CHEMISTRY AND SCIENCE PROCESS SKILL FOR VOCATIONAL CERTIFICATE (SKILL BRIDGING PROGRAM) OF POLYTECHNIC INSTITUTE OF BANTEAY MEANCHEY PROVINCE, KINGDOM OF CAMBODIA

By
Ms. Tel TAILOS

A Thesis Submitted in Partial Fulfillment of the Requirements
for Master of Education CURRICULUM AND INSTRUCTION
Department of Curriculum and Instruction
Silpakorn University
Academic Year 2022

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โดย

Ms.Tel Tailos

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรศึกษาศาสตรมหาบัณฑิต
หลักสูตรและการสอน แผน ก แบบ ก 2 ระดับปริญญามหาบัณฑิต
ภาควิชาหลักสูตรและวิธีสอน
มหาวิทยาลัยศิลปากร
ปีการศึกษา 2565

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By	Ms. Tel TAILOS
Field of Study	CURRICULUM AND INSTRUCTION
Advisor	Assistant Professor NIWAT BOONSOM, Ph.D.
Co advisor	Assistant Professor WISUD PO NEGRN, Ph.D.

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61263201 : Major CURRICULUM AND INSTRUCTION
Keyword : BLENDED LEARNING, SCIENCE PROCESS SKILL, CHEMISTRY, ACHIEVEMENT

Ms. Tel TAILOS : THE DEVELOPMENT OF CHEMISTRY INSTRUCTIONAL HANDBOOK BY BLENDED LEARNING TO ENHANCE ACHIEVEMENT ON CHEMISTRY AND SCIENCE PROCESS SKILL FOR VOCATIONAL CERTIFICATE (SKILL BRIDGING PROGRAM) OF POLYTECHNIC INSTITUTE OF BANTEAY MEANCHEY PROVINCE, KINGDOM OF CAMBODIA Thesis advisor : Assistant Professor NIWAT BOONSOM, Ph.D.

This research was to develop the chemistry instructional handbook by blended learning to enhance achievement in chemistry and science process skills for the vocational certificate (Skill Bridging Program) of the Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia. The research objectives were 1) to develop the chemistry instructional handbook by blended learning for the Skill Bridging Program of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia. 2) to study the science process skill of the students who learn with chemistry instructional handbook by blended learning. 3) to the comparison of achievement in chemistry learning before and after learning with the chemistry instructional handbook by blended learning. 4) to study teachers' satisfaction who using the chemistry instructional handbook by blended learning. The 40 samples were vocational certificate students and 2 teachers from the Polytechnic Institute of Banteay Meanchey Province, sample random sampling. The implementation lasted long 7 weeks. Data were statistically analyzed using mean, standard deviation, and dependent t-tests. The research findings were as follows:

1. The result of the chemistry instructional handbook by blended learning. Composed of 10 components; 1) instruction, 2) content, 3) objective, 4) learning process, 5) media/technology, 6) assessment and evaluation, 7) units, 8) how to use media and technology, 9) reference, and 10) bibliography. The learning process of the chemistry instructional handbook by blended learning there are 7 steps consists of; 1) elicit, 2) engage, 3) explore, 4) explain, 5) elaborate, 6) evaluate, and 7) extend. The technology or media of chemistry instructional handbook by blended learning as; Facebook, YouTube, Google application, Kahoot app, PowerPoint, and PhET app. The learning assessment of chemistry instructional handbook by blended learning as; formative assessment (Pretest, Worksheets, Science process skill (5 skills), Class and lap participation). Summative assessment (Posttest). The blended learning is face-to-face (50%) and online (50%).

2. The result of the study science process skill of the students who learn with chemistry instructional handbook by blended learning. In unit 1, science process skills are neutral (=3.30, S.D.=0.55), unit 2 of science process skills are high (=3.51, S.D.=0.50), unit 3, of science process skills, are (=3.75, S.D.=0.54), unit 4, of science process skill, are (=4.10, S.D.=0.50) which accepts with the research hypothesis

3. The result of the comparison of achievement in chemistry learning before and after learning with the chemistry instructional handbook by blended learning are

different levels of statistical significance of 0.05.

4. The result of the study teachers' satisfaction who using the chemistry instructional handbook by blended learning was at the level of "high".

ACKNOWLEDGEMENTS

A great appreciation, I would like to express my heartfelt gratitude, appreciation, and thanks to the following individuals for reviewing parts of the thesis. The royal scholarships under Her Royal Highness Princess Maha Chakri Sirindhorn Education Project to the Kingdom of Cambodia for the Master's Degree Program, at Silpakorn University are gratefully acknowledged.

To my advisor: asst. Prof. Niwat Boonsom, Ph.D and Asst. Prof. Wisud Po Negrn, Ph.D. for their patience, motivation, enthusiasm, and immense knowledge. Their guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my master's degree study.

To my thesis chairperson committee: asst. Prof. Siriwan Vanichwatanavorachai, Ph.D. and external examiner committee Asso. Prof. Marut Patphol, Ph.D., provided encouraging and constructive feedback and valuable comments and suggestions in developing my research.

To asst. Prof. Maream Nillapun, Ph.D., Dean of the Faculty of Education, Silpakorn University, for providing, contacting, and coordinating the high school to interview and observe during Covid19.

To asst. Prof. Akkachai Poomraruen, Ph.D., for taking care of the students and giving advice.

To the director of the Polytechnic Institute of Banteay Meanchey Province, Cambodia, for allowing me to continue my study and research.

To my friend: Mudmee Sritunma, Sokheng Long, Sophatt Lay, and Sreyleak Soun for imparting her knowledge, encouragement, guidance, and love.

Most importantly, I would like to thank my family. Their encouragement has been kind and supportive to me over the last several years, I wish them all the fourfold blessings of Buddha: Longevity, Nobility, Peace, and Strength.

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INDRODCUTION

1. Statements and significance of the problem

In this century education has change and the studying in the class is not fix for the student, because the world we live in now is one that is heavily reliant on technology and media, characterized by easy access to a wealth of information, rapid advancements in technological tools, and the capacity for unprecedented levels of collaboration and individual contribution. The 4'Cs, which stand for learning and innovation, are what distinguish pupils who are prepared for today's increasingly complicated work and living contexts from those who are not. Information on critical thinking, problem solving, collaboration, creativity, and innovation(Joseph, 2016).

Science education is very important; one of the science subjects taught in schools is chemistry. skill bridging program and has many unpredicted possible benefits for our future. Chemistry is the study of matter properties related to physical, chemical and energy changes. Making it possible for students to apply their knowledge and skills to address issues in daily life is one of the goals of teaching chemistry. The strategies and tactics teachers use when teaching is what will determine whether this goal is accomplished. The approach taken can either increase or decrease the student's interest in the material and have an impact on how well they learn in general(Chebii, 2008).The problem of achievement on chemistry in the Polytechnic Institute of Banteay Meanchey province, the learner does not understand, got low score because media does not support and interest and media are so old. Media that good is handbook link with blended learning. And also, the learning science better need to use media that interesting is blended learning and handbook together. According to the Kenya National Examinations Council (KNEC), secondary school pupils score poorly on chemistry practical exams, which has an impact on their total chemistry results. The strategies teachers employ may contribute to students' poor performance in chemistry(Chebii, 2008).

According to Duangtillee, (2017) definition of handbook is the document that provides knowledge related with doing something for the users by expected the reader or the users understand and capable to manage the matter correctly by themselves, achieve the same rhythm. Phumphuengphut, (2011) explained that handbook is a book written as a guide for the users to studied and understood the rules and regulations for enhance learning and organizing activities to achieve the specified goals with efficiency and created to follow correctly and appropriately.

The science process skills and academic accomplishment of students taking a plant tissue culture course can both be improved through the use of blended learning. Since it offers a variety of educational tools, including photos, animations, movies, writings, pictures, chat rooms, and more. Students start interacting because of it. Krishnan, (2015) explained that it encourages students' social and constructive learning experiences. The opportunity for children to ask questions, describe things and events, learn, build explanations of natural phenomena, test those explanations in a variety of ways, and communicate their ideas to others is also greatly expanded. All of these are essential components of learning science courses. Due to the fact that they can access and participate in their educational program at any time and from any location, blended learning offers students a singularly adaptable learning experience. To actively participate in their studies, the participants did not have to be on campus. In a blended learning environment, learners have access to a variety of learning resources that boost their confidence and competence. They also receive quick feedback that will aid them in their learning process, are freed from the limitations of traditional training, and can choose when and where to complete their training. Additionally, the students become more accountable for their education and support their own motivation. Through interactive sessions, blended learning offers collaborative activities between teachers and students that will enhance student happiness and academic success. Give everyone who needs training access by making it available in many ways (Khan et al., 2012).

The education and training policies in Cambodia can be categorized into three streams: 1) Higher education, 2) Technical Vocational Education and Training (TVET), encompassing secondary and tertiary TVET, and 3) General education, which includes the sub-sectors from early childhood education to upper secondary education. Two distinct ministries are primarily responsible for formulating policies and overseeing the many educational streams, the Ministry of Labor and Vocational

Training (MoLVT) and the Ministry of Education, Youth, and Sport (MoEYS). While TVET is governed by the Ministry of Labor and Vocational Training (MoLVT), general education and higher education are overseen by the Ministry of Education, Youth and Sport (MoEYS). The National Technical Vocational Education and Training Policy 2017-2025 is an RGC road map to direct the development of the TVET sector, particularly in skills development, by directing the provision of skills, capacities, and employment-related knowledge for Cambodians to support life-long employment with the improvement of productivity and competitiveness both locally and internationally (Ministry of Labour and Vocational Training, 2017). The courses that MoLVT currently offers are the short courses in basic skills (3-5 months in length), the certificate courses at three levels, which require grade 9 as an entry point or skills bridging, the higher diploma programming courses of two years, which require grade 12, the completion of the three certificate levels, the bachelor programming courses of four years, which require grade 12, and the master programming courses of two years after completing the bachelor degree.

Policy of Polytechnic Institute of Banteay Meanchey Province is following by policy of Technical Vocational Education and Training (TVET)(Sub-Degree No.175/KB.BrKBB dated 20 April 2017 of MLVT, 2017). Depend on the learner's studied in skill Bridging Program at Polytechnic Institute of Banteay Meanchey Province, Cambodia. Found that, the problem always staying on tandem of non-achievement's examination, instruction, motivation, observation, testing, and considering of the learner to identify the problem in the classroom. Especially, chemistry, the learner lack of satisfied to study, technology or media in teaching and learning, relationship/making closer, motivation to study, discipline, and most of the learners are stopped to study a long time.

Totally, their problem in the class, make me to solve the problem with technology-based education by blended learning. In blended learning, which uses a computer, the internet, or a smart classroom, e-learning is included into traditional classroom instruction. The teacher meets the student in person, and teacher-student interaction is incorporated into the course design (Kavitha & Jaisingh, 2018). Blended learning is an instructional combines modern learning technology with onsite teaching in the classroom, capable to save the teachers and students' time and make learning process more effective and it is link with the chemistry (vocational certificate) that study only 24 hours. Chemistry is crucial for giving all students a fair awareness of the world around them, enabling them to participate in social discussions about issues related to science and technology, as well as for providing employment prospects in the most efficient and comprehensive way feasible.

As mention above, it is interesting that using handbook with technology based on blended learning will be able to develop achievement on chemistry and science process skills or not.

2.**Conceptual Framework**

After analysis previous research paper related chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province (PIBMC). The researcher study of principle, conceptual, theories, and research related with chemistry instructional handbook by blended learning as follow as;

1) The Problems and requirement about chemistry instruction for skill bridging program of Polytechnic Institute of Banteay Meanchey Province, Cambodia. [Sub-Degree No.175/KB.BrKBB dated 20 April 2017 of MLVT]

Based on the study of the problems and requirement about chemistry instruction for skill bridging program of Polytechnic Institute of Banteay Meanchey Province, Cambodia. The researcher concluded the problem and requirement about chemistry such as; internet speed, learning experience through blended learning, and study of learning and teaching such as teacher, curriculum, and learning assessment.

2) Concept and development process of the chemistry instructional handbook by blended learning: [Englin. D., (2018), Duangtilee, K.,(2017), Chimpong, P.,(2012), Phumphuengphut, W.,(2011), Sreevishean, V.,(2008), Eisenkraft (2003), Geerativara, S., (2003), Dictionary of Merriam Webster.,(1828)].

Based on the study of the principles, theory. and concepts of the chemistry instructional handbook by blended learning. The researcher concluded that; the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program).

The components of the chemistry instructional handbook by blended learning as; instruction, objective, learning process (7Es learning cycle), instructional media (google classroom, PhET simulate, Kahoot app, and periodic table application), assessment and evaluation (authentic assessment), how to use media, example of lesson plan (10 lessons), reference, and bibliography. In the lesson plan has accomplishment tests (pre- and post-tests), and a science process skill test following the unit's conclusion, learning activities as activities sheet and experiment, and YouTube. The blended learning is face to face (50%) and online (50%). The learning process of chemistry instructional handbook by blended learning there are 7 steps consists of;

1. **Elicit:** The instructor strives to get the students interested in the topic and gauge their prior knowledge. Students are motivated by concept cartoons, video clips, animations, and straightforward scientific experiments.

2. **Engage:** To interest pupils and get their attention, teachers may do a basic experiment or point out an anomalous occurrence.

3. **Explore:** The questioning method is used to guide pupils as they examine and revise the material. By using brainstorming within the parameters of an activity linked to the subject, assumptions and hypotheses are established. To direct students and record the data, utilize a worksheet.

4. **Explain:** Learning is attempted to be interpreted by students. In addition to giving a direct lecture, a teacher may also use videos, movies, idea maps, or presentations to illustrate the theories, concepts, laws, and facts.

5. **Elaborate:** The use of understanding in new contexts is encouraged among students.

6. **Evaluate:** Using multiple choice, quizzes, puzzles, structured grids, and true-false questions to assess the students' learning in addition to formative and summative evaluation.

7. **Extend:** It is expected of students to apply and broaden their knowledge to situations in daily life.

3) Concept and theory relating to blended learning: [Shu, H., & Gu, X.,(2018), Li, L., & Tang H. T.,(2017), Shen, Q., (2016), Krishnan, D.,(2015), Elmer, S. J., et al.(2015),

Kantunyaluk, P.,(2014), Sánchez-Adsuar, M.S., & Molina-Jordá, J.M.,(2014), Lilla, K., (2014), Wardenski, R., et al. (2012)].

According to the study of the principles, theory. and concepts of the chemistry instructional handbook by blended learning. The researcher concluded that; the term blended learning (BL) refers to the instructional by blended digital technology (computers, tablets, interactive whiteboards, visualizers, different projections, internet, and software tools) teaching in the classroom. The benefits of blended learning are; the learner have greater time flexibility working part of the time technology and accessibility with up-to-date resources available technology, the learners' interaction between the instructor and their peers are increased since the method provides more opportunities, learners' management, critical thinking, and problem-solving were enhanced, with the number of withdrawals and somewhat higher grades, and the learner was blended learning experience. They usually receive more frequent feedback from their instructors.

4) Chemistry subject and lesson according to skill bridging program of Polytechnic Institute of Banteay Meanchey Province, Cambodia. [Sub-Degree No. 175/KB.BrKBB dated 20 April 2017 of MLVT]

Based on the study of the chemistry subject and lesson according to skill bridging program. The researcher concluded that; the chemistry instructional handbook by blended learning to implement 7 weeks with the sample. The lesson has 4 unit and 10 lesson, there are unit1 atoms and molecules (lesson 1: atoms and molecules and lesson 2: Periodic Table), unit 2: matter (lesson 3: state of matter, lesson 4: properties of matter, and lesson 5: classifying matter), unit 3: chemical reaction (lesson 6: chemistry reaction and lesson7: balancing chemistry equations), and unit 4: solution (lesson8: Prosperities of solutions, lesson9: acids and bases, lesson10: salts). There are 10 lesson plans' example which blended instructional media and 7Es learning cycles models. Lesson plans' examples combine blended media (software and hardware) to help the teacher 's teaching and learning. The lesson plan uses different techniques such as google classroom, Kahoot app to play games and quiz, PhET Interactive Simulations to practice and observe. PhET reports that teaching physics and chemistry now frequently makes use of interactive simulations (sims). Lectures, one-on-one or small-group inquiry exercises, homework, and labs are just a few of the educational contexts where Sims might be used.

5) Learning achievement on science process skills (Chemistry):[Kimson, J. I., Cecilia, O. N., & Anthonia, N. U., (2017), Raj, R. G. & Devi, S. N. (2014), Abungu, H. E., Okere, M. I.O., & Wachanga, S. W., (2014), Salman, M. F., Olawoye, F.A. & Yahaya, L. A.(2011)].

According to the previous research paper, , the outcome of learning activities and a change in behavior that encompasses the cognitive, emotional, and psychomotor domains are called learning achievements, and they are used as a gauge of student progress. the degree to which students have succeeded in achieving the objectives specified by each field of study after enrolling in a teaching program within a specific period of time. According to the updated Bloom's taxonomy of the cognitive domain, learning objectives may refer to six different levels of cognitive performance, from the lowest (remember) to the greatest (create).

After analysis previous research papers, study of principle, conceptual, theories, and research interview, and observation by visiting best practice schools related with the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia. The researcher has determined conceptual framework as follow as figure 1;

☑ The Problems and Requirement about Chemistry instruction for Skill Bridging Program of Polytechnic Institute of Banteay Meanchey Province, Cambodia.[Sub-Degree No.175/KB.BrKBB dated 20 April 2017 of MLVT]

☑ Concept and Development Process of Handbook of Chemistry: [Englin. D., (2018), Duangtilee, K.,(2017), Chimpong, P.,(2012), Phumphuengphut, W.,(2011), Sreevishean, V.,(2008), Geerativara, S., (2003), Dictionary of Merriam Webster.,(1828)].

☑ Concept and Theory relating to Blended Learning: [Shu, H., & Gu, X.,(2018), Li, L., & Tang H. T.,(2017), Shen, Q., (2016), Krishnan, D.,(2015), Elmer, S. J., et al.(2015), Kantunyaluk, P.,(2014), Sánchez-Adsuar, M.S., & Molina-Jordá, J.M.,(2014), Lilla, K., (2014), Wardenski, R., et al. (2012)].

☑ Chemistry subject and lesson according to Skill Bridging Program of Polytechnic Institute of Banteay Meanchey Province, Cambodia.[Sub-Degree No.175/KB.BrKBB dated 20 April 2017 of MLVT]

☑ Learning Achievement on Science Process Skills (Chemistry):[Kimson, J. I., Cecilia, O. N., & Anthonia, N. U., (2017), Raj, R. G. & Devi, S. N. (2014), Abungu, H. E., Okere, M. I.O., & Wachanga, S. W., (2014), Salman, M. F., Olawoye, F.A. & Yahaya, L. A.(2011)].

Chemistry Instructional Handbook by Blended learning to enhance achievement on chemistry and science process skill for Skill Bridging Program of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia

1. Introduction
2. Objectives
3. Blended learning
4. Learning process of 7Es learning cycle
5. Instructional media
6. Assessment and evaluation
7. Example lesson plan
8. Achievement test form
9. Reference
10. Bibliography

- Science Process skill
- Achievement on chemistry
- Teachers' satisfaction

Figure 1 conceptual framework of development of chemistry instruction handbook by blended learning

3. **Research questions**

3.1. What is the effectiveness of development the chemistry instruction handbook by blended learning for skill bridging program of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia?

3.2. How are the outcomes of the science process skills of the students who learn with chemistry instructional handbook by blended learning?

3.3. What are the differences between before and after learning with chemistry instructional handbook by blended learning for skill bridging program?

3.4. Could the chemistry instructional handbook by blended learning make the teachers have satisfaction with using?

4.**Research Objectives**

4.1. To development the effectiveness of the chemistry instructional handbook by blended learning for skill bridging program of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

4.2. To study science process skill of the students who learn with chemistry instructional handbook by blended learning.

4.3. To comparison of achievement on chemistry learning before and after learn with chemistry instructional handbook by blended learning.

4.4. To study teachers' satisfaction who use chemistry instructional handbook by blended learning.

5.**Research Hypothesis**

5.1. The vocational students who learn by chemistry instruction handbook by blended learning will have increase in science process skill

5.2. The students studied by chemistry instructional handbook by blended learning; students 'learning after higher than before their achievement on chemistry learning.

5.3. The level of satisfaction from the vocational teachers who use the handbook will have good result which be high level of satisfaction.

6.**Research Scope of the study**

The research focuses on

6.1. The contents for use on chemistry subject grades 8&9 of skill bridging program of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

6.2. Blended learning has process of blended learning in chemistry.

6.3. Population and sample

6.3.1. Population: One hundred students and five teachers of vocational certificate (Skill Bridging Program) in Serei Saophoan city, Banteay Meanchey Province in Polytechnic Institute of Banteay Meanchey Province who studying and teaching in 24 hours, semester 1, academic year 2022, Cambodia.

6.3.2. Sample: Fifth students and two teachers of vocational certificate (Skill Bridging Program) in Serei Saophoan city, Banteay Meanchey Province in Polytechnic Institute of Banteay Meanchey Province who studying and teaching in 24 hours, semester 1, academic year 2022, Cambodia, selected by Simple Random Sampling.

6.3.3. Variable of research

Independent variable: chemistry instruction handbook by blended learning

Dependent variable: science process skill, achievement on chemistry, and teachers' satisfaction

6.4. Chemistry instructional handbook by blended learning for skill bridging program of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia

7. Definitions of terms

7.1. Chemistry instruction handbook is a book that details teaching and learning content, methods, decorated for facilities to expect the readers and the users understand by themselves correctly and easy practice to achieve objective that set allows students to have ability and skill.

7.2. Blended learning is an instructional by blended digital technology (hardware and software tools) with onsite teaching in the classroom. The technology or media of chemistry instructional handbook by blended learning as; Facebook, YouTube, Google application (google classroom, google form, google Meet), Kahoot app, PowerPoint, and PhET app.

7.3. Chemistry instructional handbook by blended learning is a book of chemistry that combine 7Es learning cycle model and instructional media in the classroom.

7.4. The science process skill is how kids interact with their world in a scientifically polite way: observation, communication, measurement, classification, and prediction. Evaluation by Rubric.

7.5. Achievement on chemistry is a result of the learner after learn and examination on chemistry subject. Evaluation by pretest and posttest

7.6. Teachers' satisfaction is appraisal formed in the mind about a particular matter of teacher after teaching following chemistry instructional handbook by blended learning. Evaluation by group interview. Take the satisfaction’s teacher form to find the average(X) and the deviation standard (S.D).

7.7. Teacher is the person who teach chemistry in Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

7.8. Student is the learner who study in Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia, during 2021-2022 academic years.

7.9. Chemistry is the science in grade 8&9 that deals with the properties, composition, and structure of substances.

7.10. Skill Bridging Program is the training programs that enable young people who lack the opportunity to finish grades 7, 8, and 9 in the regular school system to continue their studies in the TVET system. The Subject of learning Skill Bridging Program are 6 subjects, there are Khmer, Mathematics, Physics, Chemistry, Gender, and Employability Skills.

7.11. Vocational Education is the education provided students with four vocational skills, namely electronic, electricity, animal husbandry, and agriculture. After completing this educational program, students are awarded a certificate that is comparable to a general education grade 12 diploma.

8.**Expectation of research**

8.1. The chemistry instructional handbook by blended learning did quality and effective.

8.2. The learner used the knowledge and abilities acquired to address issues in daily life.

8.3. The teachers did have teaching skill, understand teaching methods to help the learner increase their knowledge.

CHAPTER II

LITERATUER REVIEW

In this part of the study'' The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia". In order to provide a background for this study, there were 4 concepts addressed in this literature review;

1. The concept and theory related curriculum vocational in Polytechnic Institute of Banteay Meanchey Province, Cambodia

    1.1. Skill bridging program in Polytechnic Institute of Banteay Meanchey Province, Cambodia

        1.1.1. Skill bridge program definition

        1.1.2. The important of skill bridge program

        1.1.3. The Subject in the skill bridge program of PIBMC

    1.2. Skill on chemistry in Polytechnic Institute of Banteay Meanchey Province, Cambodia

        1.2.1. Definition of learning chemistry for the skill bridge program

        1.2.2. The content of learning chemistry for the skill bridge program

        1.2.3. The Objective of learning chemistry for the skill bridge program

2. The concept and theory related handbook of chemistry instruction

    2.1. Definition of handbook

    2.2. Procedure of development handbook

    2.3. Characteristics of handbook

    2.4. Type of handbook

    2.5. Component of handbook

    2.6. Research related with handbook

3. The concept and theory related with blended learning

    3.1. Blended learning

        3.1.1. Definition of blended learning

        3.1.2. Procedure of blended learning

1. The concept and theory related curriculum vocational in Polytechnic Institute of Banteay Meanchey Province, Cambodia

1.1. Skill bridge program of Polytechnic Institute of Banteay Meanchey Province

1.1.1. Skill bridging program definition

According to Ministry of Labour and Vocational Training, (2017) the term bridging or Skills bridging program (SBP) is a training program designed to prepare young people who won't have the opportunity to finish grades 7, 8, or 9 in the regular school system for further study in the TVET system.

Skill bridging program is bringing students up to the academic entry standard required by the government for certificate programs in technology and the standard established by the instructors who actually teach the certificate programs, so the prerequisite was competency rather than an arbitrary academic level. Additionally, the Skill Bridging Program (SBP) is a bridging program that involves a national qualification and is completed part-time in 17–18 weeks. It is being introduced to allow young people not currently in school to access the two years diploma program in skills development. After completing the SBP an assessment of performance is made at certificate level (1, 2, and 3), which is equivalent to grade 10, 11, and 12 of general education.

1.1.2. The important of skill bridging program (SBP)

Skill bridging Program has significance for the learner that used to abundant their study and they capable continue to study again. This program for the learner has a chance to get the new knowledge and continue to certificate level, and after capable study bachelor degree the same student finished general education.

1.1.3. The subject in the skill bridging program of PIBMC

Follow Sub-Degree No.175/KB.BrKBB dated 20 April 2017 of MLVT modified all technical training publications. Six disciplines make up the learning skill bridging program: gender, physics, chemistry, math, and employability skills.

What pupils know and can do by the end of the unit will be determined by the learning outcomes. For students to accomplish the specific unit learning outcome for chemistry, science instructors must choose and teach a sufficient number of these.

(Skill Bridging Program). By the end of this studied 24 hours, the student should be capable of;

1. Identify of table periodic and periodic table
2. Explain the matter, element, and capable the International Union of Pure and Applied Chemistry (IUPAC)
3. Identify characteristics of three physical state (liquids, solids, gases)
4. Carry out and report on a range of techniques for separating mixtures, including filtering and vaporization (for example, to produce pure water)
5. Specify the physical characteristics, chemical reactions and usefulness to society of the following groups of substances: Carbon, hydrogen and oxygen, acids, bases and salts

Table 1 the subject of learning skill bridging program

No	Subject	Time(hour)
1	Khmer	38
2	Mathematics	68
3	Physics	46
4	Chemistry	24
5	Gender	5
6	Employability Skills	5

Table 2 structure and levels of the Cambodian Qualifications Framework (CQF)

CQF Levels	Technical and Vocational Education and Training	Higher Education	Minimum Credits
8	Doctoral Degree of Technology/Business Education	Doctoral Degree	54
7	Master Degree of Technology/Business Education	Master Degree	45
6	Bachelor of Technology/Business Education	Bachelor Degree	120
5	Higher Diploma of Technology/Business Education	Associate Degree	60
4	Technical and Vocational Certificate 3	Secondary Education	30
3	Technical and Vocational Certificate 2		30
2	Technical and Vocational Certificate 1		30
1	**Vocational Certificate**		30

Table 3 levels of the Cambodian Qualifications Framework (CQF) in Polytechnic Institute of Banteay Meanchey Province

No	Levels of qualifications
1	Associate degrees /High diploma
2	Certificate level 3 / Diploma level training 3
3	Certificate level 2 / Diploma level training 2
4	Certificate level 1/ Diploma level training 1
5	Vocational Certificate **(Skill Bridging Program)**
6	Certificate (short course training)/4monts and 7 days

1.2. Skill on chemistry Polytechnic Institute of Banteay Meanchey Province, Cambodia

1.2.1. Definition of learning chemistry for the skill bridging program

Students must learn and comprehend the subject thoroughly because chemistry is one of the knowledge fields that has practical applications in daily life. However, because pupils have a range of potential and abilities when it comes to understanding chemistry topics, the process of studying chemistry itself is not straightforward. Chemistry is the study of the nature, traits, and makeup of matter, as well as how this change.

According to Salman et al., (2011) agreed that chemistry is a fundamental science that serves as the fundamental building block for many other fields, including biology, physics, plant sciences, engineering, geology, medicine, cosmetics, nuclear chemistry, and environmental science.

Mann (2011) concurred that because it closely examines matter, energy, and their interactions in the events of our everyday lives, chemistry is often regarded as a major discipline among the sciences. Understanding chemistry can aid in the explanation of many natural occurrences as well as changes in materials.

Follow dictionary of Merriam-Webster (1828) wrote that chemistry is a science that examines the make-up, structure, and characteristics of substances as well as the changes that they undergo.

In addition, chemistry is the branch of science and study of atoms, molecules and materials, their properties, composition and reactions, and how chemical processes work in the environment around us and in the industrial contexts. Chemistry instruction can use multimedia products that are students-centered, and allowing the students to work at their own comfort level.

1.2.2. The content of learning chemistry for the skill bridging program

In the Polytechnic Institute of Banteay Meanchey Province, the content of learning chemistry for the skill bridging program level students follows in the table 4.

Table 4 the content of learning chemistry

Unit	Sub-unit	Learning outcomes	Number of Periods	
			Sub-unit	**Total**
Unit 1: Atoms and Molecules	1. Atoms and Molecules	➢ Identify the structure of atom. ➢ Identify how to build some simple models of atoms and molecules. ➢ Identify the protons and neutrons in the nucleus and write down the atomic number (Z) and mass number (A) of each element.	2	6
	2. Periodic Table	➢ Identify the name and the symbol of an element. ➢ Identify the element use in daily life. ➢ Investigate and explain in simple terms differences between metals and non-metals	4	
Unit 2: Matter	3. State of matter	➢ Identify and explain the differences three state of matter as liquid, solid, and gas. ➢ Understand and describe the processes that occur when matter change state.	2	6
	4. Properties of Matter	➢ Conduct and report on experiments to learn about how matter changes physically and chemically. ➢ Define the terms "physical changes" and "chemical changes." ➢ Identify difference between a physical and chemical changes of matters.	2	
	5. Classification of Matter	➢ Identify the separations mixture techniques to develop an understanding in daily life ➢ Distinguish between homogeneous and heterogeneous matter	2	
Unit 3: Chemical reaction	6. Chemical reaction	➢ Understand what chemical reactions in daily life ➢ Identify the reactants and products	2	4

Unit	Sub-unit	Learning outcomes	Number of Periods	
			Sub-unit	**Total**
	7. Balancing chemical Equations	➢ Explain how chemical reaction equations are written and balanced ➢ Identify an unbalanced chemical equation, balance it by inspection	2	
Unit 4: Solution	8. Prosperities of Solutions	➢ Explain the meaning of and the difference between the following terms: solutes, solvents and solutions ➢ Explain saturated and unsaturated of solution ➢ Calculate mass of solute and solvent, percentage concentration, mole of solute, volume of solution, and molarity.	4	8
	9. Acids and Bases	➢ Classify solution as acid and base in daily life by pH scale ➢ The students are able to distinguish between strong acids and weak acids as well as between strong bases and weak bases in terms of pH. ➢ Identify different between acid and bases	2	
	10. Salts	➢ Explain the applications of various salts in daily life. ➢ Identify the acidic salts, basic salts, and neutral salts ➢ Explain the neuralization reaction	2	
		Total		**24 hours**

According to the table 4, all of this curriculum is chemistry subject. The researcher used all this contents for develop to chemistry instructional handbook by blended learning.

1.2.3. The objective of learning chemistry for the skill bridge program

Learning chemistry has objective as follow as:

- To encourage the learner to take an active part in class
- To encourage the learner to develop unexpected and spirit of a business organization
- To teach good laboratory practice and skills
- To teach the learner to analyze data from experiments or from other sources
- To provide the learner with some insight into future career prospect in the fields related to chemistry

- To provide the learner understand about chemistry and continue to study up level.

2. The concept and theory related handbook of chemistry instruction

2.1. Definition of handbook

According to Duangtillee (2017) definition of handbook is the document that provides knowledge related with doing something for the users by expected the reader or the users understand and capable to manage the matter correctly by themselves, achieve the same rhythm.

Phumphuengphut (2011) explained that handbook is the book that written for the way of the users to understand education, code of conduct, to enhance engage study, organizing activities to achieve the goals that effectively defined, capable follow correctly and appropriately.

Geerativara (2003) argued handbook mean that the publication document or systematically written books have illustration and various chart to get the knowledge, understand, facilities and the guideline for the learner got the knowledge of any matter to easy to understand.

Dictionary of Merriam Webster (1828) argued handbook is a short book that provides helpful knowledge about a certain subject or a book that can be comfortably carried as a fast reference.

As mention above, handbook as the book, document, or text book that details teaching content, methods, decorated for facilities to expect the readers and the users understand by themselves correctly and easy practice to achieve objective that set allows students to have ability and skill, and providing details briefly of that matter to the reader use handbook to practice or study interesting topics as well.

2.2. Procedure of development handbook

All the operations need principles and methods to guide for purpose. Handbook is an objective set for the purpose, method, and guidelines to make the operation of activities to develop the learners. According to Geerativara (2003)divided procedure of handbook development 4 process follow as;

1) Basic data exploration and requirement
2) Guide outline development

3) Apply handbook

4) Evaluation and Improved

As mention above, the procedure developments of handbook have planning, applying, and evaluation and improved.

2.3. Characteristics of handbook

Development of handbook must be considering the necessary characteristic of handbook because the users or handbook education will be interesting or does not depend on the appearance of good handbook. According to Chaiwut, S. (2017) showed the characteristic of handbook have 3 parts such as;

1) The content; the content presentation should be appropriate to the knowledge of the person who will study and the readers can implement of information contained in the handbook.

2) The form: the characters used should be large in size and clear, easy to read suitable for handbook users.

3) The implement: have chart, table, and an example can be practice.

Phuangsiri, S. (2016) explained that characteristic of handbook needs to have the content relevant to the subject to be studied is not too poor, readers can easily understand, have beautiful image and interesting, the letters are the right size, pictures, can be used for practical purpose, and the steps are clearly identified.

Chimpong, P. (2012) showed the technique of writing handbook need to have the content not too poor, easy to read, clearly, emphasize the method of achieving the objective in the same direction and have example, graph, chart, diagram, design process of handbook that interest have reference able to search more.

Phumphuengphut (2011) suggested that characteristics of good handbook that suitable with researcher have;

1) Modernity

2) Knowledge correctly, clearly, easy to understand, able to create knowledge, understanding

3) Practice by process

4) Suitably of method

5) The picture is beautiful

6) Durable to use

Phaophung, K. (2005) argued that characteristics of good handbook should include large characters, understandable text, an engaging structure, and a moderate size (have chart, table, picture and example capable implement), the system of procedures and handbook methods are clear, the learner should have the same comprehension and be able to execute after studying the manual, and the presentation system should range from simple to difficult or clearly, accurately of material and clearly.

As mention above, characteristics of handbook have content, knowledge correctly, suitably of method and modernity.

2.4. Type of handbook

According to Phuangsiri, S. (2016) showed that handbook capable divided into many types that depends on the purpose of the handbook; have both academic characteristics and general with the aim of readers or understanding users and can operate on that matter by themselves correctly.

Phumphuengphut (2011) divided the kind of handbook 2 types such as;

1) Instruction handbook of curriculum; as handbook that recommended method or teaching technique, use the book or innovation that relationship with other subjects or level of study that defined in curriculum such as course handbook, level of class handbook, handbook use innovation book instruction.

2) Activities of general handbook; as the handbooks that recommend of method or technique of perform other activities to enhance teaching and learning by achieve curriculum that defined. And as a guide that related the content or explanation other subjects by directed such as handbook for organizing democratic activities in school, handbook to moral encourage activities.

As mention above, the kind of handbook have many types such as; handbook of teaching activities, instruction of handbook by curriculum and innovation.

2.5. Components of handbook

According to Englin (2018) divided component of instruction handbook as;

1) Table of Contents

2) Using teacher handbook

3) Course objectives

4) Course description

5) Teacher instruction for the laboratory, quizzes, and examination

6) Suggested daily Schedule

7) Worksheets and laboratory reports, quizzes, and exams

8) Answers to worksheets, laboratory reports, quizzes, and exams

Jindanet (2010), argued of component instruction handbook as;

1) Introduction of using handbook include of
   - Objective
   - How to use teacher handbook
   - Basic knowledge of using handbook
   - Methodology
   - Recommendation

2) Content of teaching such as introduction or explain and analyze content to the learner easy understand.

3) Teaching preparation such as Preparation of place, methodology, tool/material/equipment, practice, and teaching activities.

4) Procedure, method, and instruction activities is most important of handbook as guideline of process and method, example and teaching activities, question, practice, and other media that use in teaching.

5) Assessment and evaluation are an essential component of teaching such as measurement of tool/equipment, method, and evaluation criteria.

6) Resource is considered of users' need and estimate the user often face problem and make or find data to encourage teachers 'knowledge of teaching more effective.

7) Problem and recommendation related with prevention and problem solving.

8) Reference

Bowyer (2009), divided the elements of handbook as;

1) Content

2) Aims and Objects of Teaching

3) Place of Chemistry in Science

4) Programmed Teaching

5) The Background

6) Role of the Teacher and Laboratory

7) Methods of Teaching

8) Teaching Aids

Yanimu Ecneme Pagelio (2006) component of handbook as;

1) The content

2) Secretary’s message

3) Introduction

4) Learning and teaching

5) Assessment

6) Planning and programming

7) Recording and reporting

8) Glossary

9) Appendixes

Miphlai(2006) component of handbook as;

1) Introduction

2) Content

3) Procedure, Method, and teaching activities and using media

4) Assessment and evaluation

5) Resource

6) Problem and recommendation

7) Reference

Kraiemak (1998) had created component of handbook follow as;

1) Introduction include of;

- Objective
- How to use teacher handbook
- Basic knowledge to use handbook
- Methodology
- Recommendation

2) Content of teaching such as introduction or explain and analyze content to the learner easy understand.

3) Teaching preparation such as preparation of place, methodology, tool/material/equipment, practice, and teaching activities.

4) Procedure, method, and instruction activities is most important of handbook as guideline of process and method, example and teaching activities, question, practice, and other media that use in teaching.

5) Assessment and evaluation are an essential component of teaching such as measurement of tool/equipment, method, and evaluation criteria.

6) Resource is considered of users' need and estimate the user often face problem and make or find data to encourage teachers 'knowledge of teaching more effective.

7) Problem and recommendation related with prevention and problem solving.

8) Reference

Changkhwanyurn (1996) had created component of handbook follow as;

1) Introduction

2) Objective

3) Content

4) Preparing to teach

5) Procedure

6) Resource

7) Problem and recommendation.

8) Reference

After analysis the documents and research on the components of handbooks from 8 academicians such as Englin, (2018), Jindanet, (2010), (Meporn, 2009), Bowyer, (2009), Yanimu Ecneme Pagelio, (2006), Kraiemak, (1998), and (Changkhwanyurn, 1996), it is found that the components of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for skill bridging program of Polytechnic Institute of Banteay Meanchey Province have 17 main issues by the author choose 9 components that suitable for chemistry instructional handbook follows as;

1) Introduction of handbook

2) Objective

3) The content

4) Preparing to teach
5) Procedure, Method, and teaching activities
6) Assessment and evaluation
7) Resource
8) Problem and recommendation
9) Reference

Table *5* the results of analysis previous research papers of component's instruction of handbook

No	**Component's instruction of handbook**							
	Englin (2018)	Jindanet, (2010)	Meporn, (2009)	Bowyer (2009)	Yanimu Ecneme Pagelio, (2006)	Miphlai (2006)	Kraiemak (1998)	Changkh wanyurn (1996)
1	Using teacher handbook	Introductio n to use handbook	Introducti on		Introduction	Introduction	Introductio n to use handbook	Introducti on
2	Course objective	Objective		Aim and Objective			Objective	Objective
3					Secretary's message			
4	Course descriptio n							
5				Background				
6	Content	Content	Content	Content	Content	Content	Content	Content
7	Workshee ts and laboratory reports, quizzes, and exams	Preparing to teach	Preparing to teach	Place of Chemistry in science			Preparing to teach	Preparing to teach
8	Teacher instructio n	Procedure, Method, and teaching activities	Procedure	Method of teaching	Learning and Teaching strategies	Procedure, Method, and teaching activities and using media		Procedure
9	Suggested daily schedules			Programmed teaching	Planning and programmin g			
10				Role of the teacher and laboratory				
11				Teaching aids	Recording and reporting			
12		Assessmen t			Assessment and evaluation	Assessment and evaluation	Assessmen t and evaluation	
13		Resource	Resource			Resource	Resource	Resource

No	Component's instruction of handbook							
	Englin (2018)	Jindanet, (2010)	Meporn, (2009)	Bowyer (2009)	Yanimu Ecneme Pagelio, (2006)	Miphlai (2006)	Kraiemak (1998)	Changkh wanyurn (1996)
14		Problem and recommen dation	Problem and recomme ndation			Problem and recommenda tion	Problem and Solution	Problem and recommen dation
15		Reference	Reference			Reference	Reference	Reference
16					Glossary			
17	Answers to worksheet s, laboratory reports, and exams				Appendixes			

2.6. Research related with handbook

Samathi, C. (2017) investigated the dual education manual between secondary and vocational education at Sobmoei Wittayakom School in Mae Hong Son Province. The research found that there is the problem in analyzing the subject type and program, and field of job due to the lack of survey on the primary couldn't answer to the needs of students. Finally, there's no preparation for the lectures from Mae Hong Son Industrial and Community Education College. The results from the development of administrational manual for vocational education and secondary education learning together with curriculum educational (Dual education) of Sobmoei wittayakorn School, Mae Hong Son Province. There are three elements of manual; vocational education management approach in Sobmoei wittayakhom; the approach in forming curriculum structure of Sobmoei Wittayakhom; and teaching approach. The efficiency survey of developing administrative guidance for high school and vocational education learning together with curriculum educational presented four aspects; accuracy, appropriateness, feasibility, and benefits. The score was in the highest level by overall and by aspect ($\bar{X}$ =4.86, S.D=0.08). The aspect with the highest level score were the appropriateness ($\bar{X}$ =4.87, S.D= 0.10), feasibility ($\bar{X}$ =4.87, S.D= 0.21), accuracy ($\bar{X}$ =4.85, S.D= 0.10), and benefit ($\bar{X}$ =4.84, S.D=0.18) respectively

Duangtilee, K. (2017) researched about development of manual for application on smartphones and tables for science teachers in secondary schools. 30 secondary school science teachers from Sakonraj Community Network served as the study's sample group. Sakon Nakhon's Secondary Educational Service has 23 schools. The study's findings were as follows: 1) The cover, introduction, definition, content, and bibliography were crucial components of the handbook that was created to help science teachers choose which applications to submit for secondary school students., 2) A high level of agreement was reached on the handbook used to choose science teachers for secondary schools ($\bar{X} = 4.15\ S.D. = 0.30$)and 3) The high-level agreement on the user's perspectives for the guidebook for application selection for science instructors teaching in secondary schools ($\bar{X}$=4.30 S.D.=0.45).

Phonapichat, P. (2013) researched of development of manual for constructing mathematical problem-solving diagnostic test for primary school teacher by using item model and attribute hierarchy methods. The samples were split into two group; 1) a total of 1252 grade 6 students chosen by simple random sampling; and 2) a total of 13 primary school mathematics teachers chosen by purposive sampling. The diagnostic test for solving mathematical problems and interview record forms were the instruments used to collect the data, which were then analyzed using descriptive statistics and content analysis. Based on the application and Bayes' theorem, the diagnostic score computation was completed. The diagnostic test's validity was confirmed using difficulty parameter analysis and discrimination, a two-parameter item response model, content validity, Hoyt's reliability, and inter-rater reliability. The study reveals that: 1) Students made reading comprehension errors where they were unable to discern between words when performing mathematical tasks; “what the problems ask”, “what the problem provide’, errors in interpretation significant enough to prevent correct translation of works into mathematical operation, and errors in calculation, especially in fractions where most errors were seen. 2) The development of the mathematical problem-solving diagnostic test, using item model and attribute hierarchy methods, consisted of main processes as follows; defining and sorting attributes, construction the attribute hierarchy model, constructing a Q-matrix defining the test attribute, constructing the test based on the Q-matrix, calculating the diagnostic scores for each attribute, and developing the diagnostic test using item model. The diagnostic test has its item difficulty at (-2.14)-1.06. The item discrimination is 0.77-3.07. The content validity is 1.00. Hoy’s reliability is 0.84. The inter-rater reliability is 0.90. 3) Students obviously had mastery in word problem reading and keyword interpretation; however, they lacked mastery in adding and subtracting mixed numbers attributes. 4) The use of the manual suggested that the teachers were able to construct a test based on item model and attribute hierarchy methods, but it took some time for them to study how to construct a diagnostic test from the manual, as it was a new and unfamiliar method. Moreover, there were several technical terms that the teachers needed to study further, such as attribute, Q-matrix.

Thaweesak, S. (2012) researched of development of a handbook to motivate unmotivated secondary school student: mixed methods research. The research findings were as the followings; 1) the secondary school students had the medium level of motivation. The study found that gender interacted with the level of academic achievement. That is the students who got higher academic achievement had higher level of motivation than the students, especially, the female students, who got lower academic achievement. The study further revealed that at some the level of academic achievement, the male students had higher level of motivation than the female students did. The factors of unmotivated students were sociocultural factor, classroom environment factor, and internal factor. 2) The strategies of motivation for unmotivated students could be divided into 13 strategies; tangible reward strategy, intangible strategy, leadership strategy, discipline strategy, confidence strategy, level of expectation strategy, communication strategy, class management strategy, instructional strategy, competition and cooperation strategy, building relationship strategy, learning by yourself strategy, and cooperation with parents’ strategy. 3) The results of evaluating the handbook of reinforcing motivation for unmotivated students was revealed that the handbook was qualified and could be applied to unmotivated secondary school students.

According to all the research found that, the important elements of the development of the manual for science teachers teaching in secondary schools as followed; introduction, definition, content, and bibliography. The efficiency survey of the development of administrational manual for vocational education and secondary school learning together with curriculum educational presented four aspects are accuracy, appropriateness, feasibility, and benefits. The handbook of reinforcing motivation for unmotivated students was revealed that the handbook was qualified and could be applied to unmotivated secondary school students and the teachers were able to construct a test based on item model and attribute hierarchy methods.

3. The concept and theory related blended learning model

3.1. Definition of blended learning

Online education is defined as all forms of teaching and learning using the internet including; blended learning, online learning, e-learning, web-enhanced learning, hybrid learning, flipped classroom, MOOCs (massive open online courses), and adaptive learning. Blended models, possibly the most popular use of online education technology today, have blossomed and represents instructional application across a wide spectrum of education(Picciano, 2019a). The blended means that traditional instructor-led training is being supplemented with electronic formats. Different meanings of blended learning given are as follows:

According to Whitelock & Jelfs, (2003) identified three definitions of blended learning: 1) "the integrated combination of traditional learning with web-based on-line approaches", 2) "the combination of media and tools employed in an e-learning environment", and 3) "a combination of a number of pedagogical approaches, which is not necessarily dependent on the use of learning technologies".

Oliver & Tingwell (2003) as cited in Department of Education and Early Childhood Development, (2012) argue that blended learning as the practice of mixing traditional classroom methods with technology.

Singh & Machkey, (2009) the term blended learning is currently conceived as the combination of technology and traditional face to face instruction.

Wardenski, Bazzo de Espindola, et al., (2012)defined blended learning as the combination of classroom learning methodologies, where some units or activities use onsite strategies and others use ICT mediation.

Sánchez-Adsuar & Molina-Jordá (2014) blended learning use of a learning system that combines internet and digital media with established classroom forms that require the physical co-presence of teacher and students.

Kantunyaluk (2014) showed the meaning of blended learning is integrate web based blended instruction based on the concept of technology. Teaching and learning model and onsite classroom between teacher and student by using information technology to help communication via the system of network internet, for support instruction by focus on the interaction from online learning through the network and participation in traditional learning, for develop learning challenges and respond of they need, allowing the students to develop their ability by themselves.

Li & Tang, (2017) argue that blended learning refers to connecting onsite teaching and learning with information and communication technologies (ICT). Blended learning based on an appropriate combination of learning theories such as behaviorism, cognitivism, and constructivism.

Shu & Gu, (2018) agreed that blended learning is facilitated by technology and referred to as hybrid learning or blended learning, which means that combine technology with onsite teaching in the classroom.

Kavitha & Jaisingh, (2018) blended learning is one of the forms of e-learning in which e-learning is integrated into traditional classroom learning, using a computer, internet, or smart classroom, where the teacher meets the student onsite and interaction between students and teachers is built into the course design.

As mention above, the term blended learning is an the instructional by blended digital technology (hardware and software tools) with onsite teaching in the classroom.

3.2. Procedure of blended learning

According to Li & Tang (2017) divided of blended learning process 4 parts below as;

1) Learning environment design
2) Classroom teaching
3) Online teaching
4) Learning assessment

Shen (2016) studied about blended learning activities in a chemistry divided of blended learning process 4 process follow as;

1) Preview stage: activities for theoretical knowledge
2) Operation stage: activities for experimental skills
3) Consolidation and Improvement stage: activities for problem-solving,
4) Evaluation and Reflection stage: activities for evaluation and reflection.

Elmer et al., (2015) showed that of blended learning process 3 process follow as;

1) Pre-Lab activities
   - Read laboratory
   - Watch self-paced video demonstrations
2) Blended exercise physiology laboratory
   - I>clicker quiz and Micro lecture
   - Small group experiments, student driven
   - Presentation of results and class discussion
   - Questions and warp-up
3) Assessment
   - Lab reports
   - Practicums

Sánchez-Adsuar & Molina-Jordá (2014)divided of blended learning process 4 process follow as

1) Interactive lectures
2) Problem’s resolution
3) Virtual laboratory
4) Seminars

Kantunyaluk (2014)divided of blended learning 5 process follow as;

1) Preparation
2) Problem Finding
3) Idea Finding
4) Solution Finding
5) Acceptant Finding

Hartfield (2013)divided of blended learning process 7 process follow as;

1) Lectures (face to face) with lecture notes available online
2) Lecture podcasts (mp3) and Adobe Presenter presentations available online
3) Class tutorials (face to face) to support exam preparation and completion of progressive assessment items

4) Practical laboratory classes with extensive practical support, data analysis, and data interpretation support available online

5) Self - assessment multiple choice and short answer question quizzes available online

6) Textbook resources, web–based animations, review of foundational concepts available online

7) Weekly announcements communicating information about teaching, learning and assessment activities (Blackboard and class emails)

Graham (2006) the characteristics of blended learning are summarized as follows;

1) Blended learning strategy combines different types of internet-based technology to achieve educational goals.

2) The blended learning strategy is a hybrid of traditional methods of education with technology and the internet.

3) Blended learning integrates different teaching methods based on multiple theories such as constructivism and behavioral theory.

4) Blended learning is an education program that consists of in-person classroom time as well as individual study online through e-learning applied and the internet.

Driscoll (2002) argued the blended learning approach must be student-centered and use selection process;

1) Combining or mixing web-based technology to accomplish an educational goal.

2) Combining pedagogical approaches (e.g, constructivism, behaviorism, cognitivism) to produce an optimal learning outcome with or without instructional technology.

3) Combining any form of instructional technology with face-to-face instructor-led training.

4) Combining instructional technology with actual job tasks.

As mention above, the blended learning process are combining pedagogical approaches to produce an optimal learning outcome with or without instructional technology. Combining instructional technology with actual job tasks. (Driscoll, 2002)

3.3. Characteristics of blended learning

According to Khan et al., (2012) suggested that characteristics of blended learning have 4 such as;

1) Face to face: Students capable study basic course in face to face.

2) Self-paced e-learning: Instructor can implement the practical part of lecture in the lab.

3) Live e-learning: Instructor can give lecture and additional learning contents via e-learning environment.

4) The practical part of the lecture can be simulated and available via e-learning environment.

O'Connell (2016) guided to blend learning there were 7 model such as;

1) Blended face-to-face class: sometimes called the "face-to-face driver model," is based in the classroom, although a significant amount of classroom time has been replaced by online activities. Seat time is required for this model, while online activities are used to supplement the in-person classes; readings, quizzes or other assessments are done online at home. This model allows students and faculty to share more high-value instructional time because class time is used for higher-order learning activities such as discussions and group projects.

2) Blended online class: Sometimes referred to as the "online driver model," this class is the inverse of the blended face-to-face class. The class is mostly conducted online, but there are some required in-person activities such as lectures or labs.

3) The flipped classroom: reverses the traditional class structure of listening to a lecture in class and completing homework activities at home. Students in flipped classes watch a short lecture video online and come into the classroom to complete activities such as group work, projects or other exercises. The flipped classroom model can be seen as a sub-model of the blended face-to-face or blended online class.

4) The rotation model: students in a course rotate between various modalities, one of which is online learning. There are various sub-models: station

rotation, lab rotation and individual rotation. Some of these sub-models are better suited to K–12 education; station rotation, for example, requires students to rotate between stations in the classroom at an instructor's discretion.

5) The self-blend model: While many of the blended learning models on this list are at the Course level, self-blending is a programmed-level model and is familiar to many college students. Learners using this model are enrolled in a school but take online courses in addition to their traditional face-to-face courses. They are not directed by a faculty member and choose which courses they will take online and which they will take in person.

6) The blended MOOC: is a form of flipped classroom using in person class meetings to supplement a massive open online course. Students access MOOC materials perhaps from another institution or instructor if the course is openly accessible outside of class and then come to a class meeting for discussions or in-class activities.

7) Flexible-mode courses: Flexible-mode courses offer all instruction in multiple modes in person and online and students choose how to take their course.

Heather et al., (2011) the rise of K-12 blended learning there were six models summarized as follow:

1) Face to face: The most teacher in the classroom use online learning on occasionally to supplement the learning that can take place in the back of the classroom or technology lab.

2) Rotation: Students revolve between in classroom and online learning. It frequently happens within a given course between traditional face to face learning and teaching and online instruction with a fixed schedule. It involves a split into parts in some case, between remote and onsite.

3) Flex: Online curricula with teachers to provide onsite support or tutoring session. It can be one-on one or small group sessions.

4) Online Lab: Students learn with teacher through online delivery but in a school location.

5) Self-Blend: Students take one or more courses in order to supplement face to face session.

6) Online driver: Students learn from online mode anywhere for most part and face to face can sometimes be optional and required.

Michael B & Heather (2012) classifying of K-12 blended learning there were four models, the most blended learning works on one of these four models as shown in Figure 2

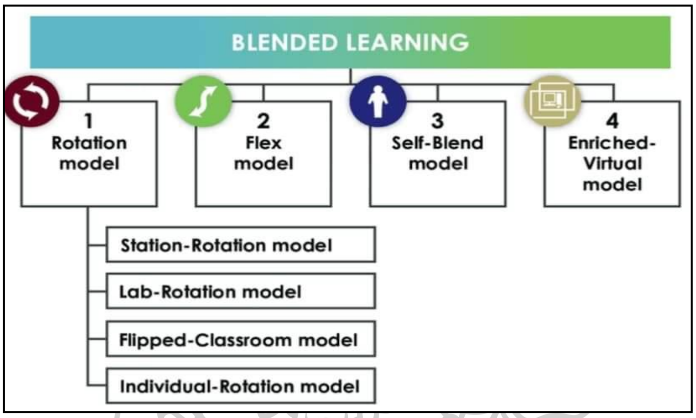

Figure 2 blended learning model (https://www.christenseninstitute.org)

1) Rotation model: students rotate through different models of learning. At least one of them is online or digital in nature and commonly comprises of four models such as

1.1) Station Rotation model is one of the primary models which are Flex model and Rotation model. Students in this model will rotate to different stations from face to face or teacher-led instruction to online learning in classroom or a computer lab.

1.2) Lab Rotation is similar to the station Rotation model, except students will rotate to a computer lab for online session instead of rotating within a classroom.

1.3) Flipped Classroom is a course that students participate in online learning outside classroom and then attend face to face instruction for teacher-led practice or projects.

1.4) Individual Rotation is a course that each student has their own rotating schedule which is set by the teacher individually.

2) Flex model: students do the learning mostly online, still done at the school under teacher supervision (The teacher provides support in face-to-face session which is flexible and adjustable by using activities such as small group learning, group projects, and tutoring.), and except for any homework assignments. This model

encourages learner to work independently and learn at their own speed in order to support their learning since students have different level proficiency.

3) A La Carte (Self-blend model): students capable select their own online course beside face-to-face instruction.

4) Enriched Virtual model: students capable generally learn in face-to-face learning sessions with their teacher of record and then are free to complete their remaining coursework remote from the face-to-face teacher.

Valiathan, (2002) identified a number of blended learning models as follows;

1) Skill-driven model: is combines self-paced learning with instructor or facilitator support to develop specific knowledge and skill.

2) Attitude-driven model: is mixes various events and delivery media to develop specific behaviors.

3) Competency-driven model: is blends performance support tools with knowledge management resources and mentoring to develop workplace competencies.

As mention above, characteristics of blended learning that fixed with chemistry instructional handbook is blended media or technology based in the classroom, although a significant amount of classroom time has been replaced by online activities use digital technology. Seat time is required for this model, while online activities are used to supplement the in-person classes; readings, quizzes, game app or other assessments are done online at home and in the classroom.

3.4. Levels of blended learning

According to Gruba, P., & Hinkelman, L. (2012) referred to a course is considered a blended/hybrid course when online activities replace 45-80% of face-to-face class meetings.

Table 6 levels of B-learning course proposed by Sloan, C. (2007)

Type of course	Description	Proportion of content delivered online
Traditional	A complete traditional course, no online technology used.	0%

Type of course	Description	Proportion of content delivered online
Web facilitated	A course which uses web-based technology such as LMS, CMS to facilitate the face-to-face course.	1 to29%
Blended/Hybrid	A course which combines online and face to face delivery. Online communication deliveries, such as online discussion, e-mail, and chart are used as a substantial for face-to-face meetings.	30 to 79%
Online	A course which most of the content is delivered online, there is no face-to-face meeting at all.	80 up %

The review above can be summarized that the proportion of content deliveries consists 30% and 79% of online content since the amount of online activity, communication, and content are greater than these implements in onsite in the classroom.

3.5. Components of blended learning

According to Rovai & Jordan, (2004) state that the components of blended learning consist of 4 components follow as;

1) Blended multimedia and virtual internet resources, there are;

- Video or DVD
- Virtual field trip
- Interactive websites
- Software packages
- Broadcasting

2) Classroom websites to create web-blended learning environment for post or announce assignment, homework, test, achievement, class policies, etc. The teacher has to create the website; to self-instruction or linked to website that relevant important component of using web enhanced classroom, and to successes blended learning has 4 components as; administration, assessment, content, and community.

3) Course Management Systems: CMS/Learning Management Systems: (LMS): the teacher uses learning management system in blended learning management to communication and learning activities in the classroom such as distribution of teaching materials, and set the deadline for submitting assignments. collection assignment of instruction management system that suitable with web based blended learning such as; WebCT, Blackboard, MOODLE, Joomla, and Edmodo. etc.

4) Synchronous and Asynchronous Discussion: blended learning approach as blended learning activities in traditional classroom and online learning. The use of online learning technology is added to the environment in the face-to-face learning of synchronous and asynchronous discussion by instructor sets the topic to discuss and facilitate and trying to create a learning environment as classroom.

Valiathan (2002) and Carman (2005) summarized components of blended learning 6 mains as;

1) Face to Face: is learning and teaching that the learner and instructor stay in the same place and time such as lectures or traditional classroom which the learner able to participate at the same time.

2) Live Event: is using technology to instruction that the learner and instructor participate at the same time but it's not the same place (Virtual classroom). Virtual classroom is synchronous focus on attention, relevance, confidence, and satisfaction.

3) Self-Paced learning: as self-study from CD-ROM or internet and the readiness of themselves will developing of their learn. This instruction is synchronous or collaboration by the learner use technology to study but they do not connect to the other learners or instructor at the same time.

4) Collaboration: as communicating with others, both the learner and instructor as well as stakeholders and experts by e-mail or real-time chat which has 2 characters of cooperation as; peer-to-peer and peer-to-mentor.

5) Assessment: as measurement and evaluation of learning both before, during, and after learn to assessment the achievement learning of the learner in different stages.

6) Performance support materials: as e-document (such as portable document format), teaching aids, and download document to improve the learner learn more.

Aryujaroen (2014) divided component of blended learning 3 parts as follow:

1) Support System is related to the program, course or equipment as the principle that use in instruction by online with the technology of Internet.

2) Courseware is a content which presented in media form, mostly it is combined from a media to another for the learning process.

3) Communication refers to a communication between students and teacher. It may in the form of Synchronous and Asynchronous.

Clark & Mayer, (2003) state that component of blended learning has 2 group such as;

1) Offline: there are 6 components as;
   - Workplace
   - Face-to-face tutoring, coaching or mentoring
   - Classroom
   - Distributable print media
   - Distributable electronics media
   - Broadcast media

2) Online: there are 6 components as;
   - Online learning content
   - E-tutoring, e-coaching, or e-mentoring
   - Online knowledge management
   - The Web
   - Mobile learning

Carman, (2005) state that blended learning should contain five components such as;

1) Live Events: as Synchronous, instructed learning events in which all learners participate at the same time, such as in live" online classroom"

2) Online content: as interactive, web-based, or CD-ROM training are examples of self-paced education that each learner completes independently at his own leisure.

3) Collaboration: as the ability to speak with people in the classroom by online media such as E-mail, Chat, Blogs, and Edmodo.

4) Assessment: as evaluate of learners' knowledge all level. Evaluation on pre-assessment, self-paced evaluation, and post-assessment. Prior knowledge can be evaluated using pre-assessments before live or self-paced evaluation, and learning

transfer can be evaluated through post-assessments after live or self-paced learning events.

5) Supporting Materials for Performance: on-the-job reference materials, such as printable references, summaries, and task aids that improve learning retention and transfer.

As mentioned above, blended learning's component parts should consist of two components that suitable with chemistry instructional handbook by blended learning follow as;

1) Blended digital technology or multiple media there are; software packages, hardware, video or DVD, virtual field trip, interactive websites, broadcasting, and/or other application.

2) Classroom websites to create web-blended learning environment for post or announce assignment, homework, test, achievement, class policies, etc. The teacher has to create the website; to self-instruction or linked to website that relevant important component of using web enhanced classroom and to successes blended learning. The teacher uses learning management system in blended learning management to communication and activities for learning in the classroom such as distribution of instruction materials and set the deadline for submitting assignments. (Rovai & Jordan, 2004). The collection assignment of instruction management system that suitable with web based blended learning such as; Google classroom, Google form, Google meet, WebCT, blackboard, Moodle, or Edmodo.

3.6. Designing of blended learning

According to Kantunyaluk (2014) designed procedure for blended learning as follow:

1) Preparation of learner
2) Presentation content
3) Mention and analysis problem
4) Make category
5) Synthesize and test data
6) Conclusion principles and knowledge from the problem
7) Evaluation

Boonchob, D. (2014) conducted research on the comparison of group investigations with blended learning and regular groups in computer project subjects, blended learning design are;

1) Purpose Statement and analysis
2) Duration
3) Prerequisites
4) Learning objectives
5) Content/Learning
6) Application of learning strategy
7) Evaluation strategy

As mention above, design of blended learning is learning objectives, content, application of learning strategy, and evaluation.

3.6.1. Benefits of blended learning

The advantages of blended learning are stated in research by Dhakiria, H. (2012), who found that it can increase students' sensitivity. For a better learning outcome, the design must take the student's profile and background into account. To maximize the learning opportunities, students must be included in the learning resource and the learning materials. The student-centered paradigm is addressed. It is important to maintain and develop the learning culture that changed from a teacher-centered to a student-centered approach. The use of technology and in-person instruction together in blended learning maximizes learning. In the classroom setting, higher-order thinking about actual problems and circumstances is explored through role plays, case studies, and other discovery learning techniques. It is more efficient than the conventional method of instruction. Both students and institutions profit from blended learning. Improved learning results, flexible access, a sense of community, efficient resource usage, and student happiness are made possible by it. The chances it provides for learning, relearning, and having fun while learning is alluring.

Cleveland-Innes and Wilton highlights the following advantages of blended learning:

1) Opportunity for collaboration at a distance: individual students collaborate electronically in an intellectual project as a learning strategy.

2) Increased flexibility: With the help of technology, learning can take place at any time and any place, removing time and location restrictions while still offering the potential for in-person interaction.

3) Increased interaction: a platform provided by blended learning allows for increased interaction between students and between students and teachers.

4) Enhanced learning: students can learn at higher and more meaningful levels with the addition of different kinds of learning activities, which also increase engagement.

5) Learning to be virtual citizens: in a virtual community of inquiry, students practice presenting themselves both socially and academically. For someone to continue learning throughout their life, having digital learning abilities is becoming increasingly important. Blended courses assist students in developing these skills.

3.6.2. Challenges of blended learning

Jeffrey et al., (2014) reported that some teachers who had been integrating blended learning in their classes indicated their preference for traditional classroom over the blended one. They mentioned that the traditional classroom exerted stronger impact over the online course due to the presence of teachers. Furthermore, they also reported the frustration with the online course due to their inability to personalize the system and to maximize the real potential of the blended learning course. When interviewing further, the finding revealed that the prominent problem in this study was teachers’ lack of time. They could not invest a quality of time in accommodating online interactions since this affected their time in completing other school responsibilities.

Poon, (2013) said that both students and institutions encounter challenges presented by technology issues. Due to the limited options for social connection in a face-to-face classroom setting, students in these courses have also expressed feeling lonely. Unrealistic student expectations, student perceptions of isolation, technological issues for students, time commitment, technological issues for institutions, lack of support for course redesign, and difficulty learning new teaching and technological skills are some of the difficulties associated with blended learning. Students and colleges may face difficulties when using blended learning. Students have obstacles such as unrealistic expectations and feelings of isolation, and universities face challenges related to time and assistance.

Table 7 summary of the benefits and challenges of blended learning

Benefits	Challenges
Improved learning outcomes for students	Unrealistic learner expectations
More freedom for teachers and students	Perceived isolation of students
Enhanced self-reliance, introspection, and research abilities	Students' technological issues
Decreased rate of student dropouts	Invasion of other life domains
Ability to foster a professional learning environment	Commitment of time
Potential cost and resource savings	Institutional technological issues
	Lack of support for redesigned courses
	Difficulty learning new teaching and technological techniques

As mention above, among blended learning's advantages are; the learner have greater time flexibility working part of the time online and accessibility with up to date resources available online, the learners' interaction between the instructor and their peers are increased since the method provides more opportunities, learners' management, critical thinking, and problem solving were enhanced, with the number of withdrawals and somewhat higher grades, and the learner were blended learning experience. They can access to online course materials anywhere and anytime. They usually receive more frequent feedback from their instructors.

3.7. Research related with blended learning

Hinampas et al., (2018) studies on the blended learning approach's impact on students' academic performance and laboratory practical abilities are available. The findings indicated that students exposed to blended learning increased their academic performance from the pretest to the posttest and leveled-up their scores with those of non-exposed students. Interpreting, communicating, planning, recording, analyzing, and questioning were among the practical skills that students demonstrated. Further findings revealed that there was no appreciable difference in academic achievement between students exposed to a blended learning strategy and those exposed to a nonblended learning method; both groups increased their performance, failing to disprove the null hypothesis. Students who were exposed to the blended learning strategy demonstrated significantly different practical skills than students who were not exposed to the blended learning approach, refuting the stated null hypothesis.

Laisema (2018) researched on “Development of Collaborative Blended Learning Activity on Mobile Learning to Enhance Undergraduate Students’ Collaboration Skills” The research was as follows: 1) The mobile learning collaborative blended learning activity had two parts and comprised six aspects in total: students, teachers, mobile devices, content, mobile learning management systems, and assessments. Before instruction began, there were three steps in the learning process: student grouping, orientation, and pre-test. The collaborative blended learning activity consists of five steps: task definition, task planning, task implementation, task presentation and discussion, and task summary. The assessment consists of two steps: an evaluation of your collaborative skills and a post-test. 2) Following exposure to the produced learning activity, the students' ability to collaborate seemed to be at its best level. 3) The learning achievement of the students who had been using the collaborative blended learning activity on mobile learning was higher at a statistically significant level.01.4) the developed collaborative blended learning activity on mobile learning received the highest level of satisfaction from the students.

Sumethea & Sochetra (2017) studied on “The perception of teachers in using blended learning in higher education in Cambodia”. The contextual investigation is completed so as to look for a response to the inquiry with respect to whether blended learning can be coordinated into the educational plan of advanced education in Cambodia dependent on the impression of the essential partners, only instructors from advanced education foundation called Institute of Foreign Languages (IFL). The viewpoints investigated extend from the understanding and individual encounters with blended learning, saw focal points and detriments of blended learning, the likelihood for coordinating, to the impediments thwarting the execution of blended learning in advanced education framework. As envisioned, it has been discovered the focused-on instructors have seen the low nature of training in advanced education coming about because of the ordinary showing styles and, in result, are genuinely positive about the utilization of blended learning in Cambodian training framework.

Kantunyaluk (2014) the study's conclusions include the use of the blended learning instructional model, collaborative problem-solving learning, and Synectic's strategies to improve student teachers' capacity for original problem-solving. consists of the following 8 parts: 1) Group, 2) Problem, 3) Project, Product, or Work piece, 4) Content or Resources, 5) Synectic Techniques, 6) Communication and Cooperation Tool, 7) Online Learning Management System, and 8) Evaluation. The five learning steps were: (1) learner preparation, (2) problem identification, (3) idea identification, (4) solution identification, and (5) acceptance identification. The ability of creative problem-solving was significantly higher at the level of.05. This was achieved by experimenting with the blended learning instructional model combining collaborative problem-solving learning and Synectic's approaches. The level of "much" satisfaction among students who used a blended learning instructional model that combined group problem-solving activities with Synectic's methods for boosting student teachers' capacity for original problem-solving was reached with this method of learning. The components of the model were given "most" approval by the experts who reviewed the blended learning instructional model employing collaborative problem-solving learning and Synectic's technique to improve student teachers' capacity for creative problem-solving.

Hinkhouse (2013), treatment group, students used online scientific modules to augment their in-person training for one semester, while in the control group, only in-person instruction was provided. The results demonstrate no appreciable shift in students' attitudes toward science, and a post-test and pre-test testing science knowledge did not reveal any appreciable differences between the groups. When compared to the control group, the treatment group that had access to a blended learning strategy did demonstrate a significant increase in their understanding of science-related material.

Tinnangwattana, C. (2012) research related with the effect of blended learning instruction lesson plans in foods and nutrient title on science for matthayomsuksa II Mathyom Watsing School. The sample in this research were randomly 85 students of matthyomsuksa II wattongpleng school 45 students for develop of Blended learning instruction management lesson plans and 40 students for find out an efficiency of student's achievement before and after study. The research instruments were blended learning model in foods and nutrient the analytical test and the satisfaction toward blended learning. Data were analyzed using the mean. Percent, the t-test, and standard deviation. The findings of this research showed that; Blended learning instructional management lesson plans in foods and nutrient have good quality level in lesson and technology. Blended learning instructional management lesson plans in foods and nutrient have attained the efficiency index at 84.55/85.30. Student's achievement before and after study was significantly higher after experiment and the blended learning strategy received "high" levels of student satisfaction.

Banchuen, H. (2006), the study showed that; 1. The blended problem-based learning model for lower secondary school students in mathematics consists of;1) For students in lower secondary schools, the problem-based blended learning model in mathematics had nine parts: a goal or objective, instructional activities, types of instruction, computer and internet system, interactive method, learner roles, teacher roles, facilitator roles, and learning evaluation. 2) Instructional steps included pre-the problem-based blended learning model in mathematics, during-the problem-based blended learning model in mathematics, and post-the problem-based blended learning model in mathematics. 3) The problem must be presented, analyzed, information gathered, and a conclusion must be reached as part of the problem-based blended learning step. 2. It was discovered that the subjects covered in the mathematics problem-based blended learning model had statistically significant at.05 level. Post-test scores for learning achievement were higher than pre-test results.

According to all the research found that, the learner who was exposed to blended learning increased their academic performance between the pre-and post-test and leveled up their scores with those of the non-exposed students. Before instruction, preparation was a part of the learning process. The student's achievement before and after study was significantly higher after experiment and the blended learning strategy received "high" levels of student satisfaction.

4. The concept and theory related 7Es learning cycle model

4.1. Backgrounds and overview of the7Es learning cycle model

According to Lawson (1995) mentioned that the learning cycle was a method for lesson planning that first appeared in the United States in 1962. It was primarily created to develop the methods of teaching science, and it was a great success because it views learning as an investigative process that is in line with how students learn and gives them a great domain for effective planning for teaching. Each phase of the learning cycle model is derived from English phrases that represent learning processes with a capital letter "E". Bybee developed a constructive educational pattern that was divided into five stages (5E); Engagement, Exploration, Explanation, Elaboration, and Evaluation (Bybee, 1997). In 2003, Eisenkraft was modified the 5Es model into the 7Es model include the following steps: Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend (Eisenkraft, 2003).

Siribunnam & Rungrawee Tayraukham (2009), Madu & Amaechi, (2012) explain how students have the chance to interpret and develop their ideas throughout the learning cycle.

Polyiem et al., (2011) prior research, the implementation of the learning cycle model can aid students in learning because it immediately interacts with the environment to examine phenomena so that they can comprehend the concept of teaching materials and meet its learning objectives.

Polyiem et al., (2011) and Sornsakda et al., (2009) concluded that the learning cycle model can help students with their science process skills since it includes an exploration component that teaches students how to master all science process skills, from fundamental science process skills to integrated science process abilities.

Marfilinda et al., (2020) state that based on the cognitive development theory a learning approach in the shape of a learning cycle was proposed by Jean Piaget, Robert Karplus, and the director of the Science Curriculum Improvement Studies. The Science Curriculum Improvement Study (SCIS), an elementary school science curriculum, uses the learning cycle as a formal teaching technique. The learning cycle model was first used in elementary schools, and studies have shown that it is still widely used today at all grade levels, even those at the university.

4.2. Definition of the7Es learning cycle model

According to Sadeq (2003), the 7E's learning cycle is a teaching and learning strategy utilized by teachers with their students inside of the classroom with the goal of empowering the student to develop his or her scientific knowledge acquisition independently. It attempts to build a variety of other scientific concepts and abilities, relying on student motivation, research, curiosity, clarification, investigation, and growth, as well as connecting and correcting some of the students' incorrect concepts.

Khataibeh (2005) defined that the 7E's Learning Cycle has a lot of benefits that aid in helping students learn concepts and apply them in new contexts and real-world situations. It also helps students improve their scientific research skills, problem-solving techniques, communication skills, and teamwork spirit, as well as correct any misconceptions they may have had about earlier mathematical concepts related to the lesson's topic.

Polyiem et al., (2011) defined that the learning cycle is a constructivist-based inquiry learning process pattern that allows students to study scientific information using science process skills and to look for knowledge or significant self-learning experiences.

Ghaliyah et al., (2015) point out that the 7E learning cycle model replaces the 5E learning cycle paradigm.

Balta & Sarac, (2016) defined that the learning cycle as a paradigm of instruction that puts learners first.

Marfilinda et al., (2019) mention that regardless of how the student constructs their thought, the learning cycle model is a constructivist instructional approach.

As mention above, the 7Es learning cycle model is an instructional design model, for students to study scientific knowledge using their science process skills and to look for information or a major self-learning experience based on constructivism.

4.3. Procedures of 7E learning cycle model

According to Eisenkraft, (2003) pointed out that the 5E learning cycle model must be expanded to a 7Es learning cycle model in order to account for research on how people learn and how to use that knowledge to design lesson plans and curricula.

The 7Es learning cycle model adds the Elicitation and Extension phases. The 7Es learning cycle model consists of;

1. **Elicit:** the instructor strives to get the students interested in the topic and gauge their prior knowledge. Students are motivated by concept cartoons, video clips, animations, and straightforward scientific experiments.

2. **Engage:** to interest pupils and get their attention, teachers may do a basic experiment or point out an anomalous occurrence.

3. **Explore:** the questioning method is used to guide pupils as they examine and revise the material. By using brainstorming within the parameters of an activity linked to the subject, assumptions and hypotheses are established. To direct students and record the data, utilize a worksheet.

4. **Explain:** learning is attempted to be interpreted by students. In addition to giving a direct lecture, a teacher may also use videos, movies, idea maps, or presentations to illustrate the theories, concepts, laws, and facts.

5. **Elaborate:** the use of understanding in new contexts is encouraged among students.

6. **Evaluate:** using multiple choice, quizzes, puzzles, structured grids, and true-false questions to assess the students' learning in addition to formative and summative evaluation.

1) **Extend:** it is expected of students to apply and broaden their knowledge to situations in daily life.

Kanlı (2009) explained the 7Es learning cycle model consists of;

1) **Elicit** is the phase where questions and scenarios are used to elicit the learner's prior knowledge.

2) **Engage** is the time frame within which events become ingrained in routine activity.

3) **Explore** is the stage where pupils examine knowledge while adopting a scientist's mentality. Students are helped to explore knowledge at this stage.

4) **Explain** is the procedure by which students must explain their research.

5) **Elaborate** is the phase in which students build new knowledge.

6) **Evaluate**: students compare and contrast their findings with those of other students in or outside of their group.

7) **Extend**: this stage is where students apply their previously learned material to a new subject.

Adesoji & Idika (2015) explained the 7Es learning cycle uses seven phases to create an efficient learning process;

1) **Elicit:** the teacher focuses students' attention to or extracts from existing information and understanding. On top of current knowledge, new knowledge is developed. This aids in the dissemination of knowledge.

2) **Engage:** this phase concentrates student thought on the subject matter and provides conversation opportunities for all students, not just a few.

3) **Explore:** while the teacher checks for understanding, the students get to record data, isolate variables, plan experiments, make graphs, interpret results, and arrange findings.

4) **Explain:** during discussions and explanations of the ideas connected to the students' exploration, the instructor takes on a more central role. Lessons in this stage introduce students to the scientific language that enables them to explain their experiences and provides them the chance to relate their experiences to the scientific ideas being studied.

5) **Elaborate:** this stage of the learning cycle gives students the chance to apply their knowledge to new fields, which may involve posing fresh questions and hypotheses to investigate. Additionally, pupils may be required to answer associated math issues throughout this phase.

6) **Evaluate:** it is possible to evaluate in a formative, summative, formal, or informal way. The teacher evaluates the level of accomplishment of the goals.

7) **Extend:** this stage was originally included to the program for the purpose of explicitly reminding teachers of the value of having pupils practice applying what they have learned. Teachers must ensure that learning goes beyond basic elaboration and is applied in fresh contexts.

As mention above, in the 7Es learning cycle model, there are elicit, engage, explore, explain, elaborate, evaluate, and extend(Eisenkraft, 2003). The 7Es learning cycle model is suitable with chemistry instructional handbook by blended learning.

Flow chat of 7Es learning cycle

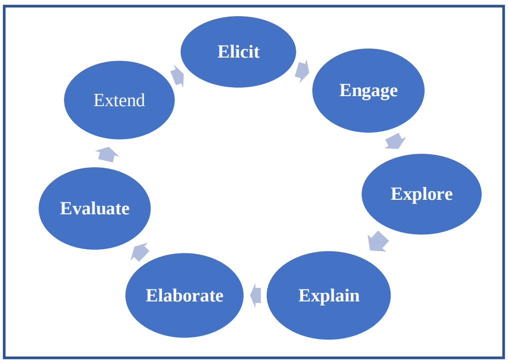

Figure 3 flowchart of the 7Es learning cycle model

Table 8 the results of analysis previous research papers of learning process (7E learning cycle models)

Karplus (2003)	Bybee (2014)	Eisenkraft (2003) Kanlı (2009), Adesoji & Idika, (2015)
Explore	Engage	Elicit
		Engage
	Explore	Explore
Explain	Explain	Explain
Expand	Elaborate	Elaborate
	Evaluate	Evaluate
		Extend

5. The Concept and theories related instructional media

5.1. Instructional media definition

Educational technologies are not single technologies but complex combinations of hardware and software.

According to Nyame (2006) explains that educational media are different items that appeal to the five senses—seeing, hearing, touching, feeling, and testing—and that this improves teaching and learning.

Naz & Akbar, (2010) argued that repeatability, portability, and enhanced equity access are just a few benefits of instructional media.

Vebrianto & Osman, (2011) argued that one of the most significant aspects of the teaching and learning process is the use of media in instruction.

Siahaan, (2007) as cited in Vebrianto & Osman, (2011) defined to improve teaching and learning, the curriculum now includes media teaching and learning as one of its educational components. A wide variety of instructional media, including textbooks, television, props, specimens, images, computers, and even the physical environment, must be changed in order to enhance teaching and learning.

Makewa et al., (2012) argued that utilizing educational materials that are pertinent to a class's core ideas aids students in understanding that subject.

Wambui (2013) as cited in Baraka Manjale & Abel (2017) the availability and suitability of instructional media help to increase student engagement because they expose students to the real world of learning and help to increase knowledge and retention since people remember things better when they are seen than when they are only heard.

As mention above, instructional media are described as equipment used in educational contexts to transmit contents and information to achieve successful teaching and learning.

5.2. Types of instructional media

According Ogunmilade (1984) as cited in Koranteng Seth (2009) defines instructional media as items of hardware (equipment) and software (consumables) that enable and support the learning process.

Opoku-Asare (2004) as cited in Jamuna & Mrs.Pankajam (2017) explain that the type of instructional media has two types follow as;

1) Hardware as projectors, radios, televisions, tape recorders, and videotape and recorders.

2) Software as videos, slides, drawings, models, maps, real things, and photographs are all acceptable visual aids.

Vebrianto & Osman, (2011) the two different instructional media kinds were distinguished by;

1) Multimedia: multimedia, also known as information and communication technology (ICT) media, combines graphics (such as images, photos, graphics, charts, diagrams, cartoons, posters, and comics), three-dimensional media (such as solid models of the media in the form of sectional models, model homes, working models, and dioramas), and media projectors (as slides, film strips, films, and OHP).

2) Environment: provides factual and innovative teaching resources that teachers can simply access from their local school.

Naumy, (2012) divides instructional media into three categories, including

1) Visual media: are those types of media, such as books, photos, photographs, maps, charts, diagrams, posters, drawings of actual items, chalkboards, and cartoons, whose content is viewed visually.

2) Audio media: radio, tapes, telephones, disc recordings, and sound delivery systems are examples of hearing-related media.

3) Audio-visual media include demonstrations, motion pictures, television, videotapes, and movies.

Faikhamta, (2020) mentioned media instructional media three types as;

1) Software

2) Hardware

3) Techniques and methods

As mention above, the instructional media that suitable use with chemistry instructional by blended learning are divided two types follow as;

1) Hardware: as the equipment that use in teaching and learning in the classroom such as LCD, projector, computer, iPad, smart phone, book.

2) Software: refer to the kind of social media such as; google app for education (google classroom, google form, or google meet), YouTube, game application, MOOCs, PhET app, quizizz, Kahoot, or application chemistry that have a lot of and free in play store.

5.3. Selecting and use instructional media

According to Vojtesek & Hutak (2019) pointed out all of the major technology companies, including Google, Microsoft, and Apple, have tools for blended learning, such as Google Classroom, Apple Classroom, or Microsoft Classroom, however some of them are paid or platform-specific.

5.4. Research related to instructional media

According to Vebrianto & Osman (2011), in this study, a "nonequivalent control group" design was used in a quasi-experiment manner. This study had one control group, two treatment groups, and two treatment groups. While the second treatment group used the environmental module, the first treatment group used the ICT module. On the other hand, the control group employed traditional teaching methods. In the secondary Siak Sri Inderapura school in Riau, Indonesia, 96 pupils participated in the study. Science achievement tests and tests to assess science process skills were the tools employed. The descriptive analysis of the data was done first, and then an inferential analysis using the ANOVA and MANOVA tests was done. The results showed that there were notable disparities between students who took the ICT and environmental modules and those who received traditional education methods in their understanding of SPS and science achievement. The results indicate that student achievement in SPS and science has greatly increased as a result of the teaching and learning process employing a variety of constructive teaching modalities..

6.The concept and theory related science process skill

6.1. Definition of science process skill

The IPST (Institute for the Promotion of Teaching Science and Technology) (2011 ,pp. 67-68) state that the term science process skill as early childhood educators are now highlighting how effective application of scientific process skills are critical criteria for discovery and problem-solving at young ages (Jirou & Zimmerman, 2015). Science process skills are crucial for teaching science content knowledge and scientific inquiry because lecturers who don't grasp them are less likely to have a favorable attitude toward them and are less inclined to teach them to their students.

According to Kimson, J. I., Cecilia, O. N., & Anthonia, N. U. (2017) said that Science process skills (SPS) are abilities that arise naturally and spontaneously in our minds as we think about how the world or nature functions individually, collectively, and logically; science reveals the knowledge of how the universe functions.

Malhi, R. K. (2017) said that science learning and application entail conceptual comprehension, which is inseparable from science process skills in practice.

Dogan & Kunt (2017), science process skills are those that make it easier to learn scientific concepts, are valuable for research and active learning, foster a person's sense of responsibility while learning, and lengthen the usefulness of knowledge.

Raj & Devi (2014) argued that science process skills are generic, relevant to many different sciences, and reflect how scientists behave.

Abungu, H. E., Okere, M. I. O., & Samuel Wachanga, W. (2014) argued that acquiring scientific information that can be used to solve societal problems requires a strong foundation in science process skills.

As mention above, children's interaction with their surroundings in a scientifically appropriate manner occurs through skills like, communication, measurement, classification, and prediction. Instructors have seen the low nature of training in advanced education coming about because of the ordinary showing styles and, in result, are genuinely positive about the utilization of blended learning in Cambodian training framework.

6.2. Basic science process skill (BSPS)

According to Chabalengula, V et al., (2012), the teaching of science process skills to students is mandated by standards for science education reform. SPS can be divided into basic and integrated levels.

Yoon (2015) showed that observation, communication, classification, measurement, inference, and prediction are six fundamental science process skills.

Basic skills and integrated skills are the two categories of abilities that are fundamental to the scientific method and cannot be distinguished from one another. Similarly, Punia et al. (2012) stated that there are two categories of science process skills;

- Basic science skills include the ability to observe, classify, predict, measure, come to a conclusion, and communicate.
- The integrated skills include the ability to define variables, establish hypotheses, tabulate data, show data graphically, describe connectedness variables, summarize and process data, analyze research, and design and conduct experiments.

Karamustafaoglu, S. (2011) Understanding of the scientific method typically refers to talents or abilities that scientists must possess during the course of scientific discovery. The two categories of skills are basic and integrated process skills. Observation, questioning, classifying, measuring, and predicting are some of the fundamental process skills. Identification and definition of variables, interpretation of data, material manipulation, data recording, formulation of hypotheses, design of research, and drawing conclusions and generalizations are all examples of integrated process capabilities.

Chiappetta, E., & Koballa, T. (2002) classified basic scientific skills as follows:

1) Observing: Noting the properties of objects and situations using the five senses. It gives an account of what was actually noticed.

2) Measuring: expressing quantitatively how much of a thing or substance there is.

3) Inferring: giving a quantitative justification for a certain thing or substance.

4) Classifying: relating things and things happening in light of their characteristics or features.

5) Predicting: predicting a future event based on prior observations or data expansion.

6) Communicating: using language, symbols, or visuals to describe a thing, something you did, or something that happened.

Handayani, et al. (2018) the basic skills include observing, classifying, predicting, measuring, summarizing, and communicating.

American Association for the Advancement of Science: AAAS, (2015) analyzed science process skill to 2 kind and 13 skills follow as;

1) Basic science process skill has eight skills, including; observing, classifying, measuring, using number, space/space and space/time relationships, organizing data and communicating, inferring, and predicting.

2) Integrated scientific process skill has 5 skills such as; formulating hypothesis, defining operationally, identifying and controlling variables (independent variables, dependent variables, and controlled variables), experimenting (experimental design, experimentation, and recording), and interpreting data and conclusion.

Rezba et. al. (2003) basic science process skills are the abilities we employ when performing science. These abilities help kids actively explore the natural world. They notice things and occurrences using their senses, and they search for patterns in their observations.

As mention above, basic science process skills that will be are observing, measuring, classifying, predicting, and communicating.

6.3. Advantage of science process skill

Zeidan, A. H. and Jayosi, M. R. (2015) showed advantage of SPS as follows;

1) The student acquires abilities that they can utilize to solve problems in their daily lives.

2) It emphasizes student participation in learning activities to the fullest extent possible and is activity- and learner-centered.

3) It inspires students and makes them more engaged in their studies.

4) Throughout the learning process, students frequently adopt the scientific way of thinking.

5) It makes it easier for learners to form concepts from the first encounters they have while acquiring new abilities.

6) It also supports the development of abilities that are the typical characteristics of scientists that students must imitate.

6.4. Disadvantage science process skill

Zeidan, A. H. and Jayosi, M. R. (2015) showed disadvantage of SPS as follows;

1) Since this method is scientifically oriented, it does not seem to have much of an impact on other subjects that are not sciences.

2) Organizing the activities to help students enhance their skills could take a lot of time and money in terms of the material resources needed.

6.5. Research related with science process skill

According to Kirimi , D. O., & Njagi, M. W. (2016) The Solomon Four-Non-Equivalent Control Group Design was utilized in this study's quasi-experimental methodology. Data were gathered from eight schools in Kenya's Tharaka-Nithi County, including 328 participants in the sample. Before beginning the study, teachers in experimental groups received training on using ISPS, whereas participants in control groups received instruction using traditional methods. Data gathering tools include the Mathematics Creativity Assessment Test (CAT) and the Classroom Creativity Observation Schedule (CCOS). Means, t-tests, and analysis of variance (ANOVA) were used to analyze the data. The Bonferroni post hoc test was performed to highlight any group differences. At a significance level of alpha = 0.05, hypotheses were tested. According to the study's findings, pupils exposed to ISPS scored on the Scientific Creativity test with better mean scores than those who were not. When compared to traditional teaching methods, ISPS application is more effective at enhancing students' creativity. Findings from the study shed light on the significance of introducing In-Service Teachers to ISPS in instructional strategies to enhance their service delivery. According to the study, science process skills should be included in instructional strategies and resources at universities and teacher training programs, respectively.

Abungu, H. E., Okere, M. I. O., & Samuel Wachanga, W. (2014), in this study, the impact of the science process skills teaching approach (SPSTA) on students' performance in chemistry was examined. Quasi-experimental Solomon four Group design was used. Four district secondary schools with an equal proportion of boys and girls were chosen through purposeful sampling. There were 153 pupils in form three in the sample. The Form Three classes were split into two experimental groups and two control groups at random. Volumetric analysis (Titration) and Qualitative analysis were two topics from the KCSE Chemistry syllabus that were addressed in the study. As a pre-test, the Chemistry Achievement Test (CAT), which included easy computations, True and False questions, and fill in the Blanks, was used. The Kuder-Richardson (K-R21) formula was used to estimate the CAT's dependability coefficient, which came out to be 0.88. Utilizing descriptive statistics, the t-test, ANOVA, and ANCOVA were used to examine the data. At a significance threshold of = 0.05, hypotheses were tested. The findings showed that SPSTA significantly impacted students' performance in chemistry. The results of this study may offer insight into how to create instructional strategies that improve student performance while also advancing chemistry teaching and learning in secondary schools.

Babafemi, A. J. (2014), the study included 120 Senior Secondary Two (SS II) chemistry students out of a total of 996 participants. The study was conducted using a non-randomized pretest, posttest, and posttest experimental control group research design. Instruments with reliability scores of 0.89 and 0.75, respectively, were the Chemistry Achievement Test (CAT) and the Science Process Skills Achievement Test (SPSAT). The study's data were analyzed using the t-test statistical technique at a significance level of 0.05 to see whether students' past exposure to laboratory equipment had any effect on their acquisition of science process skills, academic achievement, and retention of various chemistry ideas. Generally, in comparison to non-exposed students, individuals who had prior exposure to laboratory equipment on the acquisition of process skills performed better academically and retained more chemical concepts. Given the same exposure to previous laboratory equipment on acquisition and science process abilities, the results also demonstrated that both male and female students' academic achievement is significantly high. As a result, suggestions were made, including the need for science curriculum developers, secondary school supervisory bodies, science educators, and teachers to incorporate prior exposure to laboratory equipment on the development of science process skills approach into the secondary school curriculum for chemistry.

Abungu, H. E., Okere, M. I. O., & Samuel Wachanga, W. (2014) studied about Effect of Science Process Skills Teaching Approach on Secondary School Students’ Self-Concept in Chemistry in 54 districts, Kenya. The Solomon Four Group Non-Equivalent Control Group Design was used in the study's quasi-experimental research. The secondary school students in Nyando District made up the target population. In order to make sure that the proportion of boys and girls in each school was about equal, a purposeful sampling was employed to select four district secondary schools in the Nyando District. Four district secondary schools provided the 153 Form Three pupils who made up the sample. The experimental and control groups were chosen at random from among the Form Three classes. Two areas from the KCSE Chemistry curriculum were covered in the study: volumetric analysis (titration) and qualitative analysis. The students' chemistry self-concept (SSCS) questionnaire was utilized as a pre-test to ascertain students' entry point in terms of chemistry self-concept on the chosen topics. The identical exam was given to the four groups as a post-test following the delivery of the five-week therapy. The Self-Descriptive Questionnaire II (SDQ) scale served as the basis for the SSCS. SSCS reliability was calculated based on Cronbach's alpha coefficient. The instrument's dependability coefficient of 0.95 was established, and it was in fact deemed suitable. Descriptive statistics, the t-test, ANOVA, and ANCOVA were used to evaluate the data that were produced. The hypothesis was significant at a level of 0.05 for both acceptance and rejection. The findings showed that SPSTA significantly impacted students' perceptions of their own abilities in chemistry. The findings of this study could help educators create instructional strategies that improve students' perceptions of themselves as chemists and help chemistry be taught and learned more effectively in Kenyan secondary schools. The Kenya Institute of Education, education administrators, and quality assurance standards officers, who are important stakeholders in the ministry of education, are anticipated to use the study's findings to reevaluate the instructional methodologies for teaching chemistry in the secondary school curriculum.

Al-rabaani, A. (2014) studied about the development of science process skills by pre-service social studies teachers in Omani. Data were gathered utilizing a questionnaire with 14 items that covered fundamental and integrated science process skills. Each of the 59 social studies instructors at Sultan Qaboos University in the Sultanate of Oman received a copy of the questionnaire. The findings indicated that they had a modest level of science process skill learning and that there was no gender-related difference.

Bang, E., & Baker, D. (2013) studied about Gender inequalities in science achievements and attitudes among Korean high school students in three different learning environments. An initial survey was completed by three schools, three administrators, three science teachers, and 302 tenth-grade students from each of their distinct school types. Eleven academically exceptional kids were then interviewed. Results showed that both male and female students from the coed school had considerably superior science achievement and good attitudes regarding science.

Feyzioglu, B., Demirdag, B., Akyildiz, M., & Altun, E. (2012), study was done on the validity and reliability of a science process skills test for secondary pupils. 222 pupils from a Turkish vocational high school took the test. There were 30 multiple-choice questions on the test, and its reliability was (0.83). The test included sub-dimensions for observation, categorization, measurement, communication, inference, prediction, formulation of hypotheses, identification of variables, organization and interpretation of data, design of studies, and data acquisition. The test's validity and reliability were validated by the findings of the confirmatory factor analysis.

Ozgelen, S. (2012), a sample of 306 sixth and seventh graders from public, private, and bus-based schools. Science process skills were measured using the Turkish Integrated Process Skills Test, and the results frequently showed low scores. Students who attended private schools performed better than those who attended public or bus-based schools.

Chebii, R. J. (2011), this study was created to find out how well students were able to learn and master a few specific science processes using the Science Process Skills Mastery Learning Approach (SPROSMALEA). The study was conducted in Kenya's Koibatek District, where there has been a pattern of consistently poor performance in the area. The research was concentrated on form two chemistry's "salts" topic. The study used the Solomon Four Group, Non-equivalent Control Group Design. Out of the 35 secondary schools in the district, four coeducational schools were purposefully chosen and randomly allocated to the experimental group (E1), experimental group (E2), control group (C1), and control group (C2). A sample of 160 students in Form Two served as the source of the data. Data were gathered using three instruments: the Chemistry Achievement Test (CAT), the Science Process Skills Performance Test (SPSPT), and the Classroom Observation Schedule (COS). Two secondary schools in the Koibatek District that were not included in the study but had traits in common with the sampled schools were used as trial sites for the instruments. Its validity and dependability were established, and their applicability was determined. Two groups, the experimental (E1) and control (C1), underwent pre-testing; the experimental (E2) and second control (C2) groups, however, did not. Over the course of four weeks, the same course material was presented to each group, with the experimental groups employing the (SPROSMALEA) technique and the control groups using the traditional teaching strategy. COS was used to monitor and document the activity of the teachers and students throughout the lesson. After instruction on the chemical topic of salts was finished, all groups took a post-test on the CAT and SPSPT. Statistical Package for Social Sciences (SPSS) 12.0 for Windows was used to analyze the data using both descriptive and inferential statistics. The four post-test mean differences were analyzed using ANOVA and ANCOVA. To determine the differences between two means, a t-test was employed. The study's hypotheses were put to the test at a significance level of 0.05. The study's findings show that students in the experimental groups did better than those in the control groups in terms of mastering and learning particular practical chemical abilities. The results also show that during teaching, students' and teachers' actions in the experimental groups had greater mean COS frequencies than in the control groups. The study's findings and recommendations are likely to be helpful to science teachers, educators, and decision-makers since they offer them a different teaching strategy that can boost students' performance in the subject and help them develop the needed practical skills.

Akinbobola, A. O., & Afolabi, F. (2010), in this study, the physics practical tests for the West African Senior Secondary School Certificate in Nigeria during a ten-year period (1998–2007) were examined for science process skills. The study used an ex-post facto design. Out of the 15 science process skills utilized in the study, manipulating (17.20%), calculating (14.20%), recording (13.60%), observing (12.00%), and communicating (11.40%) were shown to be the five most important. As compared to integrated (higher order) science process skills (37.20%), the results also indicated a high percentage of basic (lower order) science process skills (62.8%). The results also showed that there were much more basic process skills than integrated process skills in the Nigerian physics practical exams for the West African Senior Secondary School Certificate. It is advised that the examination bodies in Nigeria include more integrated science process skills in the senior secondary school physics practical examinations to help students develop the critical thinking, problem-solving, originality, and invention skills that are essential for any country's scientific and technological advancement.

According to all the research found that, the Chemistry Achievement Test (CAT), a pre-test, was composed of easy computations, True and False questions, and fill-in-the-blank questions. The data were collected using a questionnaire which covering basic and integrated science process skills. The test included sub-dimensions for observing, classifying, measuring, communicating, inferring, predicting, formulating hypotheses, identifying variables, organizing and interpreting data, design of studies, and data acquisition. The learner demonstrated noticeably greater science achievement as well as favorable views concerning science. There was no difference in their development of science process abilities based on their gender.

7. The conceptual and theories related authentic assessments

7.1. Definition of authentic assessment

The process of evaluation or appraisal that is used to evaluate student performance should go hand in hand with the process of learning.

According to Chatterji (2003) the term authentic assessment refer only to assessment exercises that integrate actual or “real word” settings and criteria.

Fischer and King (1995), the phrase "authentic assessment" refers to all alternative assessment techniques that test students' capacity to solve issues or carry out tasks that closely mirror real-world scenarios.

Moon et al., (2005) as cites on Darling-Hammond, (1997), authentic assessments, also known as performance-based assessments, involve students in real-world activities and scenario-based problem solving more so than conventional assessments like multiple-choice, pencil-and-paper tests.

Franklin (2016), in order to demonstrate their capacity to apply pertinent knowledge and abilities, students participate in real-world assignments as part of authentic assessment.

Reynisdóttir (2016) cite O’Malley & Valdez-Pierce(1996) by stating, "Define authentic assessment," “we use the term authentic assessment to describe the multiple forms of assessment that reflect student learning, achievement, motivation, and attitudes on instructionally-relevant classroom activities.

As mention above, the term of authentic assessment refer to the multiple forms of assessment that reflect student learning, achievement, motivation, and attitudes on instructionally-relevant classroom activities((Reynisdóttir, 2016).

7.2. Characteristic of authentic assessment

According to (Sabtiawan et al., 2019) as cites Rule (2006), there are four characteristics of authentic assessment in higher education, that are

1) Involving real-world problems that mimic the work of professionals
2) Including open-ended inquiry, thinking skills, and metacognition
3) Engaging students in discourse and social learning
4) Empowering students through choice to direct their learning.

These characteristics not only help recognize an authentic assessment but also help provide theoretical constructs to describe significant elements or properties of authentic assessment.

7.3. Authentic assessment rubric

In general rubric can be interpreted as a guidance to give a score (scoring guidance) in a subjective assessment. A scoring rubric represents the level of students' performance expected to be achieved. A rubric is an established set of criteria used for scoring or rating student's tests, portfolios, or performances. A scoring rubric describes the levels of performance may be expected to attain relative to a desired standard of achievement ((Hart, 1994).

According to (Smith et al., 2015)states that an assessment rubric is a matrix, grid or cross-tabulation employed with the intention of making expert judgments of student work both more systematic and more transparent to students.

8. Learning achievement

8.1. Definition of learning achievement

According to Kanjanawasee (2013) state that learning achievement is the learning outcomes of the learner's instruction process on period of time by the learning outcomes as knowledge or skill indicate the learning behaviors of the learner in the situation.

Sanjaya (2011) states that learning achievement is something that is reached or acquired by students due to the efforts or thought which expressed in the form of mastery, knowledge and basic skills that are in various life aspects, so that it appears behavior change quantitatively.

Gronlund & Waugh (2009) state that learning achievement is the result of instruction that the learner has been achieved of learning outcomes.

Kumpha (2007) state that learning achievement is the score or learning outcomes of learner as knowledge, comprehension, scientific process, and apply depend on measurement by science learning achievement test.

Suryabrata (2005) state that learning achievement is the ability of students in the form of mastery of knowledge, attitudes, and skills that are achieved in learning after he conducts learning activities.

Institute for the Promotion of Teaching Science and Technology (IPST), Thailand (2003) argued that learning achievement is learning behaviors that desire intelligence or cognitive domain in science learning according to Klopfer (1971) by divided assessment learning achievement to 4 cognitive domains as knowledge, comprehension, scientific process, and apply.

Sudjana (2001) state that learning achievement is ability that students have after they receive their learning experience.

Tinambunan (1988) defines learning achievement as the student's grasp of some body of knowledge or proficiency in certain skills.(Travers, 1970) argues that achievement is the result of what an individual has learned from some educational experiences.

As mention above, learning achievement is the result achieved by someone in learning activities and a change in behavior that includes cognitive, affective and psychomotor domains which is a measure of student success. the level of achievement that has been achieved by students towards the goals set by each field of study after attending a teaching program within a certain time.

8.2. Assessment of learning achievement

The assessment of learning achievement is the consideration of the learning outcome in learning area of science. Evaluation of learning area of science such as evaluation understanding, science process, attitude of science, scientific laboratory skills and responsibility for scientific practice, which advances in several of the students will affect the objectives, expect learning outcome, and learning standards set by educational institutions.

Allen & Sites, 2012; Simonson, Smaldino, & Zvacek, 2015), argued that course developer should begin the design process with measurable and clearly written course-level outcomes that will be mapped or aligned to all assessments, instructional materials, activities, and technologies utilized in the course. When drafting course-level outcomes, it is helpful to review Bloom's Taxonomy for appropriate and measurable learning outcomes verbs. It is important to write course-level outcomes that are not only measurable, but that are also suited to the level of the course. This means that course-level outcomes that use verbs such as “assemble” or “synthesize” are often not suitable for a low-level introduction course

According to Institute for the Promotion of Teaching Science and Technology (IPST), (2003) has proposed important goals in assessment science learning achievement from learners ‘learning behavior divide to 4 behavior follows as;

1) Knowledge: is ability of the brain to various accumulate or all experiences and able to recall what has been learned about objectivity, concepts, principles, rules, and theories.

2) Comprehension: is ability to classify any knowledge when it appears in a new form and ability to translate knowledge from symbol to another symbol.

3) Apply: is ability to bring various knowledge and methods of science to apply in the new situations or different what has been learned before, especially in daily life.

4) Scientific Process: is the instrument used in scientific inquiry by using observation, classify, organization data and communication, Inferring, hypothesis, defining operationally, identifying and controlling variables, experiment, and interpreting data and conclusion.

Anderson & Krathwohl, (2001) had assessment the learning achievement by according to the revised version of Bloom's Taxonomy, there are six levels of cognitive learning follows as;

1) Create: Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

2) Evaluation: Making judgments based on criteria and standards through checking and critiquing.

3) Analyze: Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.

4) Apply: Carrying out or using a procedure for executing, or implementing.

5) Understand: Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.

6) Remember: Retrieving, recognizing, and recalling relevant knowledge from long-term memory

Klopfer, (1971) shown that assessment the learning achievement in science from behaviors in 3 mains follow as;

1) Learning achievement in science of cognitive domain

- Knowledge: the learner has memory in various subjects, have been learned from researching the scientific process, and whether it's reading books and listening from lecture.

- Comprehension: the learner has used knowledge is higher than remember.

- Scientific Process: the learner finds the knowledge and problem solving by scientific process which has been performed by scientific method, science process skill, and scientific attitude.

- Application: the learner applies the concepts, principles, rules, theories, and scientific method capable use to problem solving in new situation.

2) Learning achievement in science of affective domain: consideration affective domain of the learner studying science such as; consider of emotion, feeling, and acceptance level or refuse. But it does not include all the emotional behaviors that should be happen in the learner science

3) Learning achievement in science of psychomotor domain: learning achievement that focus on expert of practice and operation.

As mention above, according to the revised Bloom's taxonomy of the cognitive domain, learning objectives can imply six different types of cognitive performance, ranging from the lowest performance level (remember) to the highest (create).

Summary the concept and theory related with chemistry instructional handbook by blended learning in chapter 2

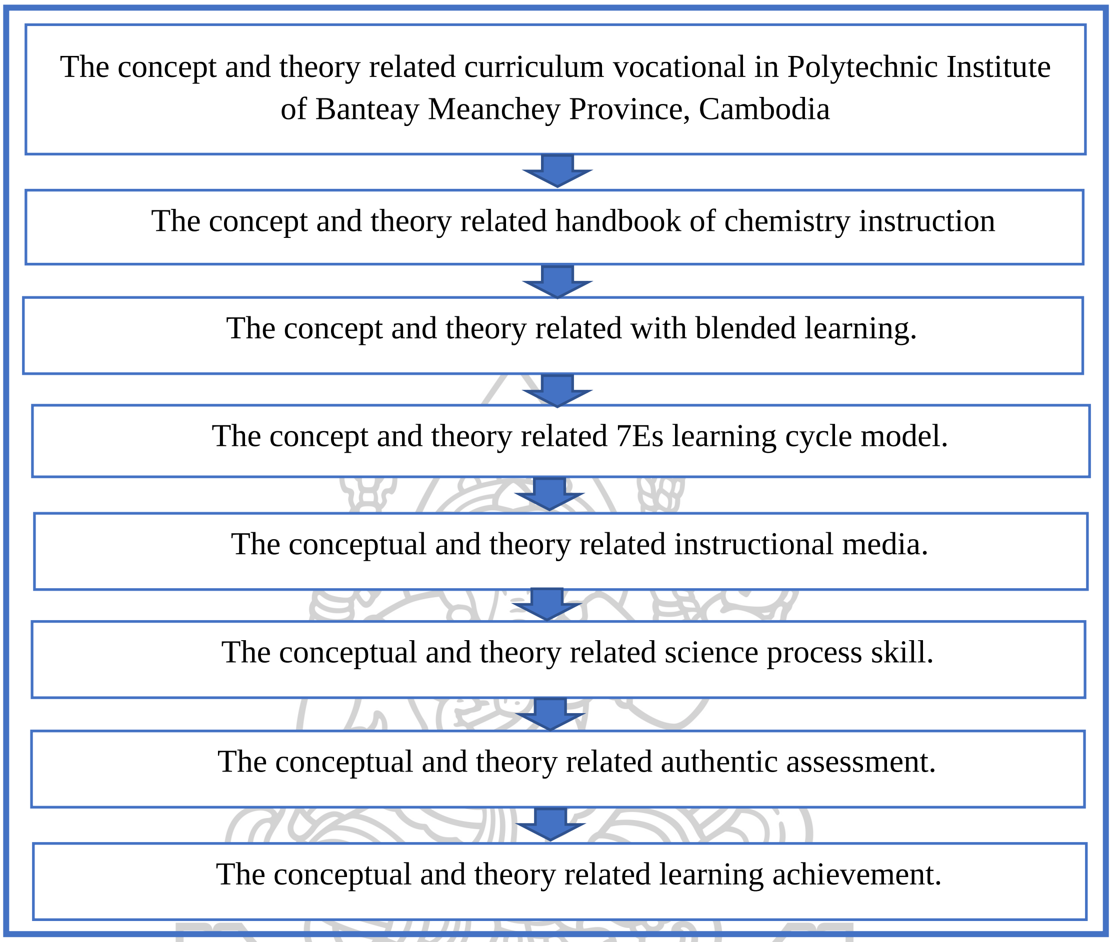

Figure 4 summary the concept and theory related chemistry instructional handbook by blended learning in chapter 2

CHAPTER III

RESEARCH METHODOLOGY

The research on'' The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia". This study uses a mixed methodology that combines quantitative and qualitative research by research and development (R & D). There are 4 steps of process as follows;

Step 1: Study of principle, conceptual, theories, and research related with the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia. (Research (R1))

Step 2: Development of the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia. (Development (D1))

Step 3: Implement of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia. (Research (R2))

Step 4: Study effective of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia. (Development (D2))

The research has set framework for conducting research as shown in this diagram;

Research procedures	Methodology	Results
Step1: Study of principle, conceptual, theories, and research related with chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province (PIBMC), Kingdom of Cambodia.	1) Analysis previous research papers 2) Analysis the core curriculum chemistry of grade 8 and 9 (Skill bridging program) 3) Study the statement of problem and need of teacher and student in chemistry of grade 8 and 9 (Skill bridging program) in PIBMC 4) Interview and observation by visiting best practice schools located in Nakorn Pathom province and Bangkok, Thailand.	Learning process, learning activities, instructional media, and assessment of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.
Step2: Development of chemistry instructional handbook by blended learning to enhance achievement on chemistry and Science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia by using data collected from studies and analyses of relevant documents and researches.	1) Development of chemistry instructional handbook by blended learning for vocational certificate (skill bridging program) (grade 8and 9) 2) Development assessment of achievement test, science process skill, and satisfactions' teacher form. 3) Focus group discussion, seven experts revising quality and recommendations of chemistry instructional handbook, achievement test, science process skills test, and satisfactions' teacher form 4) Propose the chemistry instructional handbook by blended learning to advisor for considering and revising in accordance with recommendations. 5) Final revision of chemistry instructional handbook by blended learning.	1) Qualitative data of expert's opinions on the chemistry instructional handbook by blended learning 2) Assessment of achievement test, science process skill test, and satisfactions' teacher form. 3) Good quality of chemistry instructional handbook by blended learning
Step3: Implement on chemistry instructional handbook by blended learning in Polytechnic Institute of Banteay Meanchey Province (PIBMC), Kingdom of Cambodia.	Apply the chemistry instructional handbook by blended learning to; 1) Training two chemistry 's teachers in skill bridging program (one week) in PIBMC 2) Teaching fourth students in skill bridging program (grade 8and 9) (seven weeks) in PIBMC	1) Achievement on chemistry 2) Science process skill
Step4: Study effective of chemistry instructional handbook by blended learning in Polytechnic Institute of Banteay Meanchey Province (PIBMC), Kingdom of Cambodia.	Collect data and recommendation improving.	Satisfactions' teacher

Figure 5 development of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for skill bridging program of Polytechnic Institute of Banteay Meanchey Province, Cambodia.

Step 1: Study of principle, conceptual, theories, and research related with chemistry instructional handbook by blended learning.

Analysis previous research papers, interview, and observation by visiting best practice schools. There are seven schools (1. The Demonstration School of Slipakorn University, 2. Kasetsart University Laboratory School, 3. Nakorn Pathom Reachpath University Demonstration School, 4. Prince Sirindthorn's College, and 5. Matthayom Wat Nongkhaem School, 6. Kanchanapisek wittayalai Nakon Pathom, and 7. Phrapathom Witthayalai School) and two universities (Silpakorn university and Nakorn Pathom Reachpath University) located in Nakorn Pathom province and Bankork, Thailand; focusing on learning process, learning activities, instructional media, and assessment.

1.1. Objective

1.1.1. To study of previous research papers of principle, conceptual, and theories related chemistry instructional handbook, blended learning, learning process (7Es learning cycle), learning activities, instructional media, and assessment.

1.1.2. To analysis need assessment of teacher in chemistry instructional handbook by blended learning.

1.2. Population and sample

Populations of the study are seven secondary school and two university in Nakorn Pathom and Bangkok, Thailand. The experts and professional of chemistry instructional handbook by blended learning. Their experience more than 5 year.

Sample are secondary school (16 chemistry teachers) and two universities (2 professors of chemistry) in Nakorn Pathom and Bangkok, Thailand. Using purposive sampling.

1.3. Instrument

1.3.1. Final principle, conceptual, theories, related research, problem and needs, learning process, learning activities, instructional media, and assessment of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for skill bridging program.

1.3.2. Interview form of the secondary school (16 chemistry teachers) and two universities (2 chemistry professors) by visiting best practice schools about learning process, learning activities, instructional media, and assessment by divided 2 parts as;

Part1: General questionnaire survey such as gender, age, work/career, and experience of chemistry teacher/professor.

Part2: Interview opinion related with chemistry instructional handbook by blended learning such as component of handbook, learning process, learning activities, instructional media, and assessment by structure interview

1.3.3. Observation form of the secondary school (16 chemistry teachers) and two universities (2 chemistry professors) by visiting best practice schools about learning process, learning activities, instructional media, and assessment by divided 2 parts as;

Part1: General questionnaire survey such as gender, age, work/career, and experience of chemistry teacher/professor.

Part2: Observation related with chemistry instructional handbook by blended learning such as component of handbook, learning process, learning activities, instructional media, and assessment by visiting best practice schools.

1.4. Create instrument

1.4.1. Final principle, conceptual, theories, related research, problem and needs, learning process, learning activities, instructional media, and assessment such as;

1) Study of principle, conceptual, theories, and related research were used to development learning process, learning activities, instructional media, and assessment such as;

- Analysis previous research papers for applying to development chemistry instructional handbook by blended learning
- Study of the 7Es learning cycle model
- Instructional media

2) Study of the problem and needs of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) such as;

- Internet speed

- Learning experience through blended learning

- Study of learning and teaching such as teacher, curriculum, and learning assessment.

3) Study of the core curriculum of the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program). The result of competency studies both core competency and full-time competency to be able the core in choosing the kind of subject content that apply for the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program). And develop of principle, theories, and related research, problem and need of the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) such as;

- The content that has objective to enhance the student got achievement on chemistry and science process skill.

- Study the other research that related chemistry instructional handbook, blended learning, and science process skill. The researcher studied the sample that used in the instrument and creating instrument, learning process, learning activities, instructional media, and assessment. The result of sample is the student studying in skill bridging program. The instrument that used in this research as handbook, lesson plan, achievement test, and science process skill test. The learning processes that used to enhance achievement on chemistry and science process skill in the chemistry instructional handbook is 7Es learning cycle such as; elicit, engage, explore, explain, elaborate, evaluate, and extend (Eisenkraft (2003). The media that will be used in chemistry instructional is google classroom, kahoot app, periodic table app, and PhET simulate.

4) Propose the component of chemistry instructional handbook, blended learning, learning process, learning activities, instructional media, and assessment to advisor for considering and revising in accordance with recommendations.

5) The result of the component of handbook, blended learning, learning process, learning activities, instructional media, and assessment.

5.1. Study the structure of curriculum blended learning between instruction media and learning activities that related objective, learning process, and assessment to be used as a guideline and the basis for creating a learning model that is confirmed with student 'learning in skill bridging program.

5.2. Study the principle, theories, and conceptual related;

- The chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) as component and other resources.
- 7Es learning model

5.3. Analysis the conceptual, the theories, and the research that related the chemistry instructional handbook, blended learning, instructional media, learning process (7Es learning cycle), and assessment.

Summary the procedure of the principle, conceptual, theories, and research related in figure 6

Study of principle, conceptual, theories, and related research were used to development learning process, learning activities, instructional media, and assessment.

↓

Study of the problem and needs of chemistry instructional handbook by blended learning

↓

Study of the core curriculum for the chemistry instructional handbook by blended learning

↓

Propose to advisor for considering and revising in accordance with recommendations and modify.

↓

Take the results of the study to synthesis and modify follow by recommendation of the advisors.

Figure 6 the procedure the principle, conceptual, theories, and related research

1.4.2. Interview form of the secondary school (16 chemistry teachers) and two universities (2 chemistry professors) by visiting best practice schools about learning process, learning activities, instructional media, and assessment follow as;

1) Study of principle, conceptual, theories, and related research were used to development interview form

2) Create of learning process, learning activities, instructional media, and assessment to questionnaires.

3) Propose the interview form to advisor for considering and revising in accordance with recommendations and modify.

4) Propose the interview form to experts to find quality by item objective congruence index (IOC). The questionnaire's items were scored using a scale from -1 to +1 using the index of item objective congruence (IOC). Congruent = + 1 Questionable = 0 Incongruent = -1 the items that had scores lower than 0.5 were revised. On the other hand, reserved were the items with scores more than or equal to 0.5.

5) Take the outcome of the study to synthesis and modify follow by recommendation of the experts.

6) Take the interview form that was constructed to find the quality of the tools to find validity for index of item-objective congruence (IOC). There are secondary school (16 chemistry teachers) and two universities (2 chemistry professors) of chemistry instructional handbook by blended learning.

The result analysis index of item objective congruence (IOC) of interview form (page 152) improves and modify by recommendation and suggestion of advisor and experts as;

- Eliminate the general questionnaire survey that is not related with research and choose only the relevant information such as age of experts/teacher
- Apply the interview form to collect data from chemistry teacher

Summary of create the interview form figure 7

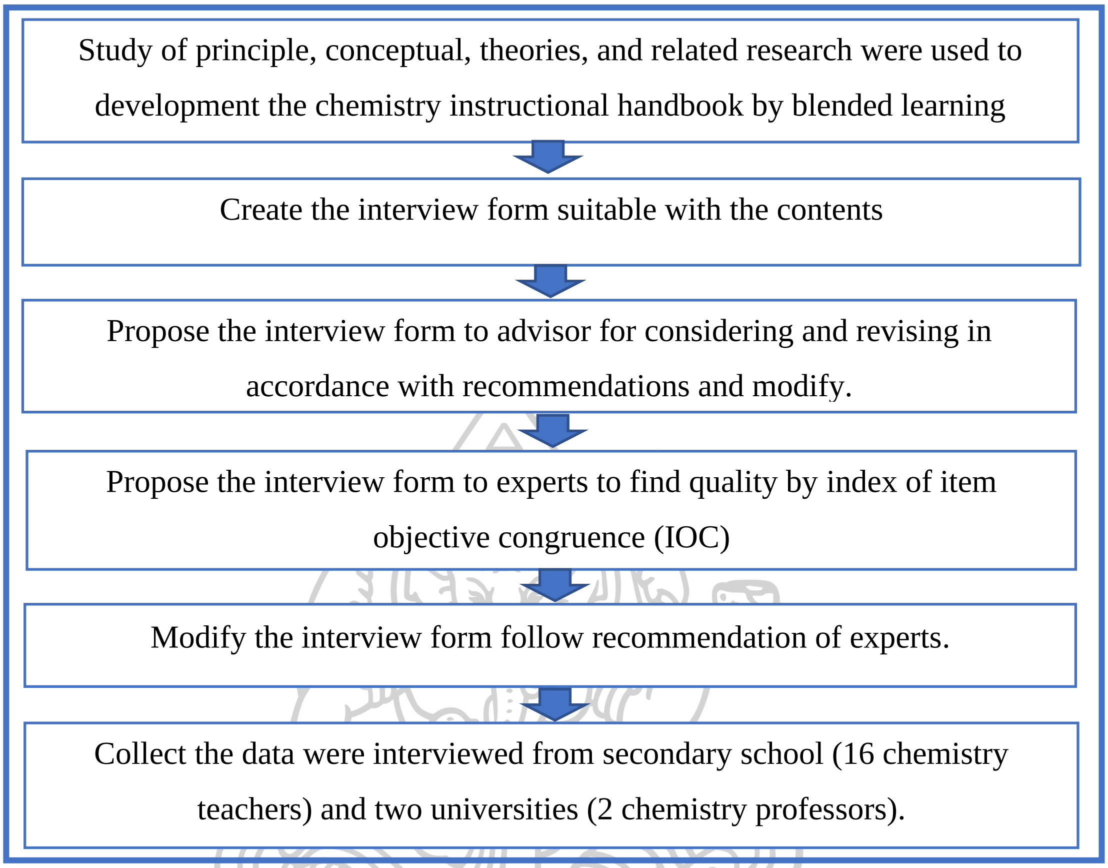

Figure7 the procedure of creates the interview form

1.4.3. Observation form of the secondary school (16 chemistry teachers) and two universities (2 chemistry professors) by visiting best practice schools about learning process, learning activities, instructional media, and assessment follow as;

1) Study of principle, conceptual, theories, and related research were used to development observe form

2) Create of learning process, learning activities, instructional media, and assessment to questionnaires.

3) Propose the observe form to advisor for considering and revising in accordance with recommendations and modify. Propose the observe form to experts to find quality by item objective congruence index (IOC). The questionnaire's items were scored using a scale from -1 to +1 using the index of item objective congruence (IOC). Congruent = + 1 Questionable = 0 Incongruent = -1 the items that had scores

lower than 0.5 were revised. On the other hand, reserved were the items with scores more than or equal to 0.5.

4) Take the outcome of the study to synthesis and modify follow by recommendation of the experts.

5) Take the observe form that was constructed to find the quality of the tools to find validity for index of item-objective congruence (IOC). There are secondary school (16 chemistry teachers) and two universities (2 chemistry professors) of chemistry instructional handbook by blended learning.

The result analysis index of item objective congruence (IOC) of observe form (page 152) improve and modify by recommendation and suggestion of advisor and experts as;

- Eliminate the general questionnaire survey that is not related with research and choose only the relevant information such as age of experts/teacher
- Apply the observe form to collect data from chemistry teacher

Summary of create the observe form figure 8

Study of principle, conceptual, theories, and related research were used to development the chemistry instructional handbook by blended learning

↓

Create the observe form suitable with the contents

↓

Propose the observe form to advisor for considering and revising in accordance with recommendations and modify.

↓

Propose the observe form to experts to find quality by index of item objective congruence (IOC)

↓

Modify the observe form follow recommendation of experts.

↓

Collect the data were observed from secondary school (16 chemistry teachers) and two universities (2 chemistry professors).

Figure 8 the procedures of create the observation form

1.5. Procedure

1.5.1. Study of the principle, conceptual, and theories related chemistry instructional handbook, blended learning, learning process (7Es learning cycle), learning activities, instructional media, and assessment by study previous research papers.

1.5.2. Analysis the core curriculum chemistry of grade 8 and 9 (skill bridging program)

1.5.3. Analysis needs assessment of the chemistry teacher related learning process, learning activities, instructional media, and assessment

1.5.4. Study the statement of problem and need of teacher and student in chemistry of grade 8 and 9 (Skill bridging program) in PIBMC

1.5.5. Analysis previous research papers, interview, and observation by visiting best practice schools. Make the interviews form to the three experts' check that related learning process, learning activities, instructional media, and assessment.

1.5.6. Contacts and make an appointment who attend on interview and observe that had experience more than 5 years.

1.5.7. Collect the data were interviewed and observed from secondary school (16 chemistry teachers) and two universities (2 chemistry professors) that related learning process, learning activities, instructional media, and assessment to modify follow by recommendation.

1.6. Data analysis

The researcher conducted an analysis of the data by statistics. The statistics that used to find quality and index of item objective congruence (IOC) of interview and observation questionnaire as;

Formula of index of item objective congruence (IOC) (Maream, N.,2015)

$$IOC = \frac{\sum R}{N}$$

IOC refer to Index of questionnaire item objective congruence

$\sum R$ refer to all the score of experts

N refer to the experts

The index of item objective congruence (IOC). The questionnaire's items were scored using a scale from -1 to +1 using the index of item objective congruence

(IOC). Congruent = + 1 Questionable = 0 Incongruent = -1 the items that had scores lower than 0.5 were revised. On the other hand, reserved were the items with scores more than or equal to 0.5.

As stated by the step 1 study of principle, conceptual, theories, and research related with the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

Summary the procedure of the step 1

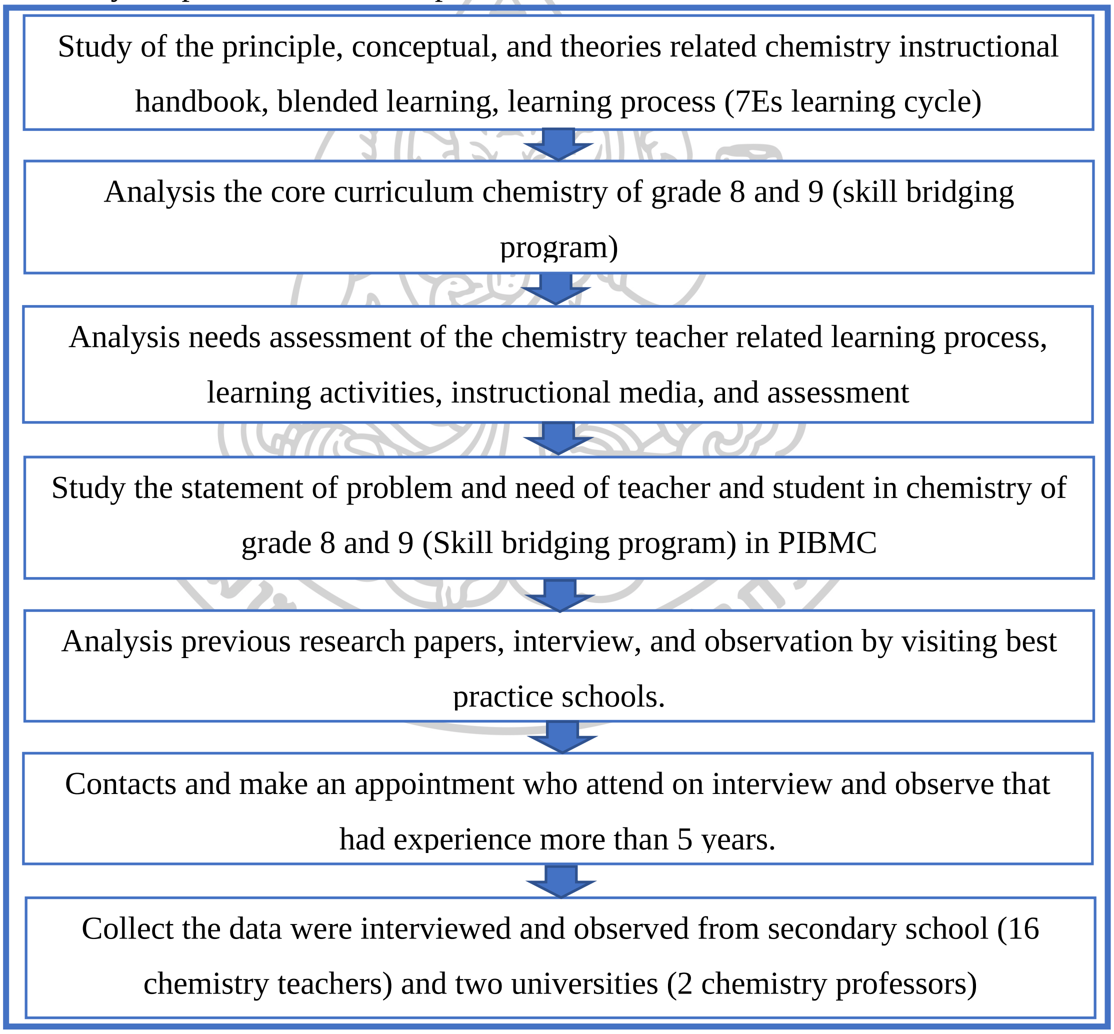

Figure 9 summary the procedure of step1

Step 2: Development of chemistry instructional handbook by blended learning

2.1. Objective

2.1.1. To develop the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) in Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

2.1.2. To study quality instrument of the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) in Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

2.2. Population and sample

Populations are experts of the development chemistry instructional handbook by blended learning that had experience more than 5 years.

Samples are seven experts of the development chemistry handbook by blended learning. Using purposive sampling. An expert is someone who possesses extensive and authoritative knowledge about or skill in a certain field.

2.3. Instrument

The instrument that used in this research as;

2.3.1. Focus group discussion form.

2.3.2. The chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program).

2.3.3. Achievement test (pretest and posttest)

2.3.4. Science process skill test

2.3.5. Satisfaction’s teacher form

2.4. Create instrument

The process to create instrument in this research follow as;

2.4.1. The questionnaires that used in focus group discussion

- The principle, conceptual, theories that related of the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) that studied to determine as questionnaires.

- Draft the questionnaires to propose and consulted with advisor to check the suitability and improved.
- The questionnaires are used in focus group discussion. There are 4 questionnaires.

Summary of create the focus group discussion questionnaires form figure 10

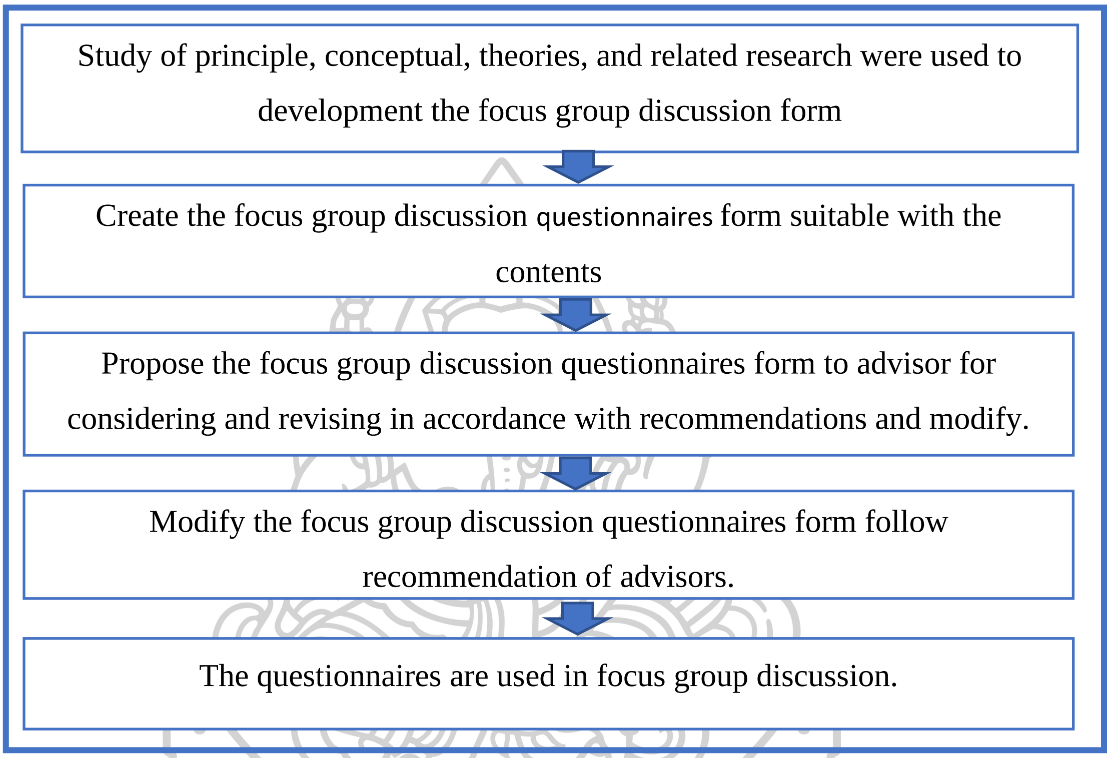

Figure 10 summary the procedure of the created focus group discussion form

2.4.2. The chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program).

- Determine conceptual of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program).
- Apply the data obtained from the analysis previous research papers of conceptual, theories, and related the research of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program).

- Create draft the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program). The components of the chemistry instructional handbook by blended learning as; instruction, content, objective, learning process (7Es learning cycle), instructional media (google classroom, PhET simulate, Kahoot app, and periodic table application), assessment and evaluation (authentic assessment), how to use media, example of lesson plan (10 lessons), reference, and bibliography. In the lesson plan has achievement test (the pre- and post-test), science process skill test after the end the unit, learning activities as activities sheet and experiment, and YouTube.

Table 9 the lesson plan of the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate.

Week	Learning procedure	Learning activities		
		Teacher activities	**Student activities**	**Evaluation**
1	Introduction and orientation: - discussion about the process of learning and experiment - Create the learning activities, time, score, individual/group working, and assessment.	➢ The teacher is introduced the process of the learning. ➢ The teacher is determined of the contents, learning activities, and assessment. ➢ The teacher is evaluated the achievement test and share the document. ➢ Orientation of google classroom and kahoot app.	➢ The students are added in the group of google classroom ➢ Group working as 3 to 5 students ➢ The student is studied the introduction and instrument	1. Evaluate of achievement test (pretest)
2	Lesson 1: Atoms and molecules			
	Elicit (15min)	➢ Revise student's prior knowledge by asking question; why we need to learn about matter in daily life? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: what is an atom?	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube. ➢ The student notes the definition of an atom.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
	Engage (15min)	➢ The teacher showed experiment on the YouTube: What is inside an atom? protons, electrons, and neutrons.	➢ The student notes what they saw and predict of protons, electrons, and neutrons. The student practices and going to PhET Interactive simulations: building atom and molecules	
	Explore (35min)	➢ The teacher post and provide the activities sheet 1.1 and 1.2 form to the student on google classroom.	➢ The student observation different of protons, electrons, and neutrons, measuring the equipment and tool to building atom and molecules, classifying atomic mass, mass number, protons, electrons, and neutrons, and communicating from activity sheet 1.1 and 1.2 form showed what they observed form YouTube and PhET simulate. ➢ Each group tries to note what they observed form YouTube, play on PhET, and write down on activity sheet. ➢ The student takes care with their experiment (building atom and molecules) and take the result post on the google classroom.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
	Explain (20min)	Let the student interpret what they have learned from experiment.	➢ The student presentation about atom, molecules, protons, electrons, and neutron activity sheet 1.1and 1.2 form and share their knowledge to other groups. ➢ The student discusses the results as a class, review the activity sheet, and send to google classroom. ➢ The student showed their result to another group.	
	Elaborate (25min)	➢ The teacher recommends and post activity sheet 1.3 form to google classroom.	➢ The student measuring the protons, electrons, neutron, the element symbols of atomic number (Z), and mass number (A). ➢ Each group tries to complete on activity sheet 1.3 form.	
	Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot on website.	➢ The student takes individual practice by play game (use kahoot on website).	
	Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in Google classroom after done.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
2	Lesson 2: Periodic Table			
	Elicit (15min)	➢ Revise student's prior knowledge by asking question; why we need to learn about matter in daily life? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: introduction to the periodic table.	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube about element, periods, group, metal, and non-metal.	
	Engage (15min)	➢ The teacher showed periodic table game application on the play store (smartphone).	➢ The student going to practice in the periodic table game application on their smartphone. ➢ The student tries to play and record their score.	
	Explore (35min)	➢ The teacher post and provide the activities sheet 2.1 and 2.2 form to the student on google classroom.	➢ The student observation different of element and symbol and communicating from activity sheet2.1 and 2.2 form. ➢ The student research the using of element in daily life on internet. ➢ Each group tries to note what they observed from play game and done on the internet. ➢ The student keeps and take the result post on google classroom.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
2	Explain (20min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation about element and symbol and element using in daily life of activity sheet 2.1 and 2.2 form and share their knowledge to other groups. ➢ The student discusses the results as a class, review the activity sheet, and send to Google classroom. ➢ The student showed their result to another group.	
	Elaborate (25min)	➢ The teacher recommends and post activity sheet 2.3 form to google classroom.	➢ The student classifying different of metals and non-metals. ➢ Each group tries to complete on activity sheet 2.3 form.	
	Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot on website.	➢ The student takes individual practice by play game (use kahoot on website).	
	Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in Google classroom after done.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
3	Lesson 3: The state of matter			
	Elicit (15min)	➢ Revise student's prior knowledge by asking question; why we need to learn about matter in daily life? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: particle the nature of matter	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube.	
	Engage (15min)	➢ The teacher showed experiment on the YouTube: state of matter	➢ The student note what they saw and predict of difference of liquid, solid, and gas. ➢ The student going to PhET Interactive simulations: state of Matter Simulation Lab	
	Explore (35min)	➢ The teacher post and provide the activities sheet 3.1form to the student on Google classroom.	➢ The student prepares equipment and ingredients to take small experiment. ➢ The student observation different of liquid, solid, and gas, measuring using the equipment and tool, classifying three states of matter, and communicating from activity sheet 3.1 form and	

Week	Learning procedure	Learning activities		
		Teacher activities	**Student activities**	**Evaluation**
	Explore (35min)		What they observe form YouTube and PhET simulate. ➢ Each group tries to note what they observed and done. ➢ The student take care with their experiment and note all the process. ➢ The student keeps and take the result post on google classroom.	
	Explain (20min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation about different of liquid, solid, and gas, the problem of experiment activity sheet 3.1 form and share their knowledge to other groups. ➢ The student discusses the results as a class, review the activity sheet, and send to Google classroom. ➢ The student showed their result to another group.	
	Elaborate (25min)	➢ The teacher recommends and post activity sheet 3.2 form to google classroom.	➢ The student measuring the ingredient of household equipment. ➢ Each group tries to complete on activity sheet 3.2 form.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
	Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot on website.	➢ The student takes individual practice by play game (use kahoot on website).	
	Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in Google classroom after done.	
3	Lesson 4: The properties of matter			
	Elicit (15min)	➢ Revise student's prior knowledge by asking question; why we need to learn chemical reaction in daily life? Count the common household? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: Physical and chemical change.	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube.	
	Engage (15min)	➢ The teacher showed experiment on the YouTube (physical and	➢ The student note what they saw and predict of physical and chemical change.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
		chemical change)	➢ All the group working prepare equipment and tools for experiment of some common household chemical.	
3	Explore (35min)	➢ The teacher post and provide the activities sheet 4.1form to the student on google classroom.	➢ The student experiments some common household chemical items. ➢ The student observation some common household chemical and chemical reaction, measuring the equipment and tool, predicting the ingredient, classifying the physical and chemical change, and communicating from their experiment. ➢ Each group tries to note what they observed and done. ➢ The student take care with their experiment and note all the process. ➢ The student keeps and take the result post on google classroom.	
	Explain (20min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation about experiments some common household chemical, the problem of	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
3			experiment activity sheet 4.1 form and share their knowledge to other groups. ➢ The student discusses the results as a class, review the activity sheet, and send to google classroom. ➢ The student showed their result to another group.	
	Elaborate (25min)	➢ The teacher recommends and post activity sheet 4.2 form to google classroom.	➢ The student measuring the ingredient of household chemical ➢ Each group tries to completed on activity sheet 4.2 form.	
	Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot app or website.	➢ The student takes individual practice by play game (use kahoot app or website).	
	Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in Google classroom after done.	
4	Lesson 5 Classify of matter			
	Elicit (15min)	➢ Revise student's prior knowledge by	➢ Discussion together in the classroom.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
		asking question; why we need to classify matter in daily life? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: homogeneous and heterogeneous mixture.	➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube	
	Engage (15min)	➢ The teacher showed experiment on the YouTube: separation technique.	➢ The student observes the experiment of kitchen equipment. ➢ The student note what they saw and predict of separation technique. ➢ All the group working prepare equipment and tools for experiment of some common kitchen equipment.	
	Explore (35min)	➢ The teacher post and provide the activities sheet 5.1 to the student on google classroom.	➢ The student experiments some common kitchen equipment. ➢ The student observes some separation technique, measuring ingredients, predicting what will be	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
			occurred on activity sheet 5.1, and communicating from their experiment by presentation. ➢ Each group tries to note what they observed and done. ➢ The student take care with their experiment and note all the process. ➢ The student keeps and take the result post on google classroom.	
	Explain (20min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation the result and the problem of experiment activity sheet 5.1 form and share their knowledge to other groups. ➢ The student showed their result to another group.	
	Elaborate (25min)	➢ The teacher recommends and post activity sheet 5.2 form to google classroom.	➢ The student play game card activity by cut the picture and sort correctly on the table (activity sheet 5.2 form) ➢ Each group tries to completed on all activity sheet 5.2 form.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
	Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot app or website.	➢ The student takes individual practice by play game (use kahoot app or website).	
	Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in google classroom after done.	
4	Lesson 6 Chemical reaction			
	Elicit (15min)	➢ Revise student's prior knowledge by asking question; why we need to learn chemical reaction in daily life? count the common household? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: water-universal solve	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
	Engage (15min)	➢ The teacher showed experiment on the YouTube how to make elephant toothpaste.	➢ The student observes the experiment of elephant toothpaste. ➢ The student note what they saw and predict of reactant and product. ➢ All the group working prepare equipment and tools for experiment of some common household chemical.	
	Explore (35min)	➢ The teacher post and provide the activities sheet 6.1 to the student on google classroom.	➢ The student experiments some common household chemical items. ➢ The student practices on PhET (phet.colorado.edu) observe and identify reactant and product. ➢ The student observation some common household chemical and chemical reaction, predicting the reactant and product, and communicating from their experiment. ➢ Each group tries to note what they observed and done.	
	Explain (20min)	➢ Let the student interpret what they	➢ The student presentation about experiments some	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
		have learned from experiment.	common household chemical, the problem of experiment activity sheet 6.1 form and share their knowledge to other groups. ➢ The student showed their result to another group.	
	Elaborate (25min)	➢ The teacher recommends and post activity sheet 6.2 form to google classroom.	➢ The student measuring the ingredient of household chemical and classifying reactants and products. ➢ Each group tries to completed on activity sheet 6.2 form.	
4	Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot website.	➢ The student takes individual practice by play game (use kahoot website).	
	Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in google classroom after done.	
5	Lesson 7 Balancing chemical equation			
	Elicit (15min)	➢ Revise student's prior knowledge by asking question; why we need to	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
		learn solutions? count the common of house solution? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: balancing chemical equation	➢ The students studied and note important thing from YouTube	
	Engage (15min)	The teacher showed experiment of burn steel wool with oxygen.	➢ The student observes the experiment of burn steel wool with oxygen. ➢ The student note what do they observe during the reaction? ➢ Describe anything see, hear, or smell.	
	Explore (35min)	➢ The teacher post and provide the activities sheet 7.1 form to the student on google classroom.	➢ The student practices on PhET (phet.colorado.edu) identify balancing chemical equation. ➢ The student observing how to balance the chemical equation, measuring their using technology, mass of steel wool and communicating from their activity sheet 7.1 form. ➢ Each group tries to note what they observed and	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
			done. ➢ The student keeps and take the result post on google classroom.	
	Explain (20min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation and explain how to write and balance chemical equation (activity sheet 7.1) and share their knowledge to other groups. ➢ The student showed their result to another group.	
	Elaborate (25min)	➢ The teacher recommends and post activity sheet7.2 to google classroom.	➢ Each group tries to completed on activity sheet 7.2 form	
	Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot website.	➢ The student takes individual practice by play game (use kahoot website).	
	Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in google classroom after done.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
5	Lesson 8 Solutions			
	Elicit (30min)	➢ Revise student's prior knowledge by asking question; why we need to learn solutions? count the common of house solution? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: water-universal solve	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube	
	Engage (30min)	➢ The teacher showed experiment of salt with water.	➢ The student observes the experiment of salt with water. ➢ The student note what they saw and test the salt solution. ➢ All the group working prepare equipment and tools for experiment of some common household solution. ➢ Each group tries to experiments and note what they observed and done.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
			➢ The student take care with their experiment and note all the process. ➢ The student keeps and take the result post on google classroom.	
	Explore (70min)	➢ The teacher post and provide the activities sheet 8.1 and 8.2 to the student on google classroom.	➢ The student experiments some common household solution items. ➢ The student practices on PhET (phet.colorado.edu) identify of concentration, mole, and volume. ➢ The student classifying some common household of solution, observing the solute, solvent, and saturated, predicting the solute, solvent, and saturated, and communicating from their experiment.	
	Explain (40min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation about experiments some common household of solution, the problem of experiment 8.1-8.2 and share their knowledge to other groups. ➢ The student showed their result to another group.	
	Elaborate (50min)	➢ The teacher recommends and post	➢ The student measuring and calculating the solvent,	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
		activity sheet8.3 to google classroom.	solute, solution, concentration, mole, volume, and molarity. ➢ Each group tries to completed on activity sheet 8.3 (individual work)	
	Evaluate (10min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot app or website.	➢ The student takes individual practice by play game (use kahoot app or website).	
	Extend (10min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in google classroom after done.	
6	Lesson 9 Acid and base			
	Elicit (15min)	➢ Revise student's prior knowledge by asking question; why we need to learn acid and base? It is important or not in your daily life? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: acid and base	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
	Engage (15min)	➢ The teacher showed common tools (pH meter, red cabbage indicator, and pH paper) and explain how to use it.	➢ The student practices on PhET (phet.colorado.edu) identify of strong and weak acid and base. ➢ The student observes the color and pH of solution ➢ All the group working prepare equipment and tools for experiment of common household.	
	Explore (35min)	➢ The teacher post and provide the activities sheet 9.1 and 9.2 to the student on google classroom.	➢ The student experiment common household items which one bases or acids by use common tools (pH test paper, pH meter, and red cabbage indicator) ➢ The student classifying the common household, observing the color pH of solution, predicting of pH solution, and communicating from their experiment. ➢ Each group tries to experiments and note what they done. ➢ The student take care with their experiment and note all the process and how to use common tools	
	Explain (20min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation about experiment of common household, the problem of experiment and share their knowledge to other groups.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
			➢ The student showed their result to another group.	
6	Elaborate (25min)	➢ The teacher recommends and post activity sheet 9.3 to google classroom.	➢ The student classification the properties of acid and base of common household. ➢ Each group tries note what they done.	
	Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot app or website.	➢ The student takes individual practice by play game (use kahoot app or website).	
	Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in google classroom after done.	
7	Lesson 10 Salts			
	Elicit (15min)	➢ Revise student's prior knowledge by asking question; what dose salt taste like? what are sources of salt? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
		them watch YouTube: salts and it's use		
	Engage (15min)	➢ The teacher showed neutralization reaction on YouTube and post activity	➢ The student observes of neutralization reaction on YouTube and note what the seen	
7		sheet 10.1 to the student on google classroom.	➢ All the group answer by predict of uses salt in daily life.	
	Explore (35min)	➢ The teacher post and provide the activity sheet10.2 to the student on google classroom.	➢ The student is observing the pH of (washing soda, baking soda, and salt with water), classifying the salts, and communicating from their experiment. ➢ Each group tries to experiments and note what they done. ➢ The student take care with their experiment and note all the process and how to use (measuring) common tools.	
	Explain (20min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation about experiment of (washing soda, baking soda, and salt with water), melting ice with salt, use different of salt in daily life and share their knowledge to other groups.	

Week	Learning procedure	Learning activities		
		Teacher activities	Student activities	Evaluation
			➢ The student showed their result to another group.	
	Elaborate (25min)	➢ The teacher recommends and post activity sheet 9.3 to google classroom.	➢ The student is observing and predicting of the combination of vinegar and baking soda about chemical reaction (acid with base). ➢ Each group tries note what they done.	
7			➢ The student completed all the activity sheet and take the result post on the google classroom.	
	Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot app or website.	➢ The student takes individual practice by play game (use kahoot app or website).	
	Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in google classroom after done.	

- Apply the draft the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) to advisor. And modify the chemistry instructional handbook by blended learning after advisors recommended.
- Apply the draft the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) were modified to seven experts. Seven experts of the chemistry instructional handbook by blended learning considering and evaluation of chemistry instructional handbook by blended learning, learning process (7Es learning cycle), learning activities (activities sheet and experiment), instructional media (google classroom, PhET simulate, Kahoot, and periodic table app), and assessment (authentic assessment) by focus group discussion.
- Modify the draft the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) after received opinions and suggestions to improve and modify from seven experts by validated and completed follow recommendation and suggestions.
- Following recommended of the experts, need to modify as; check the grammar, add more activities (active learning), and modify the hard activities sheet to suitable with ability the student. Change how students learn elicit, engage, explore, explain, elaborate, evaluate, and extend are all correct steps to do while applying the 7Es learning cycle.
- The chemistry instructional handbook by blended learning will be try out with the 10 students who study at PIBMC in technical and vocational certificate 1 level, semester 1, and academic year 2022 of skill bridging program by 2 chemistry teachers.

Summary of create the chemistry instructional handbook by blended learning figure 11

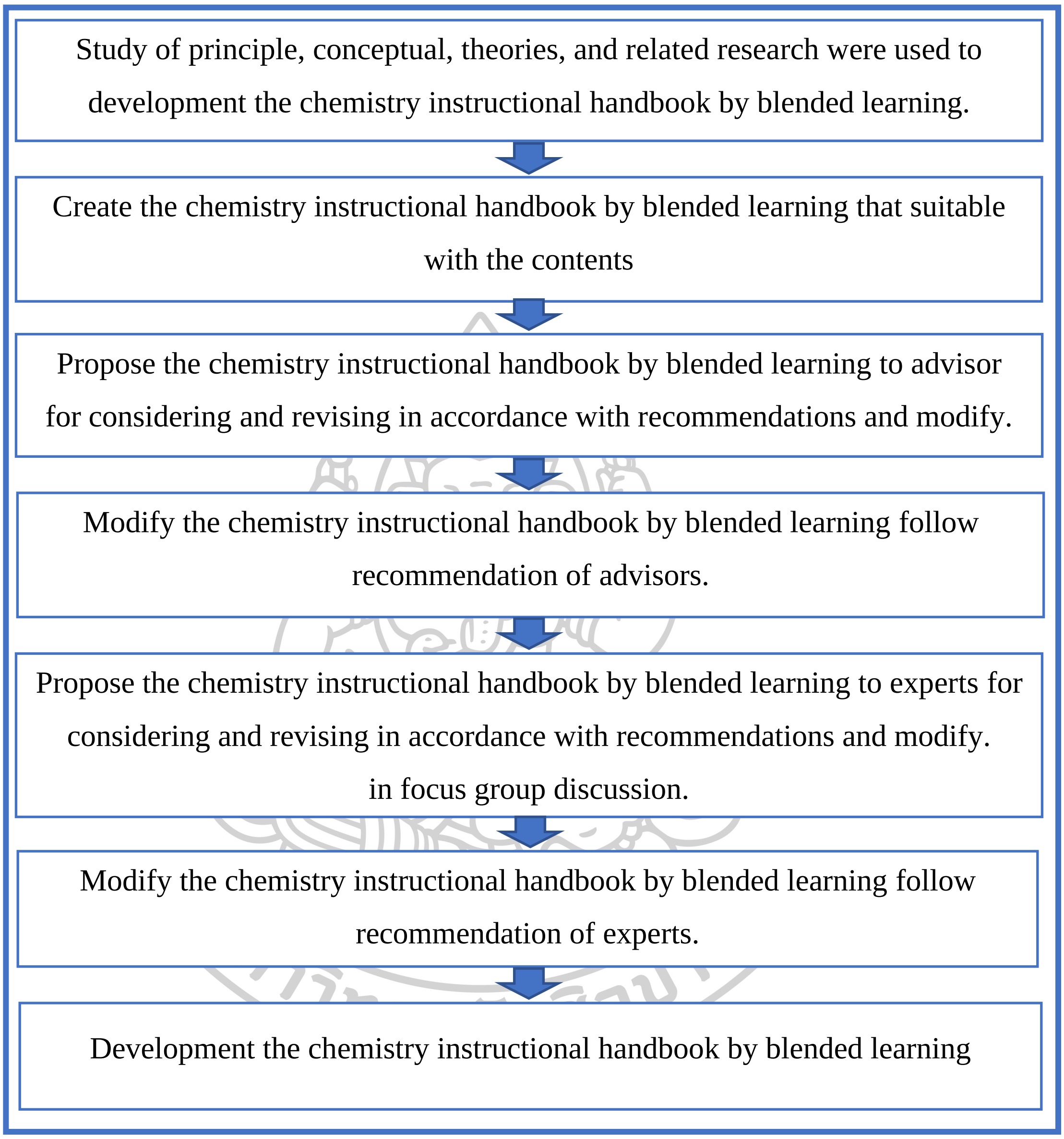

Figure 11 summary the procedure of the create the chemistry instructional handbook by blended learning.

2.4.3. Achievement test (pretest and posttest)

- Study of principle, conceptual, theories, and related research were used to development the achievement test form that available with ability of the student in grade 8 and 9 in skill bridging program.

- Create the achievement test form by 25 questionnaires. The scoring criteria were given as follows as; correct answer was given 2 points per 1 answer and wrong answer no answer was given 0 point.

Table 10 conclusion questionnaire in each unit

Unit	Unit1		Unit2			Unit3		Unit4			Total
Lesson	1	2	3	4	5	6	7	8	9	10	10
Hour	2	4	2	2	2	2	2	4	2	2	24
Questionnaire	2	4	2	2	2	2	2	4	3	2	25

- Propose the achievement test form to advisor to considering and revising in accordance with recommendations and modify.

- Propose the achievement test form to experts to find quality by focus group discussion.

- Take the results of the study to synthesis and modify follow by recommendation of the experts.

- Take the scores obtains from the test to find the mean value (X, the standard deviation (S.D.), and a dependent t-test to determine the difference of scores before and after using before and after use chemistry instructional handbook by blended learning. (Details are shown in table 21, page141)

Summary the procedure of create the achievement test form figure 12

Study of principle, conceptual, theories, and related research were used to development the achievement test form for pretest and posttest.

↓

Create the achievement test form that suitable with the ability of the students.

↓

Propose the achievement test form to advisor for considering and revising in accordance with recommendations and modify.

↓

Modify the achievement test form follow recommendation of the advisors.

↓

Propose the achievement test form to experts to find quality by focus group discussion

↓

Modify the achievement test form follow recommendation of experts.

Figure 12 summary the procedure of create the achievement test form

2.4.4. Science process skill test

- Study of principle, conceptual, theories, and related research were used to development science process skill test form that available with ability of the student in grade 8and 9 in skill bridging program.
- Create the science process skill test form that available with ability of the student in grade 8and 9 in skill bridging program. The science process skill test will be test after finished the unit.
- Create science process skill assessment to evaluate by rubric score (5 levels). 5 level is very higher, 4 is high, 3 is moderate, 2 is low, 1 is very low. Use the science process skill assessment after finished the lesson. Data analysis of science process skill test by mean rating ($\bar{x}$) and standard deviation (S.D.)

Table 11 determines the scoring criteria for the ability to complete science process skill

Skill	Criteria				
	5	4	3	2	1
Observing	Uses appropriate senses to describe objects, events, and/or experiment that are accurate in items step by step correctly.	Uses appropriate senses to accurately describe objects, events, and/or experiment step by step.	Uses appropriate senses to accurately describe objects, events, and/or experiment but not completely.	Limited to describe objects, events, and/or experiment	Unable to describe objects, events, and/or experiment
Measuring	Chooses and uses appropriate tools/unit measurements are specific, accurate, and supported by evidence.	Choose and uses measuring tools/units correctly.	Choose and use the correct measuring tools/units but not completely	Choose and use measuring tools/units most incorrect.	Unable to choose and/or use measuring tools/units.
Classifying	Separate or classer what's study interest that conform to the criteria used correctly and completely	Separate or classer what's study interest that conform to most of the criteria used	Separate or classer what's study interest that conform to some of the criteria used	Separate or classer what's study interest that is not conform to some of the criteria used.	Unable to sorting, grouping, and/or arranging based similarities and difference.
Predicting	Use previous data to predict	Use previous data to	Use previous data to predict	Use previous	Unable use previous data

Skill	Criteria				
	5	4	3	2	1
	what might be happen as correctly.	predict what might be happen	what might be happen but not completely.	data to predict what might be happen but some are incorrect.	to predict what might be happen
Communicating	Describes objects and/or events using a variety of methods, expanding on details clearly (orally, pictorially, and/or written)	Describes objects and/or events using a variety of methods, expanding on details (orally, pictorially, and/or written)	Describes objects and/or events using a variety of methods (orally, pictorially, and/or written)	Describes objects and/or events limited	Unable record or describe observations

For the interpretation of the scores obtained from the assessment as a level of ability to do science process skill, the researcher has determined the criteria as shown in table 12

Table 12 criteria for interpreting the level of ability to do science process skill (Maream, N.,2015)

Mean Value ($\bar{x}$)	**Level**
4.50-5.00	Very high
3.50-4.49	High
2.50-3.49	Moderate
1.50-2.49	Low
1.00-1.49	Very low

- Propose the science process skill test form to advisor for considering and revising in accordance with recommendations and modify.
- Propose the science process skill test form to experts to find quality by focus group discussion.
- Take the results of the study to synthesis and modify follow by recommendation of the experts. There are 10 worksheets.

Summary the procedure of create the science process skill test form figure 13

Study of principle, conceptual, theories, and related research were used to development the science process skill test.

↓

Create the science process skill test form that suitable with the ability of the students.

↓

Propose the science process skill test form to advisor for considering and revising in accordance with recommendations and modify.

↓

Modify the science process skill test form follow recommendation of the advisors.

↓

Modify the science process skill test form follow recommendation of experts.

Figure 13 summary the procedure of creates the science process skill test form

2.4.5. Satisfaction’s teacher form

- Study of principle, conceptual, theories, and related research were used to development satisfaction’s teacher form.
- Create of satisfaction’s teacher form.to questionnaires.
- Propose the satisfaction’s teacher form to advisor to considering and revising in accordance with recommendations and modify.
- Propose the satisfaction’s teacher form to experts to find quality by focus group discussion.
- Take the results of the study to synthesis and modify follow by recommendation of the experts.
- Take the satisfaction’s teacher form that was constructed to find the quality of the tools to find validity for mean rating ($\bar{x}$) and standard deviation (S.D.). There are 38 questionnaires.

Summary of create the satisfaction’s teacher form figure 14

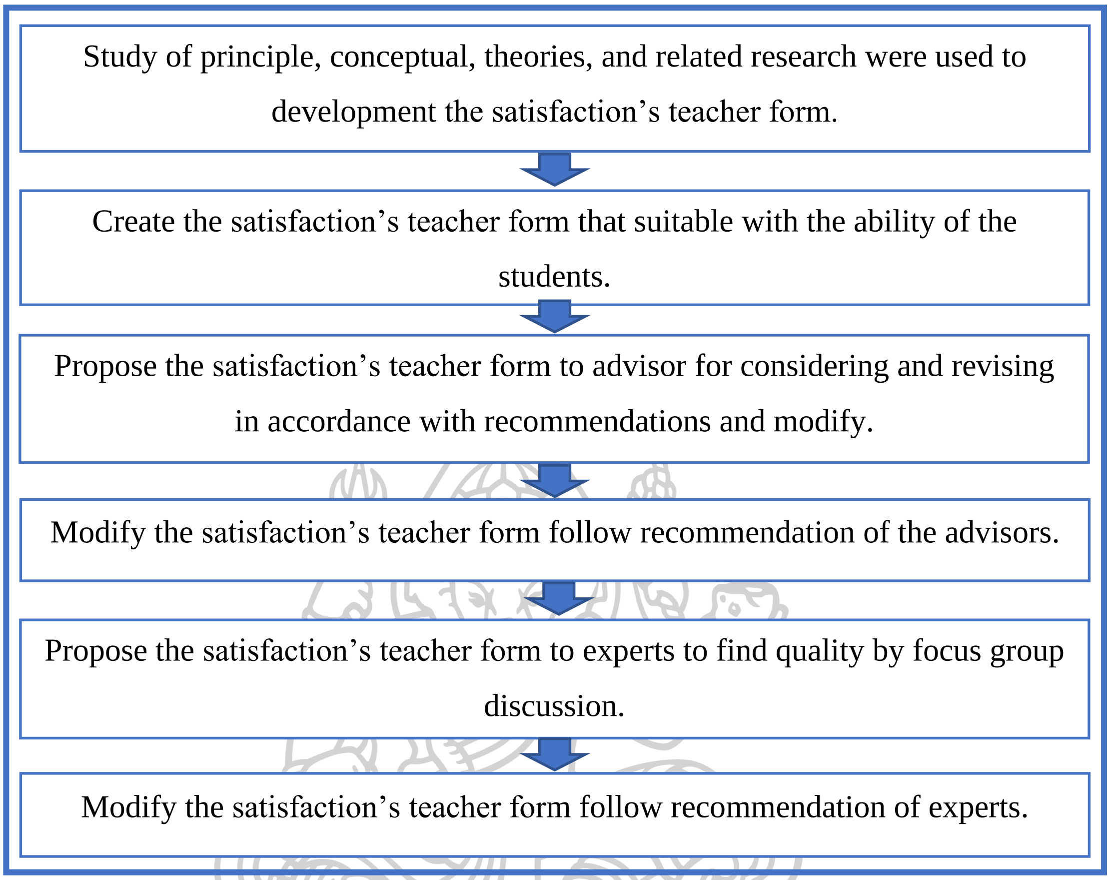

Figure 14 the procedure of creates the satisfaction’s teacher form

2.5. Procedures

The researcher conduct research follow as;

2.5.1. Analysis the need related of the create chemistry instructional handbook by blended learning.

- Create the chemistry instructional handbook by blended learning
- Finding quality of chemistry instructional handbook by blended learning.
- Finding effectiveness of the chemistry instructional handbook by blended learning.

2.5.2. Contacts and make an appointment who attend on the focus group discussion (seven experts) that had experience more than 5 years.

2.5.3. Determines and organize the focus group discussion such as; note-taker and assistant.

2.5.4. Conduct a workshop based on the questionnaire of focus group discussion.

2.5.5. Record focus group discussion based on the topic and conclusion

2.5.6. Record sound, picture, and motion picture while focus group discussion

2.5.7. Conclusion and analyze the topic of focus group discussion by take the data.

2.5.8. Take the chemistry instructional handbook, achievement test, science process skills test, and satisfaction ‘teacher form to seven experts evaluation quality.

2.5.9. Propose the chemistry instructional handbook by blended learning to advisor for considering and revising in accordance with recommendations.

2.5.10. Seven experts revising quality and recommendations of chemistry instructional handbook, achievement test, science process skills test, and satisfaction ‘teacher form.

2.5.11. Final revision of chemistry instructional handbook by blended learning.

2.6. Data analysis

The researcher conducted an analysis of the data by statistics. The statistics that used to find quality and index of item objective congruence (IOC) of interview and observation questionnaire as;

Formula of index of item objective congruence (IOC) (Maream, N.,2015)

$$IOC = \frac{\sum R}{N}$$

IOC refer to Index of questionnaire item objective congruence

$\sum R$ refer to all the score of experts

N refer to the experts

The index of item objective congruence (IOC). The questionnaire's items were scored using a scale from -1 to +1 using the index of item objective congruence (IOC). Congruent = + 1 Questionable = 0 Incongruent = -1 the items that had scores lower than 0.5 were revised. On the other hand, reserved were the items with scores more than or equal to 0.5.

Formula of standard deviation (S.D.)

$$S.D = \frac{\sqrt{\sum_{i=1}^{N}(X_i - \bar{X})^2}}{N}$$

S.D refer to sample standard deviation

N refer to sample standard deviation

X_i refer to the observed values of a sample item

$\bar{X}$ refer to the mean value of the observations

Summary the procedure of step 2

Analysis the need related of the create chemistry instructional handbook by blended learning.

↓

Contacts and make an appointment who attend on the focus group discussion

↓

Determines and organize the focus group discussion such as; note-taker and assistant.

↓

Conduct a workshop based on the questionnaire of focus group discussion.

↓

Record focus group discussion based on the topic and conclusion

↓

Record sound, picture, and motion picture while focus group discussion

↓

Conclusion and analyze the topic of focus group discussion by take the data.

↓

Take the chemistry instructional handbook, achievement test, science process skills test, and satisfaction ‘teacher form to seven experts evaluation quality.

↓

Propose the chemistry instructional handbook by blended learning to advisor for considering and revising in accordance with recommendations.

↓

Seven experts revising quality and recommendations of chemistry instructional handbook, achievement test, science process skills test, and satisfaction ‘teacher form.

↓

Final revision of chemistry instructional handbook by blended learning

Figure 15 summary the procedure of step2

Step 3: Implement of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

3.1. Objective

3.1.1. To implement the chemistry instructional handbook by blended learning to vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province.

3.2. Population and sample

3.2.1. The population for this research study were, the 100 students and five teachers in vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province who studying and teaching in semester 1, academic year 2022, and 24 hours (chemistry subject) Cambodia, selected.

3.2.2. The samples of the research study were 40 students grades 8&9 students' chemistry and two teachers in vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province who studying and teaching in semester 1, academic year 2022, and 24 hours (chemistry subject) Cambodia, selected by simple random sampling.

3.3. Instrument

3.3.1. The evaluation chemistry instructional handbook by blended learning

3.3.2. The evaluation achievement test form for the student.

3.3.3. The evaluation science process skill test form for the student.

3.3.4. The evaluation satisfaction' teacher form that used chemistry instructional handbook by blended learning.

3.4. Procedures

3.4.1. Request the letter from the graduate school, Silpakorn university to director of Polytechnic Institute of Banteay Meanchey Province, Cambodia for implement the chemistry instructional handbook by blended learning in vocational certificate (skill bridging program).

3.4.2. Training chemistry instruction handbook by blended learning 1week to two chemistries 's teachers in Polytechnic Institute of Banteay Meanchey Province.

3.4.3. Try out with other sample (10 students) in Polytechnic Institute of Banteay Meanchey Province.

3.4.4. Evaluation the achievement test (pre-test) to the student in Polytechnic Institute of Banteay Meanchey Province

3.4.5. Implement the chemistry instructional handbook by blended learning seven weeks (24hours)

Before use the chemistry instructional handbook by blended learning

- Preparation the classroom: use the chemistry laboratory which is convenient, experiment, and use computer.
- Preparation the media: prepare the chemistry instructional handbook by blended learning by create google classroom, Facebook, YouTube, and Kahoot app to communication and upload in the website.
- Preparation the student: divide the student in two group (3 to 5 student per group) by mixed ability good, medium, and poor. The teacher is introduced how to chemistry instructional handbook by blended learning and detail clearly the objectives, learning activities, and login to google classroom and kahoot app/website.

3.4.6. The step of use chemistry instructional handbook by blended learning

Table 13 the step of use chemistry instructional handbook by blended learning

Step	**Rules of teacher**	**Rules of students**
Before learn		
	✚ The teacher prepares or checks technology/ media, handouts, and the internet. ✚ The teacher teaches to follow the lesson plan.	✚ The student prepares the classroom. ✚ The student learns how to use technology. For example, google classroom, google form, and applications. ✚ The student reads the handout, research from social media, the internet, or book before going to the classroom.
During learn (7Es learning cycle)		

Step	Rules of teacher	Rules of students
Elicit	The teacher revises student's prior knowledge by posing the questions, YouTube, video, films, short movie, animations, simple scientific, demonstrations, or/and cartoons.	The student uses technology in the classroom. The student pays attention to observing, discussing, or/and note what they see and hear. The student shares their understand form media or technology by their sense to a classmate.
Engage	The teacher uses a simple experiment. For instance, PhET simulation, YouTube, hand-on, or sample.	The student pays attention to observing, classifying, measuring, communicating, and predicting for a simple experiment. The student divides group working.
Explore	The teacher proved the worksheet, the activities sheet, document, or experiment lab to the student.	The student practices with the experiment. They can search for information on the internet. The student use worksheet, document, or activities report to record data. The students divide responsible into their group.
Explain	The teacher allows the student to interpret what they have learned, research, or experiment.	The student presentation by individual or group working. They're communicating or/and share an idea. The student is capable to answer and question together.
Elaborate	The teacher posts the individual worksheet, group worksheet, or topic to the student.	The student uses them understand to answer on the worksheet or their topic. The student use observing, measuring, classifying, predicting, or communicating to improve the understand after recommendation from the teacher.
Evaluate	The teacher use game education, application, test,	The student will answer the short quiz, test, or play a game to review their

Step	Rules of teacher	Rules of students
	or quiz to assess student.	understanding by the Kahoot or another application. ✚ The student uses technology/ media to improve themselves.
Extend	✚ The teacher allowed the student to create, find a topic, or make something related to the lesson to extend their understanding to daily life.	✚ The student tries the best to find the topic by themselves or create something to improve them understand more than learning in the classroom. ✚ The student could be individual or group assignments.
After learn		
	✚ The teacher shows dateline to submit student's assignment and follow them send by google classroom, google form, or email.	✚ The students help to prepare the classroom. ✚ The student shares their difficult using technology. ✚ The student will be able to find the topic to improve they are understanding of daily life experiences.

3.4.7. Evaluation every unit of chemistry instructional handbook by blended learning (science process skill test).

3.4.8. Evaluation the achievement test (posttest)

3.4.9. Evaluation the teachers' satisfaction

3.5. Data analysis

This study was a single group pre-test and post-test experimental research study that have research plan the one group pretest and posttest design.

Pretest	Test	Posttest
T_1	**X**	**T_2**

T_1 refer to pretest achievement on chemistry instructional handbook by blended learning

X refer to Chemistry instructional handbook by blended learning

T_2 refer to posttest achievement on chemistry instructional handbook by blended learning

Summary procedure of step 3

Request the letter from the graduate school, Silpakorn University to director of Polytechnic Institute of Banteay Meanchey Province, Cambodia for implement

Training chemistry instruction handbook by blended learning 1week to two chemistries 's teachers in Polytechnic Institute of Banteay Meanchey Province

Try out with other sample (10 students) in Polytechnic Institute of Banteay Meanchey Province

Evaluation the achievement test (pre-test) to the student in Polytechnic Institute of Banteay Meanchey Province

Implement the chemistry instructional handbook by blended learning seven weeks (24hours)

Evaluation every unit of chemistry instructional handbook by blended learning (science process skill test).

Evaluation the achievement test (posttest) to the student in Polytechnic Institute of Banteay Meanchey Province

Evaluation the teachers' satisfaction.

Figure 16 summary the procedure of step3

Step 4: Study effective of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) in Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

4.1. Objective

To study effective of the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) in Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

4.2. Population and sample

4.2.1.The population for this research study were and five teachers in vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province who teaching in semester 1, academic year 2022, selected.

4.2.2.The samples of the research study were two teachers in vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province who teaching in semester 1, academic year 2022, selected by simple random sampling.

4.3. Instrument

- Satisfaction' teacher form that used chemistry instructional handbook by blended learning.

4.4. Procedures

- Studying and analysis previous research documents related satisfaction's teacher form
- Creating satisfaction's teacher form
- Propose the satisfaction's teacher form to advisor for considering and revising in accordance with recommendation.
- Take satisfaction's teacher form to seven experts revising quality and recommendations in focus group discussion.
- Improved satisfaction's teacher form follows expert's recommendation
- Modify satisfaction's teacher form to be used as instrument.

Summary procedure of created assessment from satisfaction's teacher form test in figure 19

Study and analysis previous research documents related satisfaction's teacher form

↓

Create science satisfaction's teacher form

↓

Propose the assessment form of satisfaction's teacher form to advisor for considering and revising in accordance with recommendation

↓

Take assessment form of satisfaction's teacher form to seven experts revising quality and recommendations in focus group discussion.

↓

Improved assessment form of satisfaction's teacher form follows expert's recommendation

↓

Modify assessment form satisfaction's teacher form to be used as instrument.

Figure 17 summary procedure of created assessment from science process skill test

Data analysis

Take the satisfaction's teacher form to find the mean value($\bar{x}$)and standard deviation (S.D.).

Formula of Mean rating **($\bar{x}$)** **(**Maream, N.,2015)

$$\bar{x} = \frac{\sum x}{N}$$

$\bar{x}$ refer to mean

$\sum x$ refer to the sum of x (score)

N refer to number of data (Sample)

Formula of standard deviation (S.D.) **(**Maream, N.,2015)

$$S.D = \frac{\sqrt{\sum_{i=1}^{N}(X_i - \bar{X})^2}}{N}$$

S.D refer to sample standard deviation

N refer to sample standard deviation

X_i refer to the observed values of a sample item

$\bar{X}$ refer to the mean value of the observations

Summary procedure of step 4

Evaluation chemistry instructional handbook by blended learning in Polytechnic Institute of Banteay Meanchey Province.

↓

Collect data and recommendation improving

↓

Focus group discussion with two teacher who teaching by used chemistry instructional handbook by blended learning

↓

Satisfaction's teacher

Figure 18 summary the procedure of step 4

Summaries of research procedure

The development of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia".

Table 14 summaries of research procedure

Research Objective	Procedure	Sample	Instrument	Analysis/statistic
1. **To development the chemistry instructional handbook by blended learning for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.**	Analysis previous research papers and observation by visiting best practice schools focusing on learning process, activities, media or technology, and assessment.	Analysis previous research papers and observation by visiting best practice schools, located in Nakorn Pathom province, Thailand. There are seven schools follow as; 1. The Demonstration School of Slipakorn University 2. Kasetsart University Laboratory School 3. Nakorn Pathom Reachpath University Demonstration School (NPRUDS) 4. Prince Sirindthorn's College (PSC) 5. Matthayom Wat Nongkhaem school 6. Phrapathom Witthayalai School (PPT) 7. Kanchanapisek Wittayalai Nakorn Pathom (Pratamnak Suankularb Matthayom) There are two universities follow as; 1. Silpakorn university 2. Nakorn Pathom Reachpath University	1. The lesson plan of blended learning using 7Es learning cycle 2. Chemistry instructional handbook	1. Index of item objective Congruence (IOC) 2. Focus group discussion
2. To study science process skill of the	Evaluation after using chemistry instructional	The learner chemistry grade 8 and 9 for Vocational certificate (Skill Bridging Program) in Polytechnic Institute of Banteay	Science process skill test	Rubric

Research Objective	Procedure	Sample	Instrument	Analysis/statistic
students who learn with chemistry instructional handbook by blended learning.	handbook by blended learning.	Meanchey Province, Kingdom of Cambodia.		
3. To comparison of achievement on chemistry learning before and after learn with chemistry instructional handbook by blended learning.	Evaluation achievement chemistry learning before and after learn with chemistry instructional handbook by blended learning.	The learner chemistry grade 8 and 9 for Vocational certificate (Skill Bridging Program) in Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.	Chemistry test (pretest and posttest)	Mean rating ($\bar{x}$) and standard deviation (S.D.)
4. **To study teachers' satisfaction who use chemistry instructional handbook by blended learning.**	Evaluation form after use chemistry instructional handbook by blended learning.	Chemistry's teacher of vocational certificate (skill bridging program) in Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.	Satisfaction's teacher form	Mean rating ($\bar{x}$) and standard deviation (S.D)

CHAPTER IV

DATA ANALYSIS AND DISCUSSION

The research on **"**The development of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia". This is research and development. The results follow as;

1. The result of development the chemistry instructional handbook by blended learning for Skill Bridging Program of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.
2. The result of study science process skill of the students who learn with chemistry instructional handbook by blended learning.
3. The result of comparison the achievement on chemistry learning before and after learn with chemistry instructional handbook by blended learning.
4. The result of study teachers' satisfaction who use chemistry instructional handbook by blended learning.

1. The result of development the chemistry instructional handbook by blended learning for Skill Bridging Program of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

The results of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, divided in 4 steps as;

1) The results of analysis previous research papers about media or technology, learning processes, learning assessments, component's chemistry instructional handbook, and percentage of blended learning of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province. Found that the components of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for skill bridging program of Polytechnic Institute of Banteay Meanchey Province have 17 mains issue by the author choose 9 components that suitable for chemistry instructional handbook consists;

1. Introduction of handbook
2. Objective
3. The content
4. Preparing to teach
5. Procedure, Method, and teaching activities
6. Assessment and evaluation
7. Resource
8. Problem and recommendation
9. Reference

The results of learning process in chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province is 7E learning cycle model.

2) The interview results of 16 chemistry teachers about media or technology, learning process, learning assessment, components of chemistry instruction handbook, and percentage of blended learning of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province.

1.1. The results of components chemistry instruction handbook of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province as;

- Introduction
- Objective
- Content
- Unit
- Lesson plan
- How to use handbook and media or technology
- Follow chart
- Package activities
- Reference
- Bibliography

1.2. The results of learning process in chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province as;

- STEM
- 7E learning cycle model
- 5E learning cycle model

1.3. The results of media or technology in chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province as; Google classroom, Google form, Good Meet, Kahoot app, Quizizz app, PhET app, Power Point, crocodile chemistry app, Flipped classroom, Chem draw, Game app, and MBL chemistry.

1.4. The results of learning assessment of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province as;

- Pretest and Posttest
- Questionnaires
- Class and lap participation
- Pretest and Posttest
- Worksheet
- Explore

1.5. The results of percentage blended learning of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province as; face to face (50%) and online learning (50%)

3) The observe results 4 schools of chemistry instruction about media or technology, learning process, learning assessment, components chemistry instruction handbook, and percentage of blended learning of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province

2.1. The results of components chemistry instruction handbook of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province as;

1. Introduction
2. Objective
3. Content
4. How to use handbook
5. Reference

2.2. The results of learning process in chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province as; 5E

2.3. The results using media or technology in chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province as; Google classroom, Google form, Good Meet, Kahoot app, and Zoom.

2.4. The results of learning assessment of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, the mostly as;

1. Class and lap participation
2. Worksheet
3. Pretest and Posttest

2.5. The results of percentage blended learning of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, the mostly as; face to face (50%) and online learning (50%)

After analysis previous research paper, interviewed experts and chemistry teachers, and observe chemistry instruction in Thailand will use in chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province found that;

The components of chemistry instructional handbook by blended learning as;

1. Instruction
2. Content
3. Objective
4. Learning process

5. Media/technology
6. Assessment and evaluation
7. Units
8. How to use media and technology
9. Reference
10. Bibliography

The learning process of chemistry instructional handbook by blended learning there are 7 steps consists of;

1. **Elicit:** The instructor strives to get the students interested in the topic and gauge their prior knowledge. Students are motivated by concept cartoons, video clips, animations, and straightforward scientific experiments.

2. **Engage:** To interest pupils and get their attention, teachers may do a basic experiment or point out an anomalous occurrence.

3. **Explore:** The questioning method is used to guide pupils as they examine and revise the material. By using brainstorming within the parameters of an activity linked to the subject, assumptions and hypotheses are established. To direct students and record the data, utilize a worksheet.

4. **Explain:** Learning is attempted to be interpreted by students. In addition to giving a direct lecture, a teacher may also use videos, movies, idea maps, or presentations to illustrate the theories, concepts, laws, and facts.

5. **Elaborate:** The use of understanding in new contexts is encouraged among students.

6. **Evaluate:** using multiple choice, quizzes, puzzles, structured grids, and true-false questions to assess the students' learning in addition to formative and summative evaluation.

7. **Extend:** It is expected of students to apply and broaden their knowledge to situations in daily life.

The technology or media on the chemistry instructional handbook by blended learning as;

- Facebook
- YouTube
- Google application such as google classroom, google form, google Meet

- Kahoot app
- PowerPoint
- PhET app

The learning assessment of chemistry instructional handbook by blended learning as;

- Formative assessment: Pretest, Worksheets, Science process skill (5 skills), Class and lap participation
- Summative assessment: Posttest, Presentation

The blended learning is face to face (50%) and online (50%).

3. Focus group discussion

The researcher studied the results of the draft chemistry instructional handbook by blended learning follow as the results of the evaluation of opinions for 7 experts on chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate as focus group discussion.

The researcher presentation the draff of chemistry instructional handbook by blended learning about source and importance of research, objectives, hypothesis, scope of the study, papers and research including research studies procedures. And questionnaires to seven experts related component of handbook, procedures and suitability, independent and dependent variable, lesson plan, and chemistry instruction handbook by blended learning. In the focus group the experts suggested to modify as; check the grammar, add more activities (active learning), and modify the hard activities sheet to suitable with ability the student. Change how students learn follow the 7Es learning cycle and execute each phase of elicit, engage, explore, explain, elaborate, evaluate, and extend correctly.

Following recommended of the experts, the researcher can use chemistry instructional handbook by blended learning to implement with sample is most suitable.

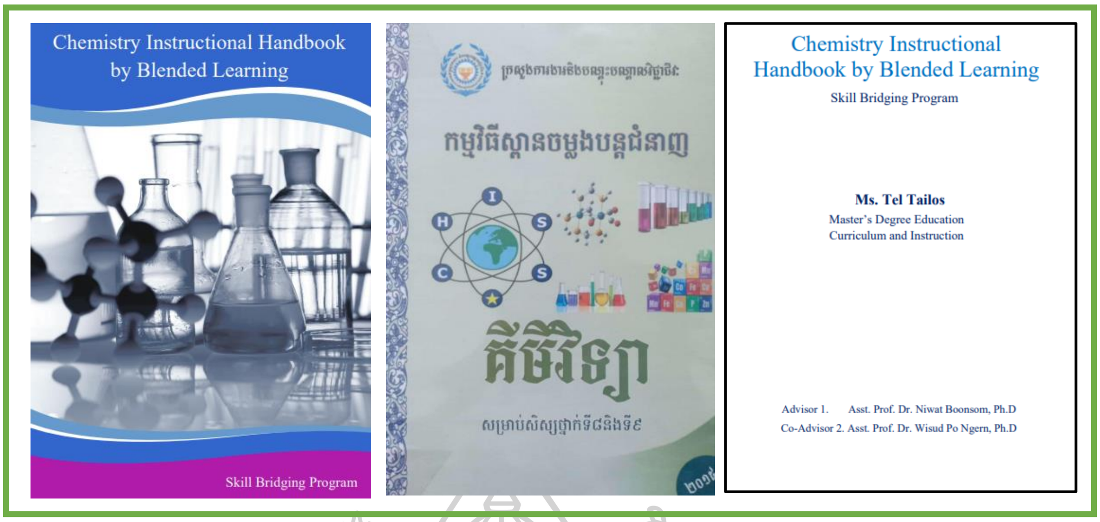

Figure 19 chemistry instructional handbook by blended learning

2. The result of study science process skill of the students who learn with chemistry instructional handbook by blended learning.

The researcher uses the chemistry instructional handbook by blended learning to implement 7 weeks with the sample as; the result of science process skill use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province

The result of science process skill during use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province

Table 15 over all the result of science process skill during use chemistry instructional handbook by blended learning

Science process skill	Unit1		Unit2		Unit3		Unit4	
	$\bar{X}$	**S.D.**	$\bar{X}$	**S.D.**	$\bar{X}$	**S.D.**	$\bar{X}$	**S.D.**
Observing	3.23	0.62	3.55	0.5	4.13	0.52	4.45	0.5
Measuring	3.2	0.56	3.55	0.5	3.75	0.49	4.2	0.41
Classifying	3.28	0.51	3.43	0.5	3.65	0.53	4.03	0.42
Predicting	3.33	0.53	3.5	0.51	3.55	0.5	3.95	0.5
Communicating	3.45	0.5	3.53	0.51	3.68	0.47	3.85	0.43
Over all	**3.3**	**0.55**	**3.51**	**0.5**	**3.75**	**0.54**	**4.1**	**0.5**

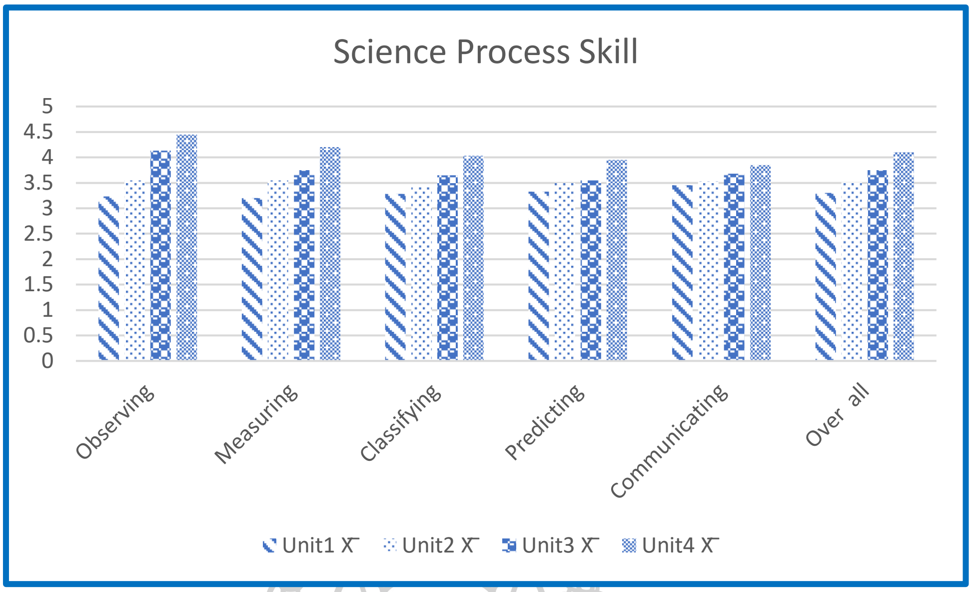

Figure 20 the result of science process skill to compare Mean rating ($\bar{x}$)

Table 16 the result of science process skill during use chemistry instructional handbook by blended learning (Unit1)

Science process skill	$\bar{X}$	S.D.	Interpretation
Observing	3.23	0.62	Moderate
Measuring	3.20	0.56	Moderate
Classifying	3.28	0.51	Moderate
Predicting	3.33	0.53	Moderate
Communicating	3.45	0.50	Moderate
Over all	3.30	0.55	Moderate

According to table 16, found that the score of the students' process skill during use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province. Overall, of science process skill are moderate ($\bar{X}$=3.30, S.D.=0.55) which accepts with the research hypothesis. In the unit 1, the mean of communicating is higher ($\bar{X}$=3.45, S.D.=0.50), predicting have ($\bar{X}$=3.33, S.D.=0.53), classifying have ($\bar{X}$=3.28, S.D.=0.51), observing have ($\bar{X}$=3.23, S.D.=0.62), and measuring have ($\bar{X}$=3.20, S.D.=0.56) interpretation all are moderate.

Table 17 the result of science process skill during use chemistry instructional handbook by blended learning (Unit2)

Science process skill	$\overline{X}$	S.D.	Interpretation
Observing	3.55	0.50	High
Measuring	3.55	0.50	High
Classifying	3.43	0.50	Moderate
Predicting	3.50	0.51	High
Communicating	3.53	0.51	High
Over all	3.51	0.50	High

According to table 17, found that the score of the students' process skill during use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province. Overall, of science process skill are high ($\overline{X}$=3.51, S.D.=0.50) which accepts with the research hypothesis. In the unit 2, the mean of observing is higher ($\overline{X}$=3.55, S.D.=0.50) interpretation is high, measuring has $\overline{X}$=3.55, S.D.=0.50) interpretation is high, communicating have ($\overline{X}$=3.53, S.D.=0.50) interpretation is high, predicting have ($\overline{X}$=3.50, S.D.=0.51) interpretation is high, and classifying have ($\overline{X}$=3.43, S.D.=0.50) interpretation is Moderate.

Table 18 the result of science process skill during use chemistry instructional handbook by blended learning (Unit3)

Science process skill	$\overline{X}$	S.D.	Interpretation
Observing	4.13	0.52	High
Measuring	3.75	0.49	High
Classifying	3.65	0.53	High
Predicting	3.55	0.50	High
Communicating	3.68	0.47	High
Over all	3.75	0.54	High

According to table 18, found that the score of the students' process skill during use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province. Overall, of science process skill are ($\overline{X}$=3.75, S.D.=0.54) which accepts with the research hypothesis. In the unit 3, the mean of observing is higher ($\overline{X}$=4.13, S.D.=0.52), measuring has ($\overline{X}$=3.75, S.D.=0.49), communicating have ($\overline{X}$=3.68, S.D.=0.47), classifying have ($\overline{X}$=3.65, S.D.=0.53) and predicting have ($\overline{X}$=3.55, S.D.=0.50) interpretation all are high.

Table 19 the result of science process skill during use chemistry instructional handbook by blended learning (Unit4)

Science process skill	$\overline{X}$	S.D.	Interpretation
Observing	4.45	0.50	High
Measuring	4.20	0.41	High
Classifying	4.03	0.42	High
Predicting	3.95	0.50	High
Communicating	3.85	0.43	High
Over all	4.10	0.50	High

According to table 19, found that the score of the students' process skill during use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province. Overall, of science process skill are ($\overline{X}$=4.10, S.D.=0.50) which accepts with the research hypothesis. In the unit 4, the mean of observing is higher ($\overline{X}$=4.45, S.D.=0.50), measuring has ($\overline{X}$=4.20, S.D.=0.41), classifying have ($\overline{X}$=4.03, S.D.=0.42), predicting have ($\overline{X}$=3.95, S.D.=0.50), and communicating have ($\overline{X}$=3.85, S.D.=0.43) interpretation all are high.

3. The result of the comparison of achievement on chemistry learning before and after learn with chemistry instructional handbook by blended learning.

The result of using the chemistry instructional handbook by blended learning for vocational certificate with 40 students in Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia. Found that, the students can perform activities in each teaching series as required. The most of students have interesting with chemistry instructional handbook by blended learning such as; learning by using application app, YouTube, Phet, kahoot app, google classroom, telegram, and zoom. All application app makes the students understand the lesson more than before, can consult with teacher, observed and noted from watching video, play game, and presentation.

Table 20 the result of implement chemistry instructional handbook by blended learning

Lesson	The results in practical
1.Atom and molecules	The teachers can teach according to the activities provided. The students watched video from home as assigned by the teacher, observed and watched YouTube or video in the classroom, interested with Phet, and play game by kahoot app. The problem is; the student has difficult use educational app and media that late to finished the lesson.
2.Periodic Table	The teachers can teach according to the activities provided. The students observed and watched video in the classroom, interested with periodic table app, and play game by kahoot app.
3.The properties of matter	The teachers can teach according to the activities provided. The students play game on kahoot app, use Phet app and YouTube. The problems are, the students do not understand the matter. Allowing students to more understand and able to do the exercises on their own by explain again and give an example. And also let the student review the again on Phet app.
4.Classify of mater	The teachers can teach according to the activities provided. The students watched video from home as assigned by the teacher, play game by kahoot app, watched YouTube in the classroom, and interested with Phet app about matter.
5.The Properties of matter	The teachers can teach according to the activities provided. The students are searching for information at home and then summarizing the results to present on the first page. The results showed that the students able to present work at a good level and can

Lesson	The results in practical
	find information.
6.Chemical Reaction	The teachers can teach according to the activities provided. The students are searching for information at home about chemical reaction, watched video from home as assigned by the teacher, and do exercise.
7.Balancing Chemical Equation	The teachers can teach according to the activities provided. The students are searching for information at home about balancing chemical equation, watched video from home as assigned by the teacher, do exercise, balancing chemical equation on Phet app. The student can explain balancing chemical to other friends in the classroom.
8.Solution	The teachers can teach according to the activities provided. The students watch videos from home as assigned by the teacher, interested with experiments, can be summarized as the results of the experiments themselves.
9.Acids and Bases	The teachers can teach according to the activities provided. The students watch videos from home as assigned by the teacher, interested with experiments, can be summarized as the results of the experiments themselves. The results showed that the students able to present work at a good level.
10. Salts	The teachers can teach according to the activities provided. The students are searching for information at home.

The researcher uses the chemistry instructional handbook by blended learning to implement 7 weeks with the sample as; the result of learning before and after use chemistry instructional handbook by blended learning.

Table 21 compare the results before and after use chemistry instructional handbook by blended learning

Test	Number of students	Score	$\overline{X}$	S.D.	T	Sig.
Pretest	40	100	22.60	7.89	-42.151	.000
Posttest	40	100	79.15	8.08		

From the table 21 it was found that, the average score of learning to use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province that posttest ($\overline{X} = 79.15, S.D = 8.08$) higher than pretest ($\overline{X} = 22.60, S.D = 7.89$) are difference level of statistical significance 0.05.

4) The result of study teachers' satisfaction who use chemistry instructional handbook by blended learning.

The researcher uses the chemistry instructional handbook by blended learning to implement 7 weeks with the sample as; the result of teacher's satisfaction who use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province.

Table 22 the result of teacher's satisfaction who use chemistry instructional handbook by blended learning

Satisfaction issue	$\overline{X}$	S.D.	Level
Objective of learning chemistry instructional handbook by blended learning	4.00	0.47	High
The content of chemistry instructional handbook by blended learning	3.63	0.52	High
Teacher's role of teaching chemistry subject using chemistry instructional handbook by blended learning	4.00	0.00	High
Management of teaching chemistry subject using chemistry instructional handbook by blended learning	3.83	0.41	High

Satisfaction issue	$\bar{X}$	S.D.	Level
The lesson of chemistry instructional handbook by blended learning	3.55	0.51	High
Type of chemistry instructional handbook by blended learning	3.92	0.29	High
Evaluation the results of chemistry subject use chemistry instructional handbook by blended learning	3.83	0.39	High
Total	3.79	0.44	High

According to table 22, found that the result of teacher's satisfaction who use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province. Overall, of teacher's satisfaction are ($\bar{X}$=3.79, S.D.=0.44) which accepts with the research hypothesis. Objective of learning chemistry and teacher's role of teaching chemistry subject of instructional handbook by blended learning are higher ($\bar{X}$=4.00, S.D.=0.00), Type of chemistry instructional handbook by blended learning has ($\bar{X}$=3.92, S.D.=0.29), management of teaching chemistry subject using chemistry instructional handbook by blended learning and evaluation the results of chemistry subject use chemistry instructional handbook by blended learning have ($\bar{X}$=3.83, S.D.=0.39), the content of chemistry instructional handbook by blended learning have ($\bar{X}$=3.63, S.D.=0.52), and the lesson of chemistry instructional handbook by blended learning have ($\bar{X}$=3.55, S.D.=0.51) interpretation all are high.

CHAPTER V

CONCLUSION AND RECOMMENTDATION

The research on'' The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia". This study uses a mixed methodology that combines quantitative and qualitative research by research and development (R & D). There are 4 objectives as follows;

1) To development the chemistry instructional handbook by blended learning for Skill Bridging Program of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia.

2) To study science process skill of the students who learn with chemistry instructional handbook by blended learning.

3) To comparison of achievement on chemistry learning before and after learn with chemistry instructional handbook by blended learning.

4) To study teachers' satisfaction who use chemistry instructional handbook by blended learning.

The samples of the research study were 40 student's grades 8&9 students' chemistry and two teachers in vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province.

The instrument that uses in this research are;

The instrument to use for develop of chemistry instructional handbook by blended learning as; Interview form, observation form, and questionnaire in focus group discussion, Chemistry instructional handbook by blended learning, Pretest and posttest, Science process skill, Teacher's satisfaction

Data analysis are average $(\overline{x})$, standard deviation (S.D.), t-test dependent, and content analysis.

Conclusion of the research

1. The result of development the chemistry instructional handbook by blended learning for Skill Bridging Program of Polytechnic Institute of Banteay Meanchey Province. Found that, chemistry instructional handbook by blended

learning as; instruction, content, objective, learning process, media/technology, assessment and evaluation, units, how to use media and technology, reference, and bibliography. The learning process of chemistry instructional handbook by blended learning there are 7 steps includes eliciting, engaging, exploring, explaining, elaborating, evaluating, and extending. The technology or media of chemistry instructional handbook by blended learning as; Facebook, YouTube, Google application (such as google classroom, google form, google Meet), Kahoot app, PowerPoint, PhET app. The learning assessment of chemistry instructional handbook by blended learning as; formative assessment (Pretest, Worksheets, Science process skill (5 skills), Class and lap participation). Summative assessment (Posttest). The blended learning is face to face (50%) and online (50%).

2. The result of the study science process skill of the students who learn with chemistry instructional handbook by blended learning. Found that the score of the students' process skill during use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province. In unit 1, the mean of communicating is higher, predicting, classifying, observing, and measuring, interpretation all are neutral. Overall, of science process skill are neutral which accepts with the research hypothesis

In unit 2, the mean of observing is higher interpretation is positive, measuring interpretation is positive, communicating interpretation is positive, predicting interpretation is positive, and classifying interpretation is neutral. Overall, of science process skill are positive which accepts with the research hypothesis.

In the unit 3, the mean of observing is higher, communicating, classifying, and predicting interpretation all are positive. Overall, of science process skill which accepts with the research hypothesis

In the unit 4, the mean of observing is higher, measuring, classifying, predicting, and communicating interpretation all are positive. Overall, of science process skill which accepts with the research hypothesis

3. The result of comparison of achievement on chemistry learning before and after learn with chemistry instructional handbook by blended learning. Found that,

the average score of learning to use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province that higher than pretest are difference level of statistical significance 0.05.

4. The result of teacher's satisfaction who use chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate of Polytechnic Institute of Banteay Meanchey Province. Overall, of teacher's satisfaction which accepts with the research hypothesis. Objective of learning chemistry and teacher's role of teaching chemistry subject of instructional handbook by blended learning are higher, Type of chemistry instructional handbook by blended learning, management of teaching chemistry subject using chemistry instructional handbook by blended learning and evaluation the results of chemistry subject use chemistry instructional handbook by blended learning, the content of chemistry instructional handbook by blended learning, and the lesson of chemistry instructional handbook by blended learning interpretation all are high.

Discussion of the research

According to the research, the development of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia". The researchers discussed and detail the results as;

1. The result of the development of chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (skill bridging program) of Polytechnic Institute of Banteay Meanchey Province. Found that, chemistry instructional handbook by blended learning as; instruction, content, objective, learning process, media/technology, assessment and evaluation, units, how to use media and technology, reference, and bibliography. The learning process of chemistry instructional handbook by blended learning there are 7 steps consists of; elicit, engage, explore, explain, elaborate, evaluate, and extend. The technology or media of chemistry instructional handbook

by blended learning as; Facebook, YouTube, Google application (such as google classroom, google form, google Meet), Kahoot app, PowerPoint, PhET app. The learning assessment of chemistry instructional handbook by blended learning as; formative assessment (Pretest, Worksheets, Science process skill (5 skills), Class and lap participation). Summative assessment (Posttest). It has been organized in a systematic and step by step based on the theory of creating a collection of mixed media teaching, lecturer who provides thesis advisor, expert and try out/test the students. Found that, it was accepted with research hypothesis.

The researcher created chemistry instructional handbook by blended learning through study curriculum of chemistry 8&9(skill bridging program) of Polytechnic Institute of Banteay Meanchey Province, need of student and teacher, create the chemistry handbook for the teacher follow process creating, and developed need through step by step of process that make chemistry instructional handbook by blended learning respond the need of the students. It is model to use in teaching and learning. After implement, chemistry instructional handbook by blended learning able to process activity follow the step. Instruction has easy to use, preparation for teaching and learning are easy to understand, and save time to explaining, make possible to add more experimental activities in the classroom, have time to check, and helping students to do exercises. The learner, able to research themselves, self-responsibility and group, able find learning resources from the lessons. Moreover, the students are comfortable and interesting with video, YouTube, PhET, Kahoot app, and google meet. The students able to study anywhere anytime, able to observed and experiment follow video or YouTube, able to research information related the lesson.

Mofeed and Al-Sous (2010) sought to determine how the use of a blended learning strategy affected instructors' capacity to create and design educational multimedia. This study is descriptive in nature. It primarily outlines the training program's characteristics and calculates the percentages of blended learning across several models of learning. (120) instructors and technology specialists made up the study's subject population. The findings show that the teachers were able to develop instructional multimedia, which gives them more confidence when dealing with e-learning and enables them to develop their own blended learning model.

Simpson and Anderson (2009) sought to determine the impact of instruction and blended learning on the level of knowledge and motivation among ninth-grade German science students. According to the findings, the experimental group's educational outcomes—particularly their cognitive processes at the higher levels—were improved by the teaching and integrated learning technique. The study discovered that the teaching and blended learning approach improved students' interests and propensities, and the findings showed a significant relationship between interest and internal motivation and cognitive learning outcomes.

In Maguire study (2005), the major goal is to determine how blended learning affects students' math achievement. In research on 56 instructors who use blended learning to teach mathematics in the Toronto area of Canada, the study sample consisted of intermediate schools. The outcomes show that the blended learning approach aids students in performing and scoring higher than the competition.

Bailey study (2003), investigating how learning tactics affect student-to-student interactions, student-teacher interactions, and student satisfaction was the goal of this study. The participants in this study, who totaled 84, were separated into two divisions at the State University of Bin Slvana, one of which used blended learning tactics for instruction while the other relied on alternative methods. The findings did not reveal any variations in the degree of student satisfaction, but they do demonstrate that a blended learning technique has positive benefits on raising awareness of student-to-student contact.

2. After study science process skill of the students who learn with chemistry instructional handbook by blended learning

In unit 1, science process skill is neutral level ($\bar{X}$=3.40, S.D.=0.49). This may be due to following reasons;

- The science teacher may not have enough information and comprehension of science content and skills. As a result, teachers are unable to instill science process skill in the student as well as they should.

- The students may be disinteresting of science and taking science process skill tests in unit 1.

In unit 2, science process skill is positive ($\bar{X}$=3.51, S.D.=0.50), unit 3 ($\bar{X}$=3.75, S.D.=0.54) and unit 4 ($\bar{X}$=4.10, S.D.=0.50) are high level.

Based on the description above, the students develop all science process skill which is consistent with the research of Akinbobola, A. O., & Afolabi, F. (2010), the physics practical tests for the West African Senior Secondary School Certificate in Nigeria during a ten-year period (1998–2007) were examined for science process skills. The study used an ex-post facto design. Out of the 15 science process skills utilized in the study, manipulating (17.20%), calculating (14.20%), recording (13.60%), observing (12.00%), and communicating (11.40%) were shown to be the five most important. As compared to integrated (higher order) science process skills (37.20%), the results also indicated a high percentage of basic (lower order) science process skills (62.8%). The results also showed that there were much more basic process skills than integrated process skills in the Nigerian physics practical exams for the West African Senior Secondary School Certificate.

Ketut Budiastra, A.,A & Hartinawati,.H (2021), a quasi-experimental method of research is used in this study. 56 students that attended Jember East's UT Regional Office in Java, Indonesia, participated in the study as respondents. The findings demonstrated that students in both the moderate and high categories had mastered the concepts and skills of the scientific method. The science content and instructional tools sparked a lot of interest in the students, according to their replies. The internet network needed to enable ICT-based tutorials and the difficulty in breaking the habit of utilizing printed science teaching materials when teaching inside blended learning are the two main challenges faced by blended learning.

3. Comparison of achievement on chemistry learning before and after learn with chemistry instructional handbook by blended learning. Found that, the result of learning by using chemistry instructional handbook by blended learning. The average score posttest higher than pretest are difference level of statistical significance 0.05. All learning with chemistry instructional handbook by blended learning that created by researcher and have variety of media. The teacher able to presented the content of each topic on internet such as; YouTube, google classroom, google meet, or telegram. The students are interested and active with learning, ability to seek knowledge themselves, and able to learned anytime anywhere, save time in the classroom to do

exercises and play gram related lesson, able to organize experiment activities, and more practice in the classroom. Which is consistent with Carroll, J.B., (1989) said that the teachers ‘teaching methods affected the students ‘learning achievement. Siribunnam, R., & Tayraukham, S., (2009) discovered that students who learned utilizing the 7E learning cycle had higher levels of science learning achievement and attitudes about learning chemistry than did students who learned using the KWL method.

4. Study teachers’ satisfaction who uses chemistry instructional handbook by blended learning. Studies have shown that teachers are satisfaction with chemistry instruction handbook. Similar, Gligorović et al., (2014) In Serbia, a study of 362 teachers from 57 primary schools revealed that teachers were more satisfied with their jobs. According to Bentea and Anghelache (2012), teachers who rise to a professional position through consistent professional development that enables them to be promoted and recognized are more satisfied with their work.

Recommendations

In light of the findings of this research, the researcher has the recommend follow as;

1. Recommendations for use chemistry instructional handbook by blended learning

1. The teacher capable use chemistry instructional handbook by blended learning as a guideline for organizing activities to develop the students as appropriate.
2. Should be studied the information in the chemistry instructional handbook by blended learning to have knowledge and understanding for organizing activities to develop students correctly.
3. Should be followed up on the results of use chemistry instructional handbook by blended learning to develop and increase the potential of students.
4. Should use encourage all students to have participate in activities as much as possible.

2. Recommendations for further research and development chemistry instructional handbook by blended learning follow as;

1) Due to the consequences on science teaching, should be involved in other courses. The utilization of the chemistry instructional handbook via blended learning in student accomplishment in other educational areas should be the subject of additional research by the researchers.

2) This study ought to serve as a starting point for further such studies that demonstrate the effects of using blended learning with other scientific topics or at higher educational levels.

3) Schools must promote the construction of additional spaces for science-related activities including laboratories and virtual classrooms.

4) Should incorporate more integrated science process skills into the skill bridging program level and chemistry practical examinations in order to increase students' propensity for creativity, problem-solving, reflective thinking, originality, and invention-essential components for any nation's science and technological development.

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NAME OF EXPERT

1. Experts of instrument tool (Focus group discussion)
    1) Asst. Prof. Dr. Maream Nillapun, Dean of faculty of education, Silpakorn University
    2) Asst. Prof. Dr. Yuwaree Yanprechaset, Silpakorn University
    3) Asst. Prof. Dr. Chintana Sirithanyarat, Nakhon Pathom Rajabhat University
    4) Dr. Witawas Handee, professor chemistry, Silpakorn University
    5) Dr. Supreeya Tantiweerakun, curriculum and instruction, Silpakorn University.
    6) Dr. Sumonmarn Chaneam, professor chemistry, Silpakorn University
    7) Asst. Prof. Dr. Rujiraporn Ramsiri, vice director of research and academic services, the Kasetsart university laboratory school center for educational research and develop
    8) Asst. Prof. Dr. Natdanai Budpub,The demonstration school of Silpakorn University
2. Experts of instrument tool (interview and observation form)
    1) Asst. Prof. Dr. Maream Nillapun, Dean of faculty of education, Silpakorn University
    2) Asst. Prof. Dr. Rujiraporn Ramsiri, Vice director of research and academic services, the Kasetsart university laboratory school center for educational research and develop
    3) Asst. Prof. Dr. Wanwisa Bungmark, Deputy dean for student development arts and culture, Silpakorn university.

Table 23 conclusion of analysis previous research papers

Component's chemistry instruction handbook	**Learning Process**	**Technology/Social Media**	**Learning assessment**	**Percentage of blended learning**
Englin, (2018), Jindanet, (2010), Meporn, (2009), Miphlai, (2006), Kraiemak, (1998)	Eisenkraft, (2003) Kanlı (2009), Adesoji & Idika, (2015)	Pimpala, (2018), Chimkul, (2016), Pooknoy, (2015), Technology for Teaching and Learning Bureau, Thailand, (2011), Mason & Rennie, (2008)	Pimpala, (2018), Daungjun, (2018), Jitrenoo, (2017), Chimkul, (2016), Phouphabang, (2016)	Bunmerod, (2018), Sualiman Baragash & Al-Samarraie, (2018), Allen et al., (2016), Gruba & Hinkelman, (2012), Allen et al., (2007)
Introduction	Elicit	YouTube	Pretest and Posttest	
Objective	Engage	Facebook	Class activities	
Content	Explore	Google app (Google Form)	Individual score form	
Preparing to teach	Explain	Power Point	Answer the questionnaires	
Procedure, Method, and teaching activities	Elaborate		Worksheets and activities sheet	30%(online)-79%(onsite)
Assessment and evaluation	Evaluate		Science process skill (explanation and experiment)	
Resource	Extend		Presentation	
Problem and Solution				
Reference				

Table 24 the content validity assessment result of interview

Description	Expert			IOC
	1	2	3	
Part1: General Questionnaire Survey	+1	+1	+1	1.00
Part 2: The objective of interview needs to get the knowledge of experts' opinion related with chemistry instructional handbook by blended learning such as learning process, learning activities, media, and assessment by structure interview 1 issue follow as;				
What are technologies should be used in chemistry instruction to enhance the learners have knowledge, skills, and attitude? How to used it?	+1	+1	+1	1.00
What should be in components of the chemistry instruction handbook? What are the characteristics?	+1	+1	+1	1.00
How many percent of face to face and online learning that you use in chemistry instruction?	+1	+1	+1	1.00
Suggestion and recommendation to develop chemistry instruction handbook by blended learning to enhance achievement on chemistry and science process skill for vocational certificate (Skill Bridging Program)?	+1	+1	+1	1.00

Table 25 the content validity assessment result of observation form

Description	Expert			IOC
	1	2	3	
Part1: General Questionnaire Survey	+1	+1	+1	1.00
Part 2: The objective of observed needs to get the knowledge of experts' opinion related with chemistry instructional handbook by blended learning such as learning process, learning activities, media, and assessment by structure interview 1 issue follow as;				
What are technologies should be used in chemistry instruction to enhance the learners have knowledge, skills, and attitude? How to used it?	+1	+1	+1	1.00
What should be in components of the chemistry instruction handbook? What are the characteristics?	+1	+1	+1	1.00
How many percent of face to face and online learning that you	+1	+1	+1	1.00

Description	Expert			IOC
use in chemistry instruction?				
Suggestion and recommendation to develop chemistry instruction handbook by blended learning to enhance achievement on chemistry 1and science process skill for vocational certificate (Skill Bridging Program)?	+1	+1	+1	1.00

Table 26 the result of science process skill after use chemistry instructional handbook by blended learning

Number of students	Observing	Measuring	Classifying	Predicting	Communicating	Total	$\bar{X}$	S.D
Score	5	5	5	5	5	25		
Unit1								
1	4	3	3	3	3	16	3.20	0.45
2	4	4	3	3	3	17	3.40	0.55
3	3	3	3	3	4	16	3.20	0.45
4	4	3	4	3	3	17	3.40	0.55
5	4	3	3	4	3	17	3.40	0.55
6	4	3	4	3	3	17	3.40	0.55
7	3	4	3	4	3	17	3.40	0.55
8	4	3	3	3	4	17	3.40	0.55
9	4	4	3	3	4	18	3.60	0.55
10	4	3	4	3	4	18	3.60	0.55
11	3	3	3	4	4	17	3.40	0.55
12	4	3	3	4	3	17	3.40	0.55
13	3	4	3	3	3	16	3.20	0.45
14	3	4	3	3	4	17	3.40	0.55
15	4	3	3	4	4	18	3.60	0.55
16	3	3	4	3	3	16	3.20	0.45
17	3	3	3	4	3	16	3.20	0.45
18	3	3	4	3	4	17	3.40	0.55
19	4	3	3	4	3	17	3.40	0.55
20	3	4	3	4	4	18	3.60	0.55
21	4	3	4	3	4	18	3.60	0.55
22	3	4	3	4	3	17	3.40	0.55
23	4	4	3	4	3	18	3.60	0.55
24	3	3	3	4	3	16	3.20	0.45
25	3	4	3	3	4	17	3.40	0.55
26	4	3	3	3	4	17	3.40	0.55
27	4	3	4	3	4	18	3.60	0.55
28	3	3	3	4	4	17	3.40	0.55
29	3	4	3	3	4	17	3.40	0.55
30	3	3	4	3	4	17	3.40	0.55
31	3	3	4	3	3	16	3.20	0.45
32	4	3	3	3	4	17	3.40	0.55
33	3	4	3	4	3	17	3.40	0.55

Number of students	Observing	Measuring	Classifying	Predicting	Communicating	Total	$\bar{X}$	S.D
Score	5	5	5	5	5	25		
34	3	3	3	4	3	16	3.20	0.45
35	3	3	4	3	3	16	3.20	0.45
36	3	3	4	3	3	16	3.20	0.45
37	4	4	3	3	3	17	3.40	0.55
38	4	4	4	3	4	19	3.80	0.45
39	4	3	4	3	4	18	3.60	0.55
40	4	3	3	3	3	16	3.20	0.45
Total	140	133	133	134	139			
X	3.50	3.33	3.33	3.35	3.48			
SD	0.51	0.47	0.47	0.48	0.51			
Unit2								
1	4	3	3	4	3	16	3.40	0.55
2	3	4	3	3	3	16	3.20	0.40
3	4	3	3	3	4	17	3.40	0.49
4	4	3	4	3	3	17	3.40	0.49
5	4	4	3	4	3	18	3.60	0.49
6	4	3	4	3	3	17	3.40	0.49
7	4	4	3	4	3	18	3.60	0.49
8	4	3	4	3	4	18	3.60	0.49
9	4	4	3	3	4	18	3.60	0.49
10	3	4	4	3	4	18	3.60	0.49
11	4	3	3	4	3	17	3.40	0.49
12	4	3	3	4	3	17	3.40	0.49
13	4	4	3	3	4	18	3.60	0.49
14	3	4	4	3	4	18	3.60	0.49
15	4	4	3	4	4	19	3.80	0.40
16	3	3	4	4	3	17	3.40	0.49
17	3	4	3	4	3	17	3.40	0.49
18	3	3	4	3	4	17	3.40	0.49
19	4	3	3	4	4	18	3.60	0.49
20	3	4	3	4	4	18	3.60	0.49
21	4	4	4	3	4	19	3.80	0.40
22	3	4	3	4	4	18	3.60	0.49
23	4	4	3	4	3	18	3.60	0.49
24	4	3	3	4	3	17	3.40	0.49
25	4	4	4	3	4	19	3.80	0.40
26	4	4	3	4	4	19	3.80	0.40
27	4	3	4	4	4	19	3.80	0.40
28	3	3	4	4	4	18	3.60	0.49
29	3	4	3	3	4	17	3.40	0.49
30	3	4	4	3	4	18	3.60	0.49
31	3	3	4	3	3	16	3.20	0.40
32	4	3	3	4	4	18	3.60	0.49
33	3	4	3	4	3	17	3.40	0.49
34	3	4	3	4	3	17	3.40	0.49
35	4	3	4	4	3	18	3.60	0.49

Number of students	Observing	Measuring	Classifying	Predicting	Communicating	Total	$\overline{X}$	S.D
Score	5	5	5	5	5	25		
36	3	4	4	4	3	18	3.60	0.49
37	3	4	3	3	3	16	3.20	0.40
38	3	4	4	3	4	18	3.60	0.49
39	3	3	3	3	4	16	3.20	0.40
40	4	3	4	3	3	17	3.40	0.49
Total	142	142	137	140	141			
X	3.55	3.55	3.43	3.50	3.53			
SD	0.50	0.50	0.49	0.50	0.50			
Unit3								
1	4	3	4	3	4	18	3.60	0.49
2	3	4	4	3	3	17	3.40	0.49
3	4	3	4	3	4	18	3.60	0.49
4	4	4	4	3	3	18	3.60	0.49
5	4	4	3	4	4	19	3.80	0.40
6	5	4	4	3	3	19	3.80	0.75
7	5	4	3	4	4	20	4.00	0.63
8	4	4	4	3	4	19	3.80	0.40
9	4	4	3	4	4	19	3.80	0.40
10	4	4	4	4	4	20	4.00	0.00
11	4	3	4	4	4	19	3.80	0.40
12	4	3	4	4	3	18	3.60	0.49
13	4	4	4	3	4	19	3.80	0.40
14	4	4	4	3	4	19	3.80	0.40
15	**5**	4	3	4	4	20	4.00	0.63
16	4	3	4	4	3	18	3.60	0.49
17	4	4	3	4	3	18	3.60	0.49
18	4	3	4	3	4	18	3.60	0.49
19	4	4	3	4	4	19	3.80	0.40
20	4	4	3	4	4	19	3.80	0.40
21	5	4	4	3	4	20	4.00	0.63
22	4	4	3	4	4	19	3.80	0.40
23	5	4	3	4	3	19	3.80	0.75
24	4	4	3	4	3	18	3.60	0.49
25	4	5	4	3	4	20	4.00	0.63
26	5	4	3	4	4	20	4.00	0.63
27	5	3	4	4	4	20	4.00	0.63
28	4	3	4	4	4	19	3.80	0.40
29	4	4	3	3	4	18	3.60	0.49
30	4	4	4	3	4	19	3.80	0.40
31	4	3	4	3	3	17	3.40	0.49
32	4	4	3	4	4	19	3.80	0.40
33	4	4	3	4	4	19	3.80	0.40
34	3	4	4	4	4	19	3.80	0.40
35	4	3	5	4	3	19	3.80	0.75
36	4	4	4	3	3	18	3.60	0.49
37	3	4	3	4	3	17	3.40	0.49

Number of students	Observing	Measuring	Classifying	Predicting	Communicating	Total	$\overline{X}$	S.D
Score	5	5	5	5	5	25		
38	4	4	4	3	4	19	3.80	0.40
39	4	3	4	3	4	18	3.60	0.49
40	5	4	4	3	3	19	3.80	0.75
Total	165	150	146	142	147			
X	4.13	3.75	3.65	3.55	3.68			
SD	0.51	0.49	0.53	0.50	0.47			
Unit4								
1	4	4	4	4	4	20	4.00	0.00
2	4	4	4	3	4	19	3.80	0.40
3	5	4	4	4	4	21	4.20	0.40
4	4	4	4	4	3	19	3.80	0.40
5	4	5	3	4	4	20	4.00	0.63
6	5	4	4	4	3	20	4.00	0.63
7	5	4	4	5	4	22	4.40	0.49
8	4	5	4	4	4	21	4.20	0.40
9	5	4	3	4	4	20	4.00	0.63
10	5	4	4	4	4	21	4.20	0.40
11	5	4	4	4	4	21	4.20	0.40
12	4	4	4	4	3	19	3.80	0.40
13	4	5	4	3	4	20	4.00	0.63
14	4	5	4	3	4	20	4.00	0.63
15	5	4	4	4	4	21	4.20	0.40
16	5	4	4	4	3	20	4.00	0.63
17	4	4	4	4	3	19	3.80	0.40
18	4	4	4	4	4	20	4.00	0.00
19	5	4	4	4	4	21	4.20	0.40
20	4	5	4	4	4	21	4.20	0.40
21	5	4	4	4	4	21	4.20	0.40
22	4	4	4	5	4	21	4.20	0.40
23	5	4	3	4	4	20	4.00	0.63
24	4	4	4	5	3	20	4.00	0.63
25	4	5	4	4	5	22	4.40	0.49
26	5	4	4	4	4	21	4.20	0.40
27	5	4	4	4	4	21	4.20	0.40
28	4	4	5	4	4	21	4.20	0.40
29	4	4	4	4	4	20	4.00	0.00
30	4	4	5	4	4	21	4.20	0.40
31	4	4	4	3	4	19	3.80	0.40
32	4	5	4	4	4	21	4.20	0.40
33	5	4	4	4	4	21	4.20	0.40
34	4	4	4	5	4	21	4.20	0.40
35	4	4	5	4	4	21	4.20	0.40
36	5	4	4	4	4	21	4.20	0.40
37	4	4	4	4	3	19	3.80	0.40
38	5	4	5	3	4	21	4.20	0.75
39	5	4	4	3	4	20	4.00	0.63

Number of students	Observing	Measuring	Classifying	Predicting	Communicating	Total	$\overline{X}$	S.D
Score	5	5	5	5	5	25		
40	5	5	4	4	4	22	4.40	0.49
Total	178	168	161	158	154			
X	4.45	4.20	4.03	3.95	3.85			
SD	0.50	0.40	0.42	0.50	0.42			

Table 27 the teacher's satisfaction who use chemistry instructional handbook by blended learning

Satisfaction issue	$\overline{X}$	S.D.	Level
Objective of learning chemistry instructional handbook by blended learning	**4.00**	**0.47**	High
The learners understand of Chemistry content by blended learning	4.00	0.00	High
The learners enjoy learning chemistry subject by blended learning	4.00	0.00	High
The learners capable to understand and calculate in chemistry subject by blended learning	4.00	0.00	High
The learners have science process skill	3.50	0.71	High
The learners have satisfied with Chemistry instructional handbook by blended learning	4.50	0.71	Very high
The content of Chemistry instructional handbook by blended learning	3.63	0.52	High
The content is conformed to the basic education core curriculum of chemistry subject	4.00	0.00	High
The content is conformed with interesting of the learner	3.50	0.71	High
The content is conformed with ability of the learner	3.50	0.71	High
The content is conformed with blended learning	3.50	0.71	High
Teacher's role of teaching chemistry subject using chemistry instructional handbook by blended learning	4.00	0.00	High
Prepare material and equipment for instruction	4.00	0.00	High
Explanation to enhance learning	4.00	0.00	High
Encourage learners learn together in online and face to face	4.00	0.00	High
Give advice to the learners how to learn with blended learning	4.00	0.00	High
Management of teaching chemistry subject using chemistry instructional handbook by blended learning	3.83	0.41	High
The instructor set the topic to the learner's study, research, and implement	4.00	0.00	High

Satisfaction issue	$\overline{X}$	S.D.	Level
The instructor let the learners' study and practice in online and face to face	3.50	0.71	High
Allow the learners have opportunity to participate and analyze both online and face to face	4.00	0.00	High
The lesson of chemistry instructional handbook by blended learning	3.55	0.51	High
Lesson 1: Atom and Molecules	3.50	0.71	High
Lesson 2: Periodic Table	4.00	0.00	High
Lesson 3: The nature of matter	3.00	0.00	Moderate
Lesson 4: Properties of matter	3.00	0.00	Moderate
Lesson5: Classifying matter	3.50	0.71	High
Lesson 6: Measurements and calculations	3.50	0.71	High
Lesson7: Properties of solutions	4.00	0.00	High
Lesson 8: Chemical Equations	3.50	0.71	High
Lesson9: Acids and Bases	4.00	0.00	High
Lesson 10: Salt	3.50	0.71	High
Type of chemistry instructional handbook by blended learning	3.92	0.29	High
Content is easy to understand	4.00	0.00	High
The content conforms with chemistry instructional handbook by blended learning	4.00	0.00	High
Equipment/tool and material is suitability with chemistry instructional handbook by blended learning	3.50	0.71	High
The format is suitability with teacher	4.00	0.00	High
The format is suitability with learner	4.00	0.00	High
Have interesting	4.00	0.00	High
Evaluation the results of chemistry subject use chemistry instructional handbook by Blended learning	3.83	0.39	High
The learners have science process skill after use chemistry instructional handbook by blended learning	3.50	0.71	High
The learners capable learn online and face to face	4.00	0.00	High
The learners have knowledge related chemistry	4.00	0.00	High
The learners easy understand and learn after use chemistry instructional handbook by blended learning	4.00	0.00	High
The learner's success with sciences process skill	3.50	0.71	High
The teachers understanding and capable use with chemistry instructional handbook by blended learning	4.00	0.00	High
Total	3.79	0.44	High

Table 28 the result of items difficulty (p) and discrimination (r)

Questionnaire	Total		Interpretation	Questionnaire	Total		Interpretation
	p	r			p	r	
1	0.60	0.40	Moderate	26	0.70	0.20	Moderate
2	0.70	0.20	Moderate	27	0.50	0.20	Moderate
3	0.50	0.20	Moderate	28	0.80	0.40	Easy
4	0.30	0.20	Moderate	29	0.70	0.20	Moderate
5	0.50	0.20	Moderate	30	0.60	0.40	Moderate
6	0.50	0.20	Moderate	31	0.60	0.40	Moderate
7	0.50	0.20	Moderate	32	0.50	0.20	Moderate
8	0.50	0.20	Moderate	33	0.80	0.40	Easy
9	0.80	0.40	Easy	34	0.50	0.20	Moderate
10	0.30	0.20	Moderate	35	0.50	0.20	Moderate
11	0.40	0.40	Moderate	36	0.70	0.20	Moderate
12	0.70	0.20	Moderate	37	0.60	0.40	Moderate
13	0.60	0.40	Moderate	38	0.70	0.20	Moderate
14	0.60	0.40	Moderate	39	0.40	0.40	Moderate
15	0.50	0.20	Moderate	40	0.60	0.40	Moderate
16	0.60	0.40	Moderate	41	0.70	0.20	Moderate
17	0.50	0.20	Moderate	42	0.60	0.40	Moderate
18	0.50	0.20	Moderate	43	0.50	0.20	Moderate
19	0.30	0.20	Moderate	44	0.60	0.40	Moderate
20	0.50	0.20	Moderate	45	0.50	0.20	Moderate
21	0.70	0.20	Moderate	46	0.50	0.20	Moderate
22	0.60	0.40	Moderate	47	0.60	0.40	Moderate
23	0.50	0.20	Moderate	48	0.60	0.40	Moderate
24	0.50	0.20	Moderate	49	0.60	0.40	Moderate
25	0.60	0.40	Moderate	50	0.50	0.20	Moderate

Appendix I Request to interview and observation

ที่ อว 8606 (หจ)/๖๘๘

บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร
พระราชวังสนามจันทร์
อ.เมือง จ.นครปฐม 73000

18 กุมภาพันธ์ 2564

เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน ผู้อำนวยการโรงเรียนสิรินธรราชวิทยาลัย

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia" มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ในรายวิชาเคมี ระดับชั้นมัธยมศึกษาปีที่ 4 ในโรงเรียนของท่าน เพื่อประกอบการทำวิทยานิพนธ์

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร จึงขอความอนุเคราะห์จากท่านโปรดให้ความอนุเคราะห์แก่นักศึกษาตามที่เห็นสมควร ทั้งนี้เพื่อประโยชน์ทางการศึกษา สำหรับกำหนด เวลา ในการเข้าสัมภาษณ์และรายละเอียดเพิ่มเติมต่าง ๆ บัณฑิตวิทยาลัย ขออนุญาตให้ Ms.Tel Tailos หมายเลขโทรศัพท์ 098-235-5021 เป็นผู้ประสานงานโดยตรงต่อไป

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

สำนักงานบัณฑิตวิทยาลัย
นครปฐม โทร.034-218790

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606(นฐ)/507 วันที่ 15 กุมภาพันธ์ 2564

เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน อาจารย์อุไรวรรณ ธรรมศิริพงษ์

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia" มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ที่โรงเรียนสาธิตมหาวิทยาลัยศิลปากร เพื่อประกอบการทำวิทยานิพนธ์

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จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)

รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย

รักษาการแทน คณบดีบัณฑิตวิทยาลัย

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606 (นฐา/509 วันที่ 15 กุมภาพันธ์ 2564

เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน อาจารย์อุไรวรรณ ธรรมศิริพงษ์

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia" มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ที่โรงเรียนสาธิตมหาวิทยาลัยศิลปากร เพื่อประกอบการทำวิทยานิพนธ์

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร จึงขอความอนุเคราะห์จากท่านโปรดให้ความอนุเคราะห์แก่นักศึกษาตามที่เห็นสมควร ทั้งนี้เพื่อประโยชน์ทางการศึกษา สำหรับกำหนด เวลา ในการเข้าสัมภาษณ์และรายละเอียดเพิ่มเติมต่าง ๆ บัณฑิตวิทยาลัย ขออนุญาตให้ Ms.Tel Tailos หมายเลขโทรศัพท์ 098-235-5021 เป็นผู้ประสานงานโดยตรงต่อไป

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)

รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย

รักษาการแทน คณบดีบัณฑิตวิทยาลัย

ที่ อว 8606 (พฐ)/๒๐

บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร
พระราชวังสนามจันทร์
อ.เมือง จ.นครปฐม 73000

4 มกราคม 2564

เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน อาจารย์สุนิสา ทับแสง

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia " มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ที่โรงเรียนสาธิตแห่งมหาวิทยาลัยเกษตรศาสตร์ วิทยาเขตกำแพงแสน เพื่อประกอบการทำวิทยานิพนธ์

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร จึงขอความอนุเคราะห์จากท่านโปรดให้ความอนุเคราะห์แก่นักศึกษาตามที่เห็นสมควร ทั้งนี้เพื่อประโยชน์ทางการศึกษา สำหรับกำหนด เวลา ในการเข้าสัมภาษณ์และรายละเอียดเพิ่มเติมต่าง ๆ บัณฑิตวิทยาลัย ขออนุญาตให้ Ms.Tel Tailos หมายเลขโทรศัพท์ 098-235-5021 เป็นผู้ประสานงานโดยตรงต่อไป

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

สำนักงานบัณฑิตวิทยาลัย
นครปฐม โทร.034-218790

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790
ที่ อว 8606 (นฐ)/507 วันที่ 15 กุมภาพันธ์ 2564
เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน อาจารย์อุไรวรรณ ธรรมศิริพงษ์

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia" มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ที่โรงเรียนสาธิตมหาวิทยาลัยศิลปากร เพื่อประกอบการทำวิทยานิพนธ์

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร จึงขอความอนุเคราะห์จากท่านโปรดให้ความอนุเคราะห์แก่นักศึกษาตามที่เห็นสมควร ทั้งนี้เพื่อประโยชน์ทางการศึกษา สำหรับกำหนด เวลา ในการเข้าสัมภาษณ์และรายละเอียดเพิ่มเติมต่าง ๆ บัณฑิตวิทยาลัย ขออนุญาตให้ Ms.Tel Tailos หมายเลขโทรศัพท์ 098-235-5021 เป็นผู้ประสานงานโดยตรงต่อไป

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

ที่ อว 8606(นร)/506

บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร
พระราชวังสนามจันทร์
อ.เมือง จ.นครปฐม 73000

15 กุมภาพันธ์ 2564

เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน อาจารย์อรอุมา กรองจิตร

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia" มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ที่โรงเรียนมัธยมวัดหนองแขม เพื่อประกอบการทำวิทยานิพนธ์

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร จึงขอความอนุเคราะห์จากท่านโปรดให้ความอนุเคราะห์แก่นักศึกษาตามที่เห็นสมควร ทั้งนี้เพื่อประโยชน์ทางการศึกษา สำหรับกำหนด เวลา ในการเข้าสัมภาษณ์และรายละเอียดเพิ่มเติมต่าง ๆ บัณฑิตวิทยาลัย ขออนุญาตให้ Ms.Tel Tailos หมายเลขโทรศัพท์ 098-235-5021 เป็นผู้ประสานงานโดยตรงต่อไป

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

สำนักงานบัณฑิตวิทยาลัย
นครปฐม โทร.034-218790

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606 (นฐา/507 วันที่ 15 กุมภาพันธ์ 2564

เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน อาจารย์อุไรวรรณ ธรรมศิริพงษ์

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia" มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ที่โรงเรียนสาธิตมหาวิทยาลัยศิลปากร เพื่อประกอบการทำวิทยานิพนธ์

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร จึงขอความอนุเคราะห์จากท่านโปรดให้ความอนุเคราะห์แก่นักศึกษาตามที่เห็นสมควร ทั้งนี้เพื่อประโยชน์ทางการศึกษา สำหรับกำหนด เวลา ในการเข้าสัมภาษณ์และรายละเอียดเพิ่มเติมต่าง ๆ บัณฑิตวิทยาลัย ขออนุญาตให้ Ms.Tel Tailos หมายเลขโทรศัพท์ 098-235-5021 เป็นผู้ประสานงานโดยตรงต่อไป

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร
พระราชวังสนามจันทร์
อ.เมือง จ.นครปฐม 73000

ที่ อว 8606(นร๑)/506

15 กุมภาพันธ์ 2564

เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน อาจารย์อรอุมา กรองจิตร

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia" มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ที่โรงเรียนมัธยมวัดหนองแขม เพื่อประกอบการทำวิทยานิพนธ์

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร จึงขอความอนุเคราะห์จากท่านโปรดให้ความอนุเคราะห์แก่นักศึกษาตามที่เห็นสมควร ทั้งนี้เพื่อประโยชน์ทางการศึกษา สำหรับกำหนด เวลา ในการเข้าสัมภาษณ์และรายละเอียดเพิ่มเติมต่าง ๆ บัณฑิตวิทยาลัย ขออนุญาตให้ Ms.Tel Tailos หมายเลขโทรศัพท์ 098-235-5021 เป็นผู้ประสานงานโดยตรงต่อไป

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

สำนักงานบัณฑิตวิทยาลัย
นครปฐม โทร.034-218790

ที่ อว 8606 (มศ) / 589

บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร
พระราชวังสนามจันทร์
อ.เมือง จ.นครปฐม 73000

18 กุมภาพันธ์ 2564

เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน ผู้อำนวยการโรงเรียนสาธิตมหาวิทยาลัยราชภัฏนครปฐม

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia" มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ในรายวิชาเคมี ระดับชั้นมัธยมศึกษาปีที่ 4 ในโรงเรียนของท่าน เพื่อประกอบการทำวิทยานิพนธ์

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร จึงขอความอนุเคราะห์จากท่านโปรดให้ความอนุเคราะห์แก่นักศึกษาตามที่เห็นสมควร ทั้งนี้เพื่อประโยชน์ทางการศึกษา สำหรับกำหนด เวลา ในการเข้าสัมภาษณ์และรายละเอียดเพิ่มเติมต่าง ๆ บัณฑิตวิทยาลัย ขออนุญาตให้ Ms.Tel Tailos หมายเลขโทรศัพท์ 098-235-5021 เป็นผู้ประสานงานโดยตรงต่อไป

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

สำนักงานบัณฑิตวิทยาลัย
นครปฐม โทร.034-218790

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606 (นฐ)/507 วันที่ 15 กุมภาพันธ์ 2564

เรื่อง ขอสัมภาษณ์และสังเกตการสอน

เรียน อาจารย์อุไรวรรณ ธรรมศิริพงษ์

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia" มีความประสงค์จะขอสัมภาษณ์และสังเกตการสอน ที่โรงเรียนสาธิตมหาวิทยาลัยศิลปากร เพื่อประกอบการทำวิทยานิพนธ์

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร จึงขอความอนุเคราะห์จากท่านโปรดให้ความอนุเคราะห์แก่นักศึกษาตามที่เห็นสมควร ทั้งนี้เพื่อประโยชน์ทางการศึกษา สำหรับกำหนด เวลา ในการเข้าสัมภาษณ์และรายละเอียดเพิ่มเติมต่าง ๆ บัณฑิตวิทยาลัย ขออนุญาตให้ Ms.Tel Tailos หมายเลขโทรศัพท์ 098-235-5021 เป็นผู้ประสานงานโดยตรงต่อไป

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

Appendix II Experts of instruments tools

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606(๑๙)/๙๔๔ วันที่ 9 มีนาคม 2564

เรื่อง ขอเชิญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัย

เรียน ผู้ช่วยศาสตราจารย์ ดร.ยุวรี ญานปรีชาเศรษฐ

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia "

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร มีความประสงค์ขอเรียนเชิญท่านในฐานะผู้เชี่ยวชาญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัยให้กับนักศึกษาดังกล่าว

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

ที่ อว 8606 (นศ)/981

บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร
พระราชวังสนามจันทร์
อ.เมือง จ.นครปฐม 73000

9 มีนาคม 2564

เรื่อง ขอเชิญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัย

เรียน ผู้ช่วยศาสตราจารย์ ดร.จินตนา ศิริธัญญารัตน์

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia "

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร มีความประสงค์ขอเรียนเชิญท่านในฐานะผู้เชี่ยวชาญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัยให้กับนักศึกษาดังกล่าว

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

ขอแสดงความนับถือ

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

สำนักงานบัณฑิตวิทยาลัย
นครปฐม โทร.034-218790

ที่ อว 8606 ([illegible])/1696

บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร
พระราชวังสนามจันทร์
อ.เมือง จ.นครปฐม 73000

1 เมษายน 2564

เรื่อง ขอเชิญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัย

เรียน อาจารย์ ดร.วิทวัส หาญดี

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia"

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร มีความประสงค์ขอเรียนเชิญท่านในฐานะผู้เชี่ยวชาญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัยให้กับนักศึกษาดังกล่าว

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

ขอแสดงความนับถือ

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

สำนักงานบัณฑิตวิทยาลัย
นครปฐม โทร.034-218790

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606 (บศ)/776 วันที่ 9 มีนาคม 2564

เรื่อง ขอเชิญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัย

เรียน ผู้ช่วยศาสตราจารย์ ดร.มาเรียม นิลพันธุ์

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia "

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร มีความประสงค์ขอเรียนเชิญท่านในฐานะผู้เชี่ยวชาญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัยให้กับนักศึกษาดังกล่าว

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)

รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย

รักษาการแทน คณบดีบัณฑิตวิทยาลัย

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606 (นฐ)/๙๗๙ วันที่ 9 มีนาคม 2564

เรื่อง ขอเชิญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัย

เรียน อาจารย์สุปรียา ตันดีวีรคุณ

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia "

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร มีความประสงค์ขอเรียนเชิญท่านในฐานะผู้เชี่ยวชาญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัยให้กับนักศึกษาดังกล่าว

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606 (นศ) /976 วันที่ 9 มีนาคม 2564

เรื่อง ขอเชิญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัย

เรียน ผู้ช่วยศาสตราจารย์ ดร.มาเรียม นิลพันธุ์

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia "

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร มีความประสงค์ขอเรียนเชิญท่านในฐานะผู้เชี่ยวชาญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัยให้กับนักศึกษาดังกล่าว

จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606 (๑๘) /1695 วันที่ 1 เมษายน 2564

เรื่อง ขอเชิญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัย

เรียน อาจารย์ ดร.สุมนมาลย์ จันทร์เอี่ยม

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia "

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จึงเรียนมาเพื่อโปรดให้ความอนุเคราะห์ จักขอบพระคุณยิ่ง

(อาจารย์ ดร.อธิกมาส มากจุ้ย)
รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย
รักษาการแทน คณบดีบัณฑิตวิทยาลัย

บันทึกข้อความ

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ที่ อว 8606(พศ)/944 วันที่ 9 มีนาคม 2564

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เรียน ผู้ช่วยศาสตราจารย์ ดร.ยุวรี ญานปรีชาเศรษฐ

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ที่ อว 8606 (ฬ๙)/๑๖๘ วันที่ 9 มีนาคม 2564

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เรียน อาจารย์ณัฐดนัย บุตรพลับ

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia "

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(อาจารย์ ดร.อธิกมาส มากจุ้ย)

รองคณบดีบัณฑิตวิทยาลัย ฝ่ายวิชาการและวิจัย

รักษาการแทน คณบดีบัณฑิตวิทยาลัย

Appendix III Expert instrument of interview and observation

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790

ที่ อว 8606( )/2512 วันที่ 13 พฤษภาคม 2563

เรื่อง ขอเชิญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัย

เรียน ผู้ช่วยศาสตราจารย์ ดร.มาเรียม นิลพันธุ์

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ที่ อว 8606 (หจ) | 2514

บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร
พระราชวังสนามจันทร์
อ.เมือง จ.นครปฐม 73000

13 พฤษภาคม 2563

เรื่อง ขอเชิญเป็นผู้ตรวจคุณภาพเครื่องมือวิจัย

เรียน ผู้ช่วยศาสตราจารย์ ดร.รุจิราพร รามศิริ

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia "

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ขอแสดงความนับถือ

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รักษาการแทน คณบดีบัณฑิตวิทยาลัย

สำนักงานบัณฑิตวิทยาลัย
นครปฐม โทร.034-218790

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร โทร.034-218790
ที่ อว 8606(หก)/2513 วันที่ 13 พฤษภาคม 2563
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เรียน ผู้ช่วยศาสตราจารย์ ดร.วรรณวิสา บุญมาก

ด้วย Ms.Tel Tailos รหัสประจำตัว 61263201 นักศึกษาระดับปริญญามหาบัณฑิต สาขาวิชาหลักสูตรและการสอน บัณฑิตวิทยาลัย มหาวิทยาลัยศิลปากร กำลังทำวิทยานิพนธ์ เรื่อง " The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province, Kingdom of Cambodia "

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รักษาการแทน คณบดีบัณฑิตวิทยาลัย

Appendix IV Request letter to collect data

No. 3382/2021

Graduate School, Silpakorn University
Sanamchandra Palace Campus,
Nakhon Pathom 73000, Thailand

July 1, 2021

Subject: Request for allowing a graduate student to collect data.

Dear Director of Polytechnic Institute of Banteay Meanchey Province, Cambodia,

Ms. Tel Tailos is a graduate student, ID 61263201, at Graduate School, Silpakorn University. She is studying for Master Degree majoring in Curriculum and Instruction Program and is currently conducting her thesis research entitled: "The Development of Chemistry Instructional Handbook by Blended Learning to Enhance Achievement on Chemistry and Science Process Skill for Vocational Certificate (Skill Bridging Program) at Polytechnic Institute of Banteay Meanchey Province, Cambodia". In this regard, I would like to ask for your permission to allow the student to collect data from students and teachers at your institute for her thesis research purpose. Ms. Tel Tailos may contact you directly about the details of her method of study.

Your kind assistance and academic contribution is much appreciated.

Sincerely yours,

Sathit Niratisai

(Asst. Prof. Sathit Niratisai, Ph.D.)
Associate Dean for Administration, acting for
Dean of Graduate School

Graduate School, Silpakorn University
Sanamchandra Palace Campus,
Nakhon Pathom 73000, Thailand
Office Tel. +668 8229 2013

Appendix V Interview and observation activities

1. Interview

2. Observation

Appendix VI Focus group discussion activities

Appendix VII Teaching activities

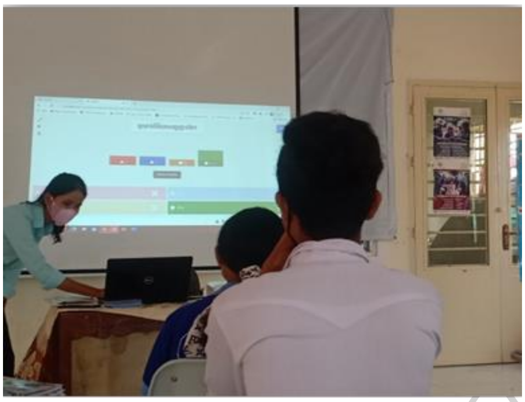
1. Teaching activities

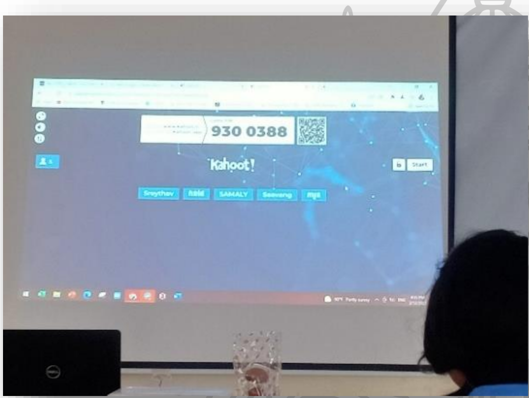


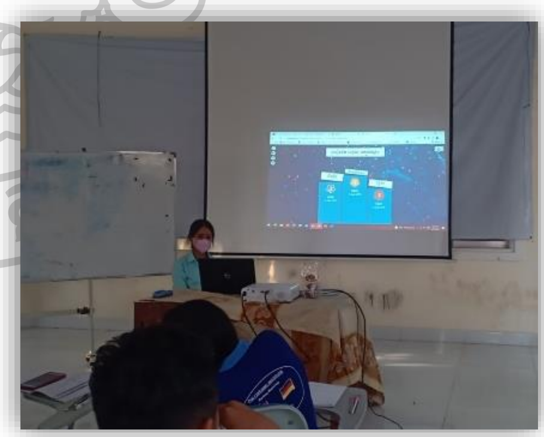





2. Kahoot activities

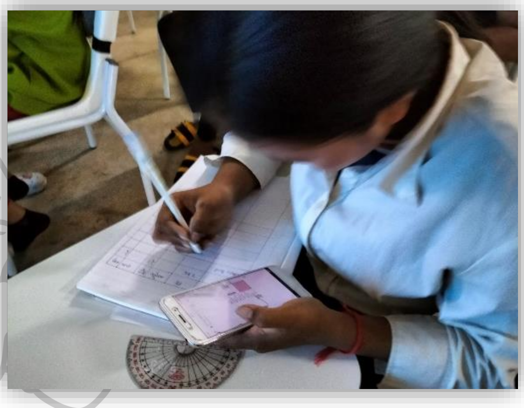






3. Group working activities

4. PhET application activities



5. Video and YouTube activities

6. Examinations

Appendix VIII Chemistry instructional handbook by blended learning

Chemistry Instructional Handbook by Blended Learning

Skill Bridging Program

ក្រសួងការងារនិងបណ្តុះបណ្តាលវិជ្ជាជីវៈ

កម្មវិធីស្ពានចម្លងបន្តជំនាញ

គីមីវិទ្យា

សម្រាប់សិស្សថ្នាក់ទី៨និងទី៩

Chemistry Instructional Handbook by Blended Learning

Skill Bridging Program

Ms. Tel Tailos

Master's Degree Education

Curriculum and Instruction

Advisor 1. Asst. Prof. Dr. Niwat Boonsom, Ph.D

Co-Advisor 2. Asst. Prof. Dr. Wisud Po Ngern, Ph.D

Contents

Introduction

This chemistry instructional handbook is the teacher guides to teach chemistry in skill bridging program level that studies on 24 hours in Polytechnic Institute of Banteay Meanchey Province, Cambodia. A chemistry instructional handbook has been developed for teachers to teaches learning contents to their students more effectively by using the chemistry textbook in Skill Bridging Program. As for the features of this teacher's handbook, its contents correspond to that in the textbook according to the grade 8&9 chemistry textbook in the skill bridging program. Therefore, information in this teacher's handbook will help teachers to prepare lesson plans, materials, media/technology, and to conduct lessons in line with the syllabus. It will inspire teachers to conduct study and explore for innovative, difficult methods of assisting chemistry learning in kids.

The chemistry instructional handbook provides guidance for an instructor in using the 7E learning cycle models in a traditional classroom and blended technology. To ensure that pupils learn the material, a chemistry teacher must provide clear instructions for all of the ideas, teaching methods, and activities they employ.

This chemistry instructional handbook by blended learning using 7E learning cycle models examples of chemistry teaching and learning methodologies, as well as tasks and activities for evaluation. The goal of both teaching and learning is to help students learn. Activities in the classroom or lab are created to aid students in achieving the learning objectives. The part on marking and reporting demonstrates to the teacher how to mark students' work and how to produce reports based on the learning objectives. With the help of this blended learning instruction handbook for chemistry, teachers will be better able to use their creativity to create engaging sessions with high-level teaching objectives.

1. The objective of the chemistry instructional handbook by blended learning

The purpose of chemistry instructional handbook by blended learning as;

- The instructors understand and have an attitude to use the chemistry instructional handbook by blended learning to enhance achievement on chemistry and science process skill for the vocational certificate (Skill Bridging Program) of Polytechnic Institute of Banteay Meanchey Province.

➢ The instructors of chemistry to study and implement chemistry instructional handbook by blended learning.

2. Theory of teaching

2.1. Blended learning

Online education is defined as any online teaching and learning methods including; blended learning, online learning, e-learning, web-enhanced learning, hybrid learning, flipped classroom, MOOCs (massive open online courses), and adaptive learning. Blended models, possibly the most popular use of online education technology today, have blossomed and represented instructional application across a wide spectrum of education(Picciano, 2019a).

According to (Shu & Gu, 2018), hybrid learning, also known as blended learning, is supported by technology and combines online learning with in-person instruction in the classroom. Blended learning is one of the types of e-learning in which e-learning is included in conventional classroom instruction utilizing a computer, the internet, or a smart classroom, where the teacher and student engage in person and where the course is designed to encourage student-teacher interaction. Kavitha & Jaisingh, (2018). Blended learning is based on an appropriate admixture of learning theories, such as behaviorism, cognitivism, and constructivism. Blended learning is when face-to-face instruction and learning are combined with ICT (information and communication technologies)(Li & Tang, 2017). Blended learning, which blends the internet and digital media with traditional classroom structures that need the actual presence of the teacher and pupils, appears more than fit (Sánchez-Adsuar & Molina-Jordá, 2014). Blended learning is the blending of classroom teaching practices where some lessons or exercises involve face-to-face techniques while others involve ICT(Wardenski, Bazzo de Espındola, et al., 2012). Base on (Picciano, 2019b) Hardware, software, manpower, training, facilities, student and student support infrastructure, financial resources, and policies are the components of technology application.

As mention above, the term blended learning (BL) refers to the instructional by blended digital technology (computers, tablets, interactive whiteboards, visualizers, different projections, internet, and software tools) teaching in the classroom.

2.2. Advantage of blended learning

The advantages of blended learning are stated in research by Dhakiria, H. (2012), who found that it can increase students' sensitivity. For a better learning outcome, the design must take the student's profile and background into account. To maximize the learning opportunities, students must be included in the learning resource and the learning materials. The student-centered paradigm is addressed. It is important to maintain and develop the learning culture that changed from a teacher-centered to a student-centered approach. The use of technology and in-person instruction together in blended learning maximizes learning. In the classroom setting, higher-order thinking about actual problems and circumstances is explored through role plays, case studies, and other discovery learning techniques. It is more efficient than the conventional method of instruction. Both students and institutions profit from blended learning. Improved learning results, flexible access, a sense of community, efficient resource usage, and student happiness are made possible by it. The chances it provides for learning, relearning, and having fun while learning is alluring.

Cleveland-Innes and Wilton highlights the following advantages of blended learning.:

1) Opportunity for collaboration at a distance: individual students collaborate electronically in an intellectual project as a learning strategy.

2) Increased flexibility: With the help of technology, learning can take place at any time and any place, removing time and location restrictions while still offering the potential for in-person interaction.

3) Increased interaction: a platform provided by blended learning allows for increased interaction between students and between students and teachers.

4) Enhanced learning: students can learn at higher and more meaningful levels with the addition of different kinds of learning activities, which also increase engagement.

Learning to be virtual citizens: in a virtual community of inquiry, students practice presenting themselves both socially and academically. For someone to continue learning throughout their life, having digital learning abilities is becoming increasingly important. Blended courses assist students in developing these skills.

The benefits of blended learning are; the learner have greater time flexibility working part of the time technology and accessibility with up-to-date resources available technology, the learners' interaction between the instructor and their peers are increased since the method provides more opportunities, learners' management, critical thinking, and problem-solving were enhanced, with the number of withdrawals and somewhat higher grades, and the learner was blended learning experience. They usually receive more frequent feedback from their instructors.

2.3. Learning process of the 7Es learning cycle models

According to constructivist theory, the 7Es learning cycle model is a methodology for instructional design that encourages students to study scientific information using science process skills and to look for knowledge or significant self-learning experiences.

The previous papers research, interview, and observation on chemistry instructional in seven schools and two University, Thailand. Mostly, the teacher uses the 5Es learning cycle and uses a lot of technology to help instruction chemistry. Based on the development of Eisenkraft, (2003) pointed out that the 5E learning cycle model must be expanded to a 7Es learning cycle model in order to account for research on how people learn and how to use that knowledge to design lesson plans and curricula. It can be concluded that the 7Es learning cycle model consists of;

1. **Elicit:** The instructor strives to get the students interested in the topic and gauge their prior knowledge. Students are motivated by concept cartoons, video clips, animations, and straightforward scientific experiments.

2. **Engage:** To interest pupils and get their attention, teachers may do a basic experiment or point out an anomalous occurrence.

3. **Explore:** The questioning method is used to guide pupils as they examine and revise the material. By using brainstorming within the parameters of an activity

linked to the subject, assumptions and hypotheses are established. To direct students and record the data, utilize a worksheet.

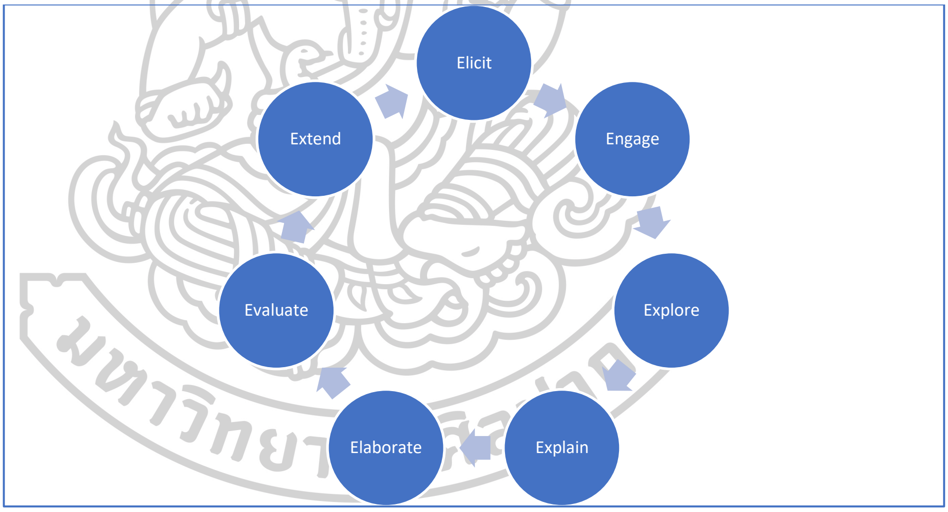
4. **Explain:** Learning is attempted to be interpreted by students. In addition to giving a direct lecture, a teacher may also use videos, movies, idea maps, or presentations to illustrate the theories, concepts, laws, and facts.

5. **Elaborate:** The use of understanding in new contexts is encouraged among students.

6. **Evaluate:** using multiple choice, quizzes, puzzles, structured grids, and true-false questions to assess the students' learning in addition to formative and summative evaluation.

7. **Extend:** It is expected of students to apply and broaden their knowledge to situations in daily life.

Flow chat of 7Es learning cycle



2.4. Rules of teacher and student

Step	Rules of teacher	Rules of students
Before learn		
	✚ The teacher prepares or checks technology/ media, handouts, and the internet. ✚ The teacher teaches to follow the lesson plan.	✚ The student prepares the classroom. ✚ The student learns how to use technology. For example, google classroom, google form, and applications. ✚ The student reads the handout, research from social media, the internet, or book before

Step	Rules of teacher	Rules of students
		going to the classroom.
During learn (7Es learning cycle)		
Elicit	The teacher revises student's prior knowledge by posing the questions, YouTube, video, films, short movie, animations, simple scientific demonstrations, or/and cartoons.	The student uses technology in the classroom. The student pays attention to observing, discussing, or/and note what they see and hear. The student shares their understand form media or technology by their sense to a classmate.
Engage	The teacher uses a simple experiment. For instance, PhET simulation, YouTube, hand-on, or sample.	The student pays attention to observing, classifying, measuring, communicating, and predicting for a simple experiment. The student divides group working.
Explore	The teacher proved the worksheet, the activities sheet, document, or experiment lab to the student.	The student practices with the experiment. They can search for information on the internet. The student use worksheet, document, or activities report to record data. The students divide responsible into their group.
Explain	The teacher allows the student to interpret what they have learned, research, or experiment.	The student presentation by individual or group working. They're communicating or/and share an idea. The student is capable to answer and question together.
Elaborate	The teacher posts the individual worksheet, group worksheet, or topic to the student.	The student uses them understand to answer on the worksheet or their topic. The student use observing, measuring, classifying, predicting, or communicating to improve the understand after recommendation from the teacher.

Step	Rules of teacher	Rules of students
Evaluate	The teacher use game education, application, test, or quiz to assess student.	The student will answer the short quiz, test, or play a game to review their understanding by the Kahoot or another application. The student uses technology/ media to improve themselves.
Extend	The teacher allowed the student to create, find a topic, or make something related to the lesson to extend their understanding to daily life.	The student tries the best to find the topic by themselves or create something to improve them understand more than learning in the classroom. The student could be individual or group assignments.
After learn		
	The teacher shows dateline to submit student's assignment and follow them send by google classroom, google form, or email.	The students help to prepare the classroom. The student shares their difficult using technology. The student will be able to discover the topic to improve they are understanding of daily life experiences.

3. The chemistry in skill bridging program

The Chemistry in skill bridging program of Polytechnic Institute of Banteay Meanchey province. The result of sequencing is a course framework where each component relates to a particular learning objective and helps students attain the overall course aim.

The policy of Polytechnic Institute of Banteay Meanchey Province is following by policy of Technical Vocational Education and Training (TVET) (Sub-Degree No.175/KB.BrKBB dated 20 April 2017 of MLVT). The National Technical Vocational Education and Training Policy 2017-2025 is an RGC road map to direct the development of the TVET sector, particularly in skills development, by directing the provision of skills, capacities, and employment-related knowledge for Cambodians to support life-long employment with the improvement of productivity and competitiveness both locally and internationally (Ministry of Labour and Vocational Training, 2017).

3.1. The learning outcomes of chemistry

By the end of the unit, students' knowledge and skills are determined by the learning outcomes. For students to successfully complete the specific unit learning outcome of the chemistry, science teachers must choose and teach enough of these. (Skill Bridging Program). According to (Ministry of Labour and Vocational Training, 2015) the curriculum of chemistry (Skill Bridging Program), by the end of this study 24 hours, the student should be capable of;

1. Identify of table periodic and periodic table
2. Explain the matter, element, and capable the International Union of Pure and Applied Chemistry (IUPAC)
3. Identify the characteristics of three physical state (liquids, solids, gases)
4. Carry out and report on a range of techniques for separating mixtures, including filtering and vaporization (for example, to produce pure water)
5. Specify the physical characteristics, chemical reactions, and usefulness to society of the following groups of substances: Carbon, hydrogen and oxygen, acids, bases, and salts

The students develop their understanding of the classification and structure of mater, and use their knowledge in some practical applications. They develop their understanding of some of the basic terms and concepts of chemistry that will be required for more advanced study.

3.2. The contents of chemistry

The course overview is designed purposely for the systematic follow of the grade content. It is helpful in the preparation of the course program to effectively plan for teaching. The strands of chemistry are core strands of science in the syllabus.

Table 1 the strands of chemistry are core strands of science in the syllabus.

Unit	Sub-unit	Learning outcomes	Number of Periods	
			Sub-unit	**Total**
Unit 1: Atoms and Molecules	11. Atoms and Molecules	➢ Identify the structure of atom. ➢ Identify how to build some simple models of atoms and molecules. ➢ Identify the protons and neutrons in the nucleus and write down the atomic number (Z) and mass number (A) of each element.	2	6
	12. Periodic Table	➢ Identify the name and the symbol of an element. ➢ Identify the element use in daily life. ➢ Investigate and explain in simple terms differences between metals and non-metals	4	
Unit 2: Matter	13. State of matter	➢ Identify and explain the differences three state of matter as liquid, solid, and gas. ➢ Understand and describe the processes that occur when matter change state.	2	6
	14. Properties of Matter	➢ Conduct and report on experiments to learn about how matter changes physically and chemically. ➢ Define the terms "physical changes" and "chemical changes." ➢ Identify difference between a physical and chemical changes of matters.	2	
	15. Classification of Matter	➢ Identify the separations mixture techniques to develop an understanding in daily life ➢ Distinguish between homogeneous and heterogeneous matter	2	
Unit 3: Chemical reaction	16. Chemical reaction	➢ Understand what chemical reactions in daily life ➢ Identify the reactants and products	2	4
	17. Balancing chemical Equations	➢ Explain how chemical reaction equations are written and balanced ➢ Identify an unbalanced chemical equation, balance it by inspection	2	
Unit 4: Solution	18. Prosperities of Solutions	➢ Explain the meaning of and the difference between the following terms: solutes, solvents and solutions ➢ Explain saturated and unsaturated of solution ➢ Calculate mass of solute and solvent, percentage concentration, mole of solute, volume of solution, and molarity.	4	8

Unit	Sub-unit	Learning outcomes	Number of Periods	
			Sub-unit	**Total**
	19. Acids and Bases	➢ Classify solution as acid and base in daily life by pH scale ➢ The students are able to distinguish between strong acids and weak acids as well as between strong bases and weak bases in terms of pH. ➢ Identify different between acid and bases	2	
	20. Salts	➢ Explain the applications of various salts in daily life. ➢ Identify the acidic salts, basic salts, and neutral salts ➢ Explain the neuralization reaction	2	
		Total		**24 hours**

According to the table 1, all of this curriculum is chemistry subject. The researcher used all this contents for develop to chemistry instructional handbook by blended learning.

4. Instructional media

Technology and instructional media give teachers and students the tools they need to effectively engage students in the learning process. Tools used in educational settings to offer resources and information to achieve effective teaching and learning are known as instructional media.

4.1. Type of instructional media

Modern technology and digital teaching tools are combined with a variety of traditional teaching techniques in the new generation of classrooms, which can increase student engagement and effectively develop their new knowledge.

The type of instructional media that suitable use in chemistry instructional handbook by blended learning has 2 types follow as;

1) Hardware: as the equipment that uses in teaching and learning in the classroom such as LCD, projector, computer, iPad, smartphone, book.

2) Software: refer to the kind of social media such as; google form, google classroom, google meet, YouTube, game application, MOOCs, PhET app, quizizz, Kahoot, or application chemistry that have a lot of and free in play store.

4.2. Guide to blended instructional media

Teachers can assist students in learning how to use computers safely, successfully, and appropriately by using blended instructional media and a comprehensive curriculum. The curriculum is broken down into lessons in the following matrix, which also explains when particular lessons are appropriate.

In this study, after analysis previous paper, interviewed 7 schools and 2 University in Thailand, the most secondary and high schools use instructional media or technology to help in teaching and learning such as;

- Google classroom, google form, google doc, and google meet to help the teacher prepare test or assignment and it is easy to use and free.
- YouTube: have a lot of video and information
- Application: as PhET Interactive Simulations that help the teacher and the students to study and practice similar hand on practice.
- Kahoot app: this app easy to use and design game for learning and show the result faster.

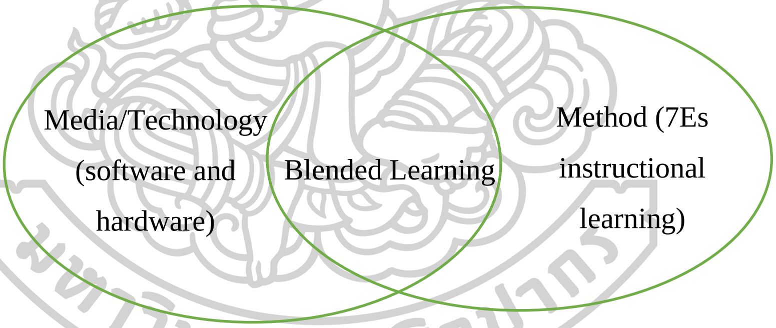


Figure 1. Blended instructional media with 7Es learning cycle model

4.1.1. Google Apps for Education

According to Han, (2010) as cited on Asomba, (2015), Google Apps enables organizations to brand the user experience with their logo and use their own domain name with the service. In this way, a college or university can provide Google Apps capabilities in a package (and with a URL) that is comfortable and recognizable to its users. Google Apps for Education. (n.d), the software package Google Docs/Drive offers online word editing, spreadsheet, and presentation tools.

Hartnett, (2012) as cited on Asomba, (2015) google apps are a group of web-based applications and file hosting that can be used in a web browser and don't require users to purchase or install any software. It comprises of the Google Apps package, which includes Mail, Docs/Drive, Calendar, and Sites. These solutions are advantageous and appealing to customers looking for free or inexpensive, user-friendly, and adaptable ways to handle electronic communication services and resources.

GAFE one sheet, (2014) google provides schools and educational organizations with a free core suite of productivity software called "google apps for education" (GAFE). These collaboration and communication tools include Classroom, Gmail, Drive, Calendar, Vault, Docs, Sheets, and Sites.

By allowing document sharing at any time and from any location, Google Apps provides collaboration capabilities to academic employees that will improve 17 communications. The Google Apps services are shown in Figure 1 for free.

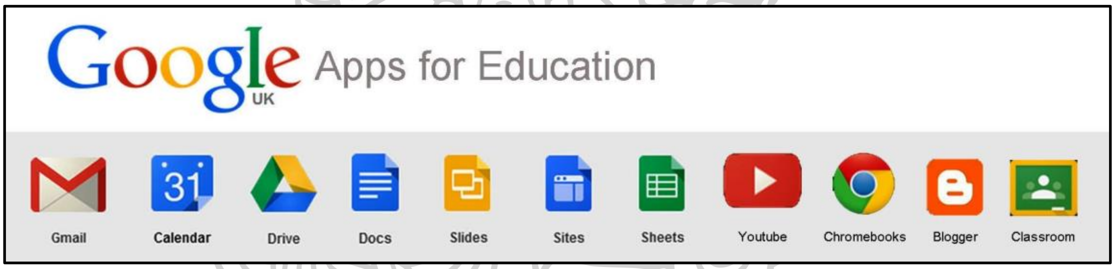


Figure2: Google Apps for Education suite (https://alphaplus.ca/event/tech-tuesdays-google-apps-education-gafe/)

In 2014, Google Apps for Education included a new feature called Google Classroom. Teachers can create and arrange assignments rapidly in this classroom, give feedback swiftly, and connect with their classes easily.

Google Forms is a free online application that enables users to make forms, surveys, and quizzes. Users can also update the forms together and share them with others. Google Forms can be used by teachers to test their students' knowledge before a lesson and determine prior understanding. Google Forms can also be used to provide feedback to students and parents and get input from them. Students can similarly utilize Google Forms to evaluate their learning, define learning objectives, and gather information for research projects.

4.1.2. PhET Interactive simulation

According to Wieman et al. (2010), the website PhET offers free physics and chemistry learning simulations that can be downloaded for use in the classroom or for personal learning.

Perkins et al. (2012), an interactive computer simulation called Physics Education Technology (PhET) is used to teach physics and chemistry. At the University of Colorado Boulder, the PhET Interactive Simulations Project was created.

University of Colorado Boulder (2018) as cited on Jansoon & Rakbamrung (2018) PhET Interactive Simulations (PhET) is a collection of research-based interactive computer simulations from the University of Colorado at Boulder, USA, that offers enjoyable, interactive, and research-based science and mathematics simulations for use in teaching and learning physics, chemistry, math, and other sciences at the elementary, middle, high school, and university levels.

Jansoon & Rakbamrung (2018) explained that PhET interactive simulation has effect on the learning and conceptual understanding of the student. The use of PhET interactive simulation is unable to respond to learning science by the practice of this experiment. However, it will depend on the learning objective set by the teacher. It's more effective on student's learning if PhET interactive simulation is used with the classroom experiments. PhET simulations can be used for demonstrations in lectures, homework, and lap.

Students can simulate unseen phenomena including atoms, electrons, photons, and magnetic fields using animated representations produced by PhET simulation. In order to promote quantitative inquiry, simulation also provides measurement tools including rulers, stopwatches, voltmeters, and thermometers. Users can interact with an interactive tool, and instantly animated replies show certain linked scientific representations, such as the movement of objects and other images.

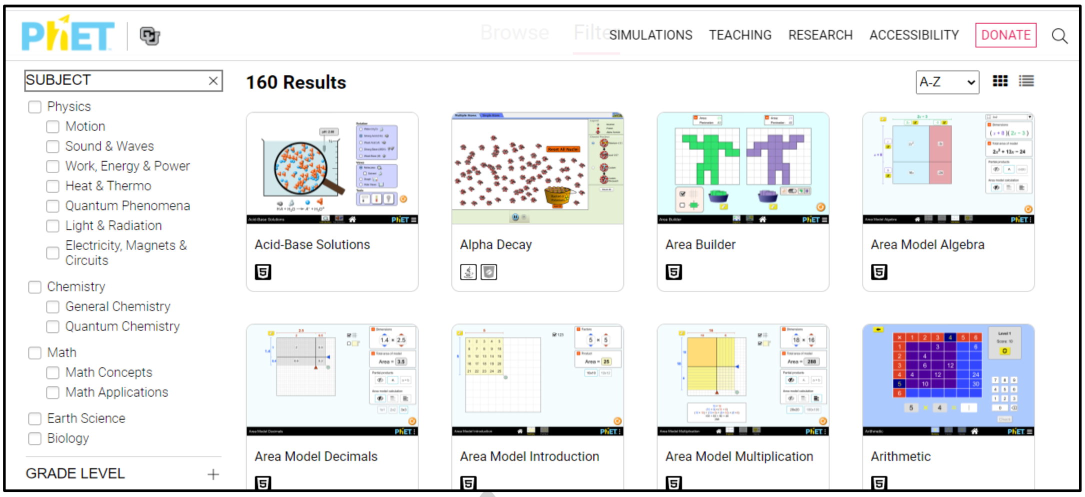


Figure 3 PhET (https://phet.colorado.edu/en/simulations/filter?sort=alpha&view=grid)

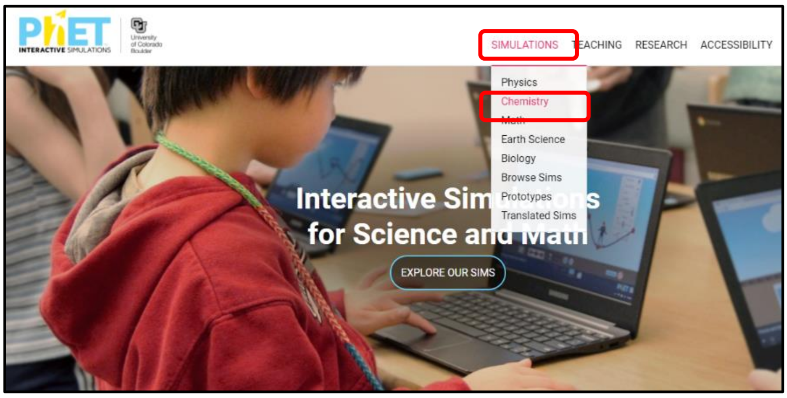
PhET is available for free download from the PhET website and can be used online. The simulations are interactive, animated environments that resemble games and allow students to learn through exploration, graphics, etc.

The PhET iPad app offers the following unique features:

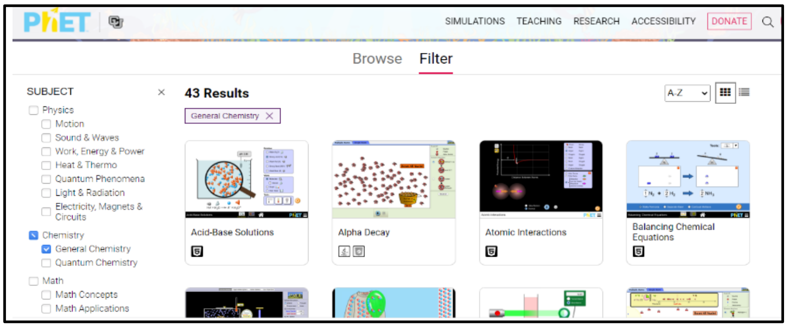
- Offline play: without Wi-Fi, learn in the park or on the bus.
- Multiple languages: Many languages are supported by the app.
- Favorites: create a personalized collection with your preferred Sims.
- Automatic updates: obtain the most recent HTML5 simulations as soon as they are available.
- Easy sorting: discover the ideal sims.
- Fullscreen: for the best sim exploration, expand the area of your screen.

How to use PhET interactive simulation

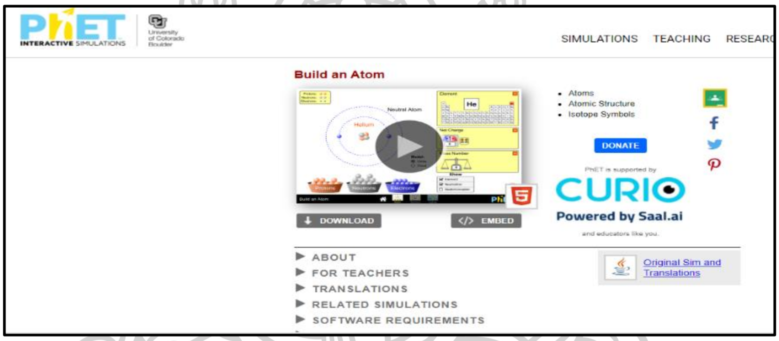
- Access the PhET interactive simulation desktop site by entering https://phet.colorado.edu/
- Going to Simulation and Select the chemistry



- ➢ Click Chemistry, we will see all the interactive simulations available in PhET



- ➢ For example, Click the topic talk about builds an atom. So, we can play, download, or share on (google classroom, Facebook, Twitter, or Pinterest)



4.1.3. Kahoot Application

According to Wang & Lieberoth (2016), on a laptop linked to a big screen, the teacher can start Kahoot, a game-based student response system (GSRS), through the web browser. The quiz-making application Kahoot! has the ability to include YouTube videos and images in the questions. It also enables you to publish, share, and edit quizzes you've created as well as quizzes created by others.

Icard (2014), digital games in the classroom help kids develop their ability to deal with success and failure as well as their ability to think critically and solve problems. Using the online game Kahoot! teachers may help their pupils learn about their subject matter while having fun. Students are challenged by Kahoot! While simultaneously fostering a joyful learning environment.

- ➢ The teacher signs into their account and chooses from the list of quiz, discussion, or survey options under "Create new Kahoot" to start creating a test. The teacher will be prompted to submit a name for the quiz by choosing the option with a question mark. The teacher can write the first quiz question after selecting "Go!" after deciding on a quiz name.

- Once the quiz has been generated, teachers can access it by logging into their accounts and finding it under "My Kahoots." Following the "launching" of the quiz by logging into their Kahoot! Accounts, teachers are given a PIN code (Kahoot, 2014). The PIN code is shown on the screen, and students can participate in the activity or quiz by going to Kahoot! And entering the PIN code and a "name" they'll use for the test (Byrne, 2013; Thomas, 2014).
- When playing Kahoot, the students will sign in using a nickname and a game pin (a number). The pupils' objective is to provide the right response as quickly as possible in order to receive the most points. Kahoot gameplay is depicted in Figure 1. Four or fewer possible solutions are presented on the big screen beside the question, each in a distinct color with a corresponding visual symbol. The answer is provided by the student by selecting the color and symbol that, in her or his opinion, correspond to the right response.
- Before a scoreboard of the top five players, a distribution of the students' responses is displayed between each question. Individual feedback is given to each student regarding the correctness of their answers, the number of points they receive, their ranking, how far behind the student placed above they are, and the right response if a wrong response is provided.
- In order to create a lively and competitive environment throughout the quiz, Kahoot! Makes use of a humorous graphical user interface as well as music and sounds. The students are also invited to provide comments on the quiz they have taken by rating it on various criteria, including whether they thought it was entertaining, educational, or recommendable to others. The winner's moniker points total and Kahoot session is displayed on the big screen at the conclusion of each round.
- There are two game styles available on Kahoot: player vs. player and team vs. team. Last but not least, Kahoot offers the ability for the teacher to export the quiz results in an Excel spreadsheet and replay a quiz in ghost mode.

5. Assessment and evaluation

5.1. Authentic assessment

The conduct of learning should be complemented with a procedure of assessment or appraisal that can accurately evaluate student performance.

Real-world assignments are completed by students as part of authentic assessment, which gauges how well they can apply their knowledge and abilities. (Franklin, B, 2016). According to (Reynisdóttir, 2016) cite (O'Malley & Valdez-Pierce, 1996) by stating the following, "we use the term authentic assessment to describe the multiple forms of assessment that reflect student learning, achievement, motivation, and attitudes on instructional relevant classroom activities. Ministry of Education and Culture Regulation (2014) defines authentic assessment as a kind of assessment that requires learners to show attitudes and to use knowledge and skills gained from learning in performing tasks in real situations. Authentic assessment refers only to assessment exercises that integrate actual or "real world" settings and criteria(Chatterji, 2003).

Fischer and King (1995) authentic assessment" is a broad word for alternative assessment techniques that check pupils' aptitude for handling tasks or difficulties that closely reflect real-world scenarios.

Moon et al., (2005) as cited on Darling-Hammond, (1997) Authentic assessments, also known as performance-based assessments, involve students in real-world activities and scenario-based problem-solving more than conventional assessments like multiple-choice, pencil-and-paper tests.

5.2. Characteristic of authentic assessment

According to (Sabtiawan et al., 2019) as cited on Rule (2006), In higher education, there are four qualities of authentic assessment that are;

1) involving practical issues that resemble the work of professionals
2) Including metacognition, cognitive abilities, and open-ended inquiry
3) Getting kids talking and participating in social learning
4) Giving students the freedom to choose how to pursue their education.

Not only do these traits aid in identifying an authentic assessment, but they also aid in supplying theoretical constructs to characterize important aspects or qualities of authentic assessment.

5.3. Authentic assessment rubrics

In general, a rubric can be thought of as scoring instructions for a subjective assessment. The standard of performance that should be attained by students is represented by a scoring rubric. A rubric is a predetermined list of standards used to grade or assign a grade to student examinations, portfolios, or performances. A grading rubric outlines the performance levels that may be anticipated in relation to an ideal level of achievement (Hart, 1994).

According to (Smith et al., 2015) explains that an assessment rubric is a matrix, grid, or cross-tabulation used to make expert evaluations of student work more methodical and apparent to students.

5.4. Science Process Skill

Rubrics is a great tool for many different evaluation styles, and they're a crucial part of real assessment.

Table 2 definition of Basic Science Process Skills

Science Process Skills	Definitions
Observing	Ability to use one of the senses such as eye, ear, nose, tongue, and body or combined depending on the object or observation items. Writing about what is perceived through sight, sound, touch, smell, and taste. The teacher will help the student learn of matter or objective to be observed, which senses should be used in the observation. For instance, - Observing different characteristics of the ring. The student should be able to observe using their eyes to identify the characteristics of what they have seen and physical appearance surface texture or hardness of the ring but should not be observed by using tasting, etc. - Compare two brands' names of orange juices. The student should be able to observe by their eyes to identify the characteristics of color in orange juices, use nose to identify the smell of orange juices, use the tongue to taste orange juices, and describe.

Science Process Skills	Definitions
Measuring	The ability to measuring instruments using quantitative data such as measurement of height, weight, mass, or volume. ability to select measurement tools, the use of measurement tools, and identify suitable units of measurement. For instance, - Measuring distance from the school to pagoda should be use meters. - 2 apples weigh the same as 1 mango, comparing objects should be use the quantities
Classifying	The ability to classify grouping things arranges of objective, items with specific criteria or self-established criteria which observing similarities, differences, or interrelationships. For instance, to explore the matter in daily life, the student should be observed and classify the grouping of solid, liquid, and gas. The student will need to specify the criteria that can be used in clustering. In addition, the student sort of objective or things by criteria such as sort of kind matter of solid, liquid, and gas or sort of by size.
Predicting	The ability to predict or estimate the answer by use information of observation basic. For instance, the student experiments and found that dissolves sugar in hot water is more quickly than dissolves the sugar in warm water. The student capable observe from predicting when dissolving sugar in cool water is will be solutes late than hot water. In performing an activity or experiment in which the student collected data that could be summarized as a quantitative relationship.
Communicating	Ability to talking and listening, making and labeling pictures, making and labeling graphs, and playing out scenarios are all ways of exchanging ideas.

6. Examples of lesson plan

There is 10 lesson plans' example which blended instructional media and 7Es learning cycles models. Lesson plans' examples combine blended media (software and hardware) to help the teacher's teaching and learning. The lesson plan uses different techniques such as google classroom, Kahoot app to play games and quiz, PhET Interactive Simulations to practice and observe. According to PhET, interactive simulations (sims) are currently employed extensively in the teaching of physics and chemistry. Sims can be utilized in a wide range of educational contexts, including lectures, one-on-one or small-group inquiry exercises, homework, and lab.

Allotment of Periods

For Units and Sub-units of Chemistry, Skill Bridging Program grade 8&9

Unit	Sub-unit	Learning outcomes	Number of Periods	
			Sub-unit	**Total**
Unit 1: Atoms and Molecules	21. Atoms and Molecules	➢ Identify the structure of atom. ➢ Identify how to build some simple models of atoms and molecules. ➢ Identify the protons and neutrons in the nucleus and write down the atomic number (Z) and mass number (A) of each element.	2	6
	22. Periodic Table	➢ Identify the name and the symbol of an element. ➢ Identify the element use in daily life. ➢ Investigate and explain in simple terms differences between metals and non-metals	4	
Unit 2: Matter	23. State of matter	➢ Identify and explain the differences three state of matter as liquid, solid, and gas. ➢ Understand and describe the processes that occur when matter change state.	2	6
	24. Properties of Matter	➢ Conduct and report on experiments to learn about how matter changes physically and chemically. ➢ Define the terms "physical changes" and "chemical changes." ➢ Identify difference between a physical and chemical changes of matters.	2	
	25. Classification of Matter	➢ Identify the separations mixture techniques to develop an understanding in daily life ➢ Distinguish between homogeneous and heterogeneous matter	2	
Unit 3: Chemical reaction	26. Chemical reaction	➢ Understand what chemical reactions in daily life ➢ Identify the reactants and products	2	4
	27. Balancing chemical Equations	➢ Explain how chemical reaction equations are written and balanced ➢ Identify an unbalanced chemical equation, balance it by inspection	2	

Unit	Sub-unit	Learning outcomes	Number of Periods	
			Sub-unit	**Total**
Unit 4: Solution	28. Prosperities of Solutions	➢ Explain the meaning of and the difference between the following terms: solutes, solvents and solutions ➢ Explain saturated and unsaturated of solution ➢ Calculate mass of solute and solvent, percentage concentration, mole of solute, volume of solution, and molarity.	4	8
	29. Acids and Bases	➢ Classify solution as acid and base in daily life by pH scale ➢ The students are able to distinguish between strong acids and weak acids as well as between strong bases and weak bases in terms of pH. ➢ Identify different between acid and bases	2	
	30. Salts	➢ Explain the applications of various salts in daily life. ➢ Identify the acidic salts, basic salts, and neutral salts ➢ Explain the neuralization reaction	2	
Total				**24 hours**

Table 3 the structure lists of science process skills in the lessons

Units	**Lessons**	**Basic science Process Skill**					**Total**
		Observing	Measurement	Classifying	Predict	Communicate	
Unit 1 atom and molecules	Lesson 1 Atom and molecules	√	√	√	√	√	5
	Lesson 2 Periodic Table	√		√		√	3
Unit 2 Matter	Lesson 3 State of mater	√	√	√	√	√	5
	Lesson 4 Properties of Matter	√	√	√	√	√	5
	Lesson 5 Classifying Matter	√	√	√		√	5
Unit 3 Chemical reaction	Lesson 6 Chemical reaction	√	√	√	√	√	5
	Lesson 7: Balancing chemical Equations	√	√			√	3
Unit 4 Solutions	Lesson 8 Solution	√	√	√	√	√	5
	Lesson 9 Acid and Base	√	√	√	√	√	5
	Lesson10 Salt	√	√	√	√	√	5
Total		10	9	9	8	10	46

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Achievement Test (Pre- test)

(Duration: 50 min)

Student's name or ID: ____________________Section __________Score______/100___

Directions: carefully read and respond to each question. Please mark the right response with a circle. Don't leave any questions unanswered. There are 25 questionnaires. All the question as deductive (1question 2points)

1. What element has a mass number of 19 protons, 19 electrons, and 20 neutrons?
   a. 19
   b. 39
   c. 20
   d. 58
2. Which chemical is used in swimming pools?
   a. F
   b. Cl
   c. Zn
   d. Pb
3. Which is an element having in the shells and bones?
   a. Calcium
   b. Iron
   c. Aluminum
   d. Platinum
4. Which is an element having in the lights and signs?
   a. Potassium
   b. Neon
   c. Iron
   d. Hydrogen
5. Which the element chemical use in balloons?
   a. F
   b. Cl
   c. B
   d. Pb
6. What's ingredients should be use in toothpaste to prevent tooth decay?
   a. Neon
   b. Iron

c. Fluoride

d. Aluminum

7. When a person wearing glasses comes inside from the cold of the outside into a warm environment, their glasses fog up because of;
   a. melting then boiling
   b. freezing then thawing
   c. vaporization then condensation
   d. condensation then vaporization
8. What happens when baking soda combined with vinegar?
   a. Possible answer may include formation of bubbles, balloon inflates rapidly.
   b. Possible answers may include that there is no reaction, balloon does not inflate.
   c. Possible answers may include formation of bubbles, balloons inflate very slowly.
   d. Possible answers may include formation of small bubbles, balloon inflates very slowly.
9. Which of the following is physical change?
   a. Your bicycle rusts when left outside in the rain.
   b. Burning coal for a barbecue
   c. A marshmallow is toasted over a campfire
   d. A sugar cube dissolves
10. Which of the following as being false?
    a. A physical change is one that affects size or shape.
    b. A chemical transformation entails the formation of a new material with novel properties.
    c. When platinum is heated and then brought back to its initial temperature, we refer to this as a physical change.
    d. Since a change in the smell doesn't necessarily signify a chemical change, milk turning sour is a physical change.
11. How will you separate the following of mustard seeds and common salt?
    a. sieving
    b. hand picking
    c. hand storing
    d. filtration
12. Of the following, which is heterogeneous matter?
    a. Muddy water

b. Salt water

c. Orange juice

d. All of these

13. The equation provided depicts the interaction between vinegar (acetic acid) and baking soda (sodium bicarbonate). Which of the following chemical equations as product?

a. Sodium bicarbonate + acetic acid → Carbon dioxide

b. Sodium bicarbonate + acetic acid → Water

c. Sodium bicarbonate + acetic acid → Carbon oxide + Water

d. Sodium bicarbonate + acetic acid → Carbon dioxide + Water

14. Identify the reactant of this reaction: sodium bicarbonate + acetic acid → Carbon dioxide + water

a. Sodium bicarbonate and acetic acid

b. Carbon dioxide and water

c. Acetic acid

d. Carbon dioxide

15. Identify X of this reaction: $C_3H_8 + 5O_2 \rightarrow 3CO_2 + x\ H_2O$.

a. 3

b. 4

c. 5

d. 6

16. Identify X of this reaction: $FeCl_3 + 3NaOH \rightarrow Fe\ (OH)_3 + x\ NaCl$.

a. 3

b. 4

c. 5

d. 6

17. The solution 10g of salt and 90g of water, how many percent of concentration?

a. 5%

b. 10%

c. 20%

d. 35%

18. Dissolving 28g of sugar into 100g of water. Calculation mass of solution.

a. 128g

b. 72g

c. 0.28

d. 3.57g

19. In 0.75 l of solution, there are 0.42 moles of solution. Determine the solution's molarity.
    a. 0.56M
    b. 0.40M
    c. 2M
    d. 1.5M
20. Calculate concentration if 0.025 moles of HCl are present in 0.05 l.
    a. 0.5 mol/l
    b. 0.4 mol/l
    c. 0.3 mol/l
    d. 0.2 mol/l
21. What's the farmers put in the soil to neutralize acid?
    a. $Ca(NO_3)_2$
    b. Ca
    c. $CaCl_2$
    d. $Ca(OH)_2$
22. The pH of human urine is
    a. 3-5
    b. 7-9
    c. 5-7
    d. 9-10
23. Acids react with certain substances to produce salt and water, which are referred to as ______
    a. Acids
    b. Bases
    c. Salts
    d. Indicators
24. Which substance is salt?
    a. $ZnCl_2$
    b. CO_2
    c. $Mg(OH)_2$
    d. Ca
25. Which of the following is a neutral solution but not salt solution?
    a. Sodium chloride
    b. Sodium sulfate
    c. Potassium nitrate
    d. Starch solution

Key answers

Questionnaire	Answer	Bloom's taxonomy
1	b	Understand
2	b	Understand
3	a	Understand
4	b	Understand
5	c	Understand
6	c	Understand
7	b	Understand
8	a	Understand
9	d	Understand
10	d	Understand
11	a	Understand
12	a	Understand
13	d	Understand
14	a	Understand
15	b	Understand
16	a	Understand
17	b	Understand
18	a	Understand
19	a	Understand
20	a	Understand
21	d	Remember
22	c	Remember
23	b	Understand
24	a	Remember
25	d	Remember

UNIT 4

Solution

Lesson Plan

Blended learning and the 7Es learning cycles model

Teaching overview

This unit consist of 3 lessons;

Lesson No	Lesson title	Activity	Duration
8	Solution	Activity sheet.8.1. Experiment and explain solvent, solute, and solution. Activity sheet.8.2. Experiment and explain of saturated and unsaturated of solution. Activity sheet.8.3. Calculate mass of solute and solvent, percentage concentration, mole of solute, volume of solution, and molarity. Kahoot 8 Ten multiple choices	4 hours
9	Acid and base	Activity sheet 9.1. Classify solution as acid and base in daily life by pH scale. Activity sheet 9.2. Experiment toothpastes, fruit, vegetables, and other common household items to find which one bases or acids by use common tools (pH meter, red cabbage indicator, and pH paper). Activity sheet 9.3. Identify different between acid and bases. Kahoot 9 Ten multiple choices	2 hours
10	Salt	Activity sheet 10.1: write the uses of different salts in daily life Activity sheet 10.2: Identify salts as acidic salts, basic salts, or neutral salts Activity sheet 10.3: Observation neutralization reaction of vinegar (acetic acid) and baking soda (sodium bicarbonate). Kahoot 10 Ten multiple choices	2 hours
		Total	8 hours

This unit consist of 5 science process skill;

Science Process Skills	Definitions
Observing	Ability to use one of the senses such as eye, ear, nose, tongue, and body or combined depending on the object or observation items. Writing about what is perceived through sight, sound, touch, smell, and taste. The teacher will help the student learn of matter or objective to be observed, which senses should be used in the observation.
Measuring	The ability to measuring instruments using quantitative data such as measurement of height, weight, mass, or volume. ability to select measurement tools, the use of measurement tools, and identify suitable units of measurement.
Classifying	The ability to classify grouping things arranges of objective, items with specific criteria or self-established criteria which observing similarities, differences, or interrelationships.
Predicting	The ability to predict or estimate the answer by use information of observation basic.
Communicating	Ability to talking and listening, making and labeling pictures, making and labeling graphs, and playing out scenarios are all ways of exchanging ideas.

Lesson plan 8: Solution

1. Learning outcomes

At the conclusion of this lesson, students will be able to;

- Explain the meaning of and the difference between the following terms: solutes, solvents and solutions
- Explain saturated and unsaturated of solution
- Calculate mass of solute and solvent, percentage concentration, mole of solute, volume of solution, and molarity.

2. Learning objectives

- The student will able to explain the meaning of and the difference between the following terms: solutes, solvents and solutions.
- The student will able to explain saturated and unsaturated of solution
- The student will able to calculate mass of solute and solvent, percentage concentration, mole of solute, and volume of solution.

3. Learner competencies

3.1. Knowledge

- The student will able to experiment and explain saturated and unsaturated of solution and the meaning of and the difference between the following terms: solutes, solvents and solutions.
- The student will able to use PhET application and calculate mass of solute and solvent, percentage concentration, mole of solute, and volume of solution.

3.2. Skill/process

- Observing
- Measuring
- Classifying
- Prediction
- Communicating

4. Tasks

4.1. Experiment and explain solvent, solute, and solution (Activity sheet.8.1)

4.2. Experiment and explain of saturated and unsaturated of solution (Activity sheet.8.2)

4.3. Calculate mass of solute and solvent, percentage concentration, mole of solute, and volume of solution. (Activity sheet.8.3)

5. Procedures (Based on the development of Eisenkraft, (2003) 7E learning cycle Models)

Phase of Instructions	Learning and teaching activities	
	Teacher	**Students**
1. Elicit (30min)	➢ Revise student's prior knowledge by asking question; why we need to learn solutions? count the common of house solution? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: water-universal solve	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube
2. Engage (30min)	➢ The teacher showed experiment of salt with water.	➢ The student observes the experiment of salt with water. ➢ The student note what they saw and test the salt solution. ➢ All the group working prepare equipment and tools for experiment of some common household solution.
3. Explore (70min)	➢ The teacher post and provide the activities sheet 8.1 and 8.2 to the student on google classroom.	➢ The student experiments some common household solution items. ➢ The student practices on PhET (phet.colorado.edu) identify of concentration, mole, and volume. The student classifying some common household of solution, observing the solute, solvent, and saturated, predicting the solute, solvent, and saturated, and

		communicating from their experiment. ➢ Each group tries to experiments and note what they observed and done. ➢ The student take care with their experiment and note all the process. ➢ The student keeps and take the result post on google classroom.
4. Explain (40min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation about experiments some common household of solution, the problem of experiment 8.1-8.2 and share their knowledge to other groups. ➢ The student showed their result to another group.
5. Elaborate (50min)	➢ The teacher recommends and post activity sheet8.3 to google classroom.	➢ The student measuring and calculating the solvent, solute, solution, concentration, mole, and volume. ➢ Each group tries to completed on activity sheet 8.3 (individual work)
6. Evaluate (10min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot app or website.	➢ The student takes individual practice by play game (use kahoot app or website).
7. Extend (10min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in google classroom after done.

6. Media and resources

Software:

➢ YouTube: water- universal solve (https://www.youtube.com/watch?v=PXdbwMc4d0M)

➢ PhET Interactive Simulations at the University of Colorado Boulder, available via CC-BY 4.0. (https://phet.colorado.edu/sims/html/concentration/latest/concentration_en.html)

(https://phet.colorado.edu/sims/html/molarity/latest/molarity_en.html)

- Google classroom
- Kahoot 8.1

Hardware:

- Activity sheet 8.1 identify the term of solution, solvent, and solute
- Activity sheet 8.2 identify saturated and unsaturated of solution
- Activity sheet 8.3 calculation of solvent and solute, percent concentration, mole and volume of solution.
- Computer/smart phone/iPad with internet access
- Projector
- LCD

7. Assessment and evaluation

Category	Methods	Instruments	Criteria
The student will able to explain the meaning of and the difference between the following terms: solutes, solvents and solutions	➢ Activity sheet 8.1	➢ Activity sheet 8.1 form	➢ Correct up to 80percents
The student will able to explain the appearance of a saturated or unsaturated	➢ Activity sheet 8.2	➢ Activity sheet 8.2 form	➢ Correct up to 80percents ➢ Science process skill (observing, classifying, measuring, predicting, and communicating)
The student will able to calculate mass of solute and solvent, percentage concentration, mole of solute, and volume of solution.	➢ Activity sheet 8.3	➢ Activity sheet 8.3 form ➢ Kahoot 8.1	➢ Correct up to 80percents ➢ Science process skill (measuring, observing, and communicating)

8. Record after teaching

8.1.Problem/how to fit

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

8.2.Recommendation

…………………………………………………………………………………

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…………………………………………………………………………………

Teacher's signature

……………………..

Date……....................

Academic department 's signature

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Date……………..................

Excusive record

…………………………………………………………………………………

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Director 's signature

………………………

Date……................................

Activity sheet 8.1

[LO8.1: The student able to explain the meaning of and the difference between the following terms: solutes, solvents and solutions.]

Equipment

- Salt
- Starch
- Powdered chalk
- Water
- Oil
- Sugar
- Sand
- Glass
- Food coloring
- Dropper
- Teaspoon

Procedures

- Pour about ½ glass into a clear glass.
- Make a prediction for what you think will happen when each item is added to the glass of water.
- Solute that dissolves in the water are soluble, while items that settle to the bottom of the glass do not dissolve or are insoluble in the solvent.
- Use teaspoon to scoop one of the solutes into the first glass of water and stir well with the teaspoon for a few seconds.
- Record on the data table your observations. You may write what you observed, or write "soluble" if it disappeared into the solvent or "insoluble" if it separated.
- Repeat until you have tested all of the possible solutes that you chose.

Predicting, which substance will be good at dissolving.

Solvents	Solutes	Predictions and ideas (What we think might happen?)
Water	Salt	
	Starch	
	Sand	
	Baking powder	
	Sugar	
Oil	Salt	
	Starch	
	Sand	
	Baking powder	
	Sugar	

Experiment

Solvents	**Solutes**	**Step** (What we did?)	**Observation/result** (What we saw?)
Water	Salt		
	Starch		
	Sand		
	Baking powder		
	Sugar		
Oil	Salt		
	Starch		
	Sand		
	Baking powder		
	Sugar		
How can we explain these results?			
Explain the meaning of and the difference between the following terms: solutes, solvents and solutions			
Conclusion	**What is solute?**	**What is solvent?**	**What is solution?**

Activity sheet 8.2 form

[LO8.2 Explain the appearance of a saturated or unsaturated]

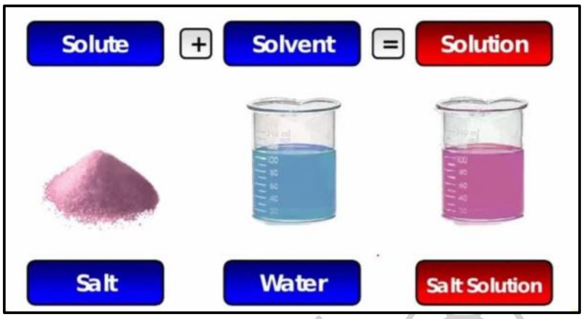
Material
✚ Teaspoon ✚ Glass of water ✚ Measurement glass ✚ Bottle ✚ Stir ✚ Thermometer ✚ Sugar

Procedures	
➢ Put 15ml of water in a bottle. ➢ Add ½ teaspoon of sugar and stir ➢ Continue adding ½ teaspoon of sugar to the same glass until the added sugar no longer dissolves.	
Observation	
What is the appearance of the solutions?	How many teaspoons of sugar have you added until the sugar no longer dissolves?
Conclusion	

Activity sheet 8.3 form

(LO8.3 Calculate mass of solute and solvent, percentage concentration, mole of solute, and volume of solution.)

1. Calculate mass of solute and solvent



Complete the table by identifying the solvent and solute for each solution

Solution	Solvent	Solute
Coffee solution made up of 98.8% water and the rest consists 1.2% of another chemical		
Cola is a solution made up of about 12% sugar and roughly 87% water		
Vinegar is a solution made up of 3.4% acetic acid and 96.6% water.		

Percent concentration of solution

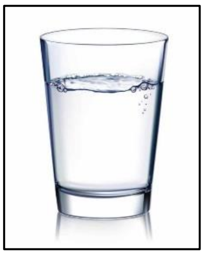
C%= (mass of solute/mass of solution) ×100%	
where	C% = percent concentration of solution m_s = mass of solute m_t = mass of solution

Molarity of a solution

c = n ÷ v	
where	c = concentration of solution in mol L^{-1} (mol/L or M), n = moles of substance being dissolved (moles of solute), v = volume of solution in liters (L)
Moles of solute	n = c × v
Volume of solution	v = n ÷ c

1) Dissolving 25g of sugar into 100g of water. Calculation mass of solution.

25g of sugar



100g of water

Solution of sugar

Solution

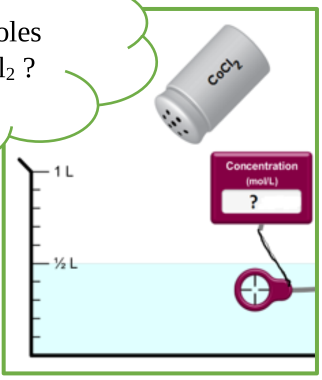
2) Use phET, write down your own observation

2. How many moles is 130 g of $CoCl_2$?

A. 1.4 molar

B. 1.0 molar

C. 2.0 molar



Observation

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………………………………………

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3) **A saline solution with a mass of 355g has 36.5 g of NaCl dissolved in it. What is the percent concentration of solution?**

Solution

4) **Dissolving 20g of salt into 75g of water. Calculation mass of solution**

Solution

Kahoot 8

Read the sentences below and decide which ones are true and which ones are false. Circle the right answers.

1. Sand dissolves in boiling water.

   a. true b. false

2. Sugar dissolves in lemon juice.

   a. true b. false

3. Soil dissolves in water.

   a. true b. false

4. Sugar dissolves in sand

   a. true b. false

5. Vegetable oil do no dissolved in vinegar

   a. true b. false

6. Dissolving 30g of salt into 75g of water. Calculation mass of solution

   a. 45g b. 105g c. 115g d. 100g

7. Calculate concentration if 0.025 moles of HCl are present in 2 l.

   a. 0.0125mol/l b. 0.125mol/l c. 1.25mol/l d. 0.0125mol

8. Calculate moles of $\boldsymbol{Na_2CO_3}$ present in 20 ml of 0.5 mol/ml solution.

   a. 10mol b. 11mol c. 40mol d. 100mol

9. The solution 10g of salt and 90g of water, how many percent of concentration?

   a. 35% b. 20% c. 10% d. 5%

10. Dissolving 28g of sugar into 100g of water. Calculation mass of solution.

    a. 0.28g b. 72g c. 128g d. 3.57g

Answer key lesson 8

Kahoot 8

Questionnaire	Answer	Questionnaire	Answer
1	b	6	b
2	a	7	a
3	b	8	a
4	b	9	c
5	a	10	c

Authentic assessment of lesson 8: Solution

Authentic assessments
Activity sheet 8.1 form
Activity sheet 8.2 report of experiment and presentation
Activity sheet 8.3 form
Kahoot 8

Rubric of assessment for observing

Student's name: ____________________Section____________ Score ___________

Direction: Use this rubric to evaluation a student's observing skill. Assign a score to student for each section.

Skill	Criteria				
	5	4	3	2	1
Observing	Uses appropriate senses to describe objects, events, and/or experiment that are accurate in items step by step correctly.	Uses appropriate senses to accurately describe objects, events, and/or experiment step by step.	Uses appropriate senses to accurately describe objects, events, and/or experiment but not completely.	Limited to describe objects, events, and/or experime nt	Unable to describe objects, events, and/or experiment

Quality Criteria

Scores	**Criteria**
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………../…………./……

Rubric of assessment for measuring

Student's name: ________________________Section__________ Score __________

Direction: Use this rubric to evaluation a student's measuring skill. Assign a score to student for each section.

Skill	Criteria				
	5	4	3	2	1
Measuring	Chooses and uses appropriate tools/unit measurements are specific, accurate, and supported by evidence.	Choose and uses measuring tools/units correctly.	Choose and use the correct measuring tools/units but not completely	Choose and use measuring tools/units most incorrect.	Unable to choose and/or use measuring tools/units.

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………../…………./……

Rubric of assessment for classifying

Student's name: ________________________Section_____________ Score _________

Direction: Assign a score to student's classifying skill for each section.

Skill	Criteria				
	5	4	3	2	1
Classifying	Separate or classer what's study interest that conform to the criteria used correctly and completely	Separate or classer what's study interest that conform to most of the criteria used	Separate or classer what's study interest that conform to some of the criteria used	Separate or classer what's study interest that is not conform to some of the criteria used.	Unable to sorting, grouping, and/or arranging based similarities and difference.

Quality Criteria

Scores	**Criteria**
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………../…………./……

Rubric of assessment for predicting

Student's name: ____________________Section___________ Score ___________

Direction: Assign a score to student's predicting skill for each section.

Skill	Criteria				
	5	4	3	2	1
Predicting	Use previous data to predict what might be happen as correctly.	Use previous data to predict what might be happen	Use previous data to predict what might be happen but not completely.	Use previous data to predict what might be happen but some are incorrect.	Unable use previous data to predict what might be happen

Quality Criteria

Scores	**Criteria**
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………../…………./……

Rubric of assessment for Communicating

Student's name: __________________ Section_______________ Score ____________

Direction: Use this rubric to evaluation a student's communicating skill. For each area, give the student a grade. Next, tally together all of the student scores for each section, and divide that total by the number of students to get the sample mean for each section. Less desirable results point to areas where pupils need to develop.

Skill	Criteria				
	5	4	3	2	1
Communicating	Describes objects and/or events using a variety of methods, expanding on details clearly (orally, pictorially, and/or written)	Describes objects and/or events using a variety of methods, expanding on details (orally, pictorially, and/or written)	Describes objects and/or events using a variety of methods (orally, pictorially, and/or written)	Describes objects and/or events limited	Unable record or describe observations

Quality Criteria

Scores	**Criteria**
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Teacher's signature

…………………………………….

Date………./…………./……….

Student's basic science process skill assessment list

Direction: The teacher/instructors put the total scores of student's science process skill assessments in the column items.

No	Student's name	Sex	Observing	Measuring	Classifying	Predicting	Communicating	Total scores
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Lesson plan 9: Acids and Bases

1. Learning outcomes

By the end of this lesson the students will be able;

- Classify solution as acid and base in daily life by pH scale
- The students be able to identify pH of acid and base, strong acids and weak acid, strong base and weak base.
- Identify different between acid and bases

2. Learning Objectives

- The students will be able to classify of acid and base in daily life
- The students will be able to identify pH of acid and base, strong acids and weak acid, strong base and weak base.
- The students will be able to identify different between acid and bases,

3. Learner's competencies

3.1. Knowledge

- The students will be able to experiment and observation the solution as acid and base in daily life by pH scale. And identify pH of acid and base, strong acids and weak base, strong base and weak acid.
- The students will be able to experiment acid and base on PhET application and use common tools (pH meter and pH paper)

3.2. Skills/processes

- Observing
- Classifying
- Measuring
- Predicting
- Communicating

4. Tasks

4.1. Classify solution as acid and base in daily life by pH scale. (Activity sheet 9.1 classify solution)

4.2. Experiment toothpastes, fruit, vegetables, and other common household items to find which one bases or acids by use common tools (pH meter and pH paper). (Activity sheet 9.2: experiment and presentation)

4.3. Identify different between acid and bases. (Activity sheet 9.3)

5. Learning activities based on the development of Eisenkraft,(2003) 7Es learning cycle Models

Phase of Instructions	Learning and teaching activities	
	Teacher	**Students**
1. Elicit (15min)	➢ Revise student's prior knowledge by asking question; why we need to learn acid and base? It is important or not in your daily life? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: acid and base	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube
2. Engage (15min)	➢ The teacher showed common tools (pH meter, red cabbage indicator, and pH paper) and explain how to use it.	➢ The student practices on PhET (phet.colorado.edu) identify of strong and weak acid and base. ➢ The student observes the color and pH of solution ➢ All the group working prepare equipment and tools for experiment of common household.
3. Explore (35min)	➢ The teacher post and provide the activities sheet 9.1 and 9.2 to the student on google classroom.	➢ The student experiment common household items which one bases or acids by use common tools (pH test paper, pH meter, and red cabbage indicator) ➢ The student classifying the common household, observing the color pH of solution, predicting of pH solution, and communicating from their experiment. ➢ Each group tries to experiments and note what they done. ➢ The student take care with their experiment and note all the process

Phase of Instructions	Learning and teaching activities	
	Teacher	**Students**
		and how to use common tools.
4. Explain (20min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation about experiment of common household, the problem of experiment and share their knowledge to other groups. ➢ The student showed their result to another group.
5. Elaborate (25min)	➢ The teacher recommends and post activity sheet 9.3 to google classroom.	➢ The student classification the properties of acid and base of common household. ➢ Each group tries note what they done.
6. Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot app or website.	➢ The student takes individual practice by play game (use kahoot app or website).
7. Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in google classroom after done.

6. Media and resources

Software:

- ➢ YouTube: Acid and base (https://www.youtube.com/watch?v=V5Mq_cL9Bck)
- ➢ PhET: https://phet.colorado.edu/sims/html/ph-scale-basics/ latest/ ph-scale-basics_en.html
- ➢ Google classroom
- ➢ Kahoot 9.1

Hardware:

- ➢ Activity sheet 9.1: classify solution as acid and base in daily life by pH scale
- ➢ Activity sheet 9.2: experiment the common household and presentation

- Activity sheet 9.3: identify different between acid and bases
- Equipment/tools for experiment (such as pH meter, pH paper, common household, and materials)
- Computer/smart phone/iPad/ tablets for each student or pair of students
- Projector
- LCD

7. Assessments and evaluation

Objectives	Methods	Instruments	Criteria
The students will be able to classify solution as acid and base in daily life by pH scale	➢ Activity sheet 9.1	➢ Activity sheet 9.1 form	➢ Correct up to 80percents ➢ Science process skills as observing, classifying, and predicting.
The students will be able to identify pH of acid and base, strong acids and weak acid, strong base and weak base.	➢ Activity sheet 9.2	➢ Activity sheet 9.2 form	➢ Correct up to 80percents ➢ Science process skills as observing, classifying, communicating, and predicting.
The students will be able to identify different between acid and bases.	➢ Activity sheet 9.3	➢ Activity sheet 9.3 form ➢ Kahoot	➢ Correct up to 80percents ➢ Science process skills as observing and classifying

8. Record after teaching

8.1. Problem/how to fit

……………………………………………………………………………………………

……………………………………………………………………………………………

8.2. Recommendation

……………………………………………………………………………………………

……………………………………………………………………………………………

Teacher's signature
……………………
Date……..........................

Academic department 's signature
………………………..
Date…………...................

Excusive record

……………………………………………………………………………………………

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Director 's signature
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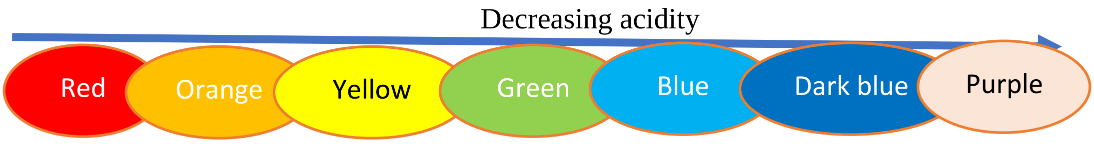
Date……..................................

Activity sheet 9.1 classification of acid and base

Student's name: ______________Section__________________ Score ______________

[LO9.1: The students will be able to classify solution as acid and base in daily life by pH scale]

1. The colors exhibited by the universal indicator are shown below.



Different chemicals and household materials were tested with the universal indicator

Substance	Color of universal indicator
Bleach	Dark blue
Citrus drink	Yellow
Deionized water	Green
Limewater	Dark blue
Toothpaste	Blue
Vinegar	Orange
Washing soda	Blue
Wine	Orange

Name three acidic substance listed above;

……………………………………………………………………………………………

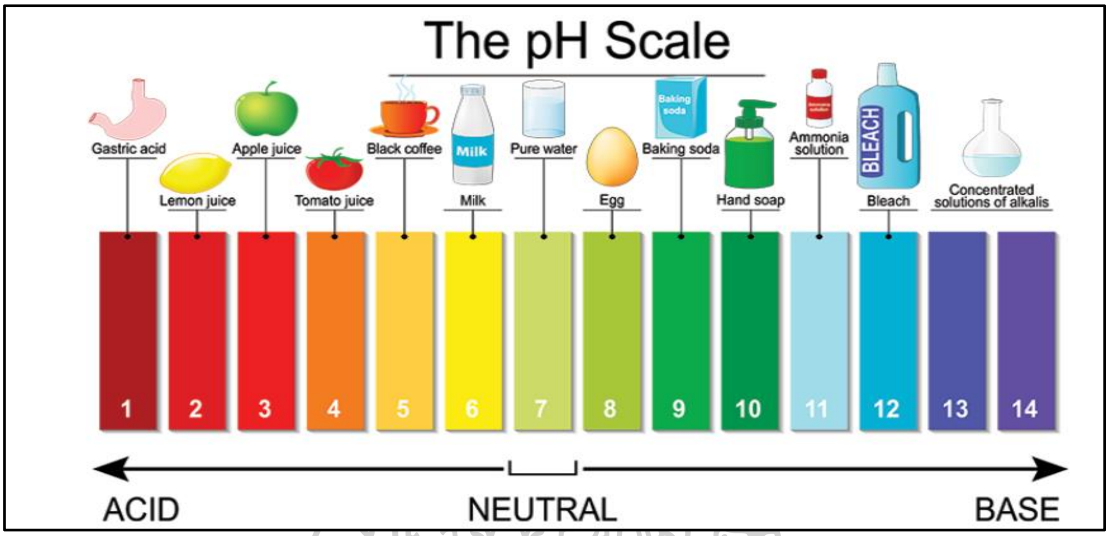
……………………………………………………………………………………………

Name three basic substance listed above;

……………………………………………………………………………………………

……………………………………………………………………………………………

2. Please, put the following label the picture and write down the words in the correct box;



Acid	Base

3. Please, tick (√) in the correct answer below;

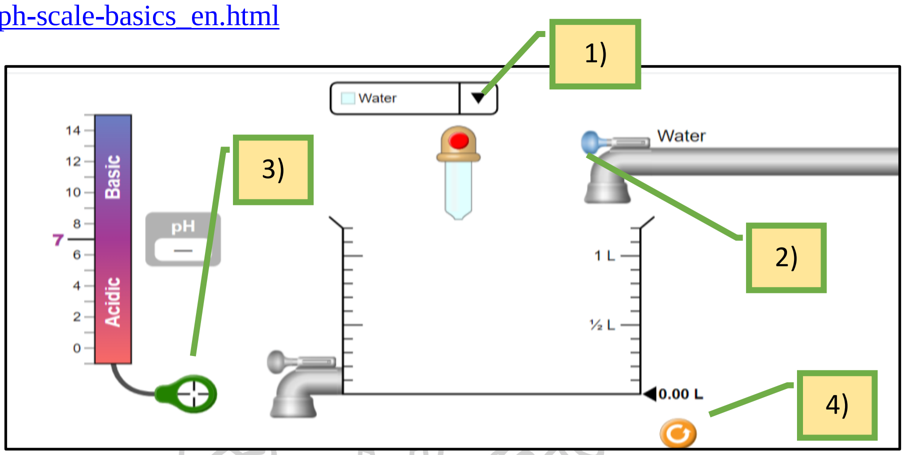
pH	Acidic	Basic	pH	Acidic	Basic	pH	Acidic	Basic
1.00			2.99			1.50		
4.00			4.95			3.99		
6.00			8.05			7.87		
10.00			10.23			9.10		
9.00			5.55			12.11		
13.00			7.61			2.02		

Activity sheet 9.2: experiment and presentation

Student's name: ____________________Section_________________ Score __________

(LO9.2: the student will be able identify pH of acid and base, strong acids and weak acid, strong base and weak base.)

1. Go to the following simulation: https://phet.colorado.edu/sims/html/ph-scale-basics/latest/ ph-scale-basics_en.html



1) Choose household substance
2) Put the water
3) Move the pH probe into the beaker. Record the pH in the table below.
4) Repeat for the other pH listed in the table below.

Household substance	pH of the solution	Acid	Base
Drain cleaner			
Hand soap			
Blood			
Spit			
Water			
Milk			
Chicken soup			
Coffee			
Orange juice			
Soda pop			
Vomit			
Battery acid			

2. Experiment common household by universal indicator

Materials	Common household substance	Method
1. Spotting plate 2. Universal indicator color chart 3. Universal indicator	1. Coke/fizzing drink 2. Dishwashing detergent 3. Baking power 4. Water 5. Vinegar 6. Lemon juice 7. Tea 8. Sugar solution 9. Salt solution 10. Soap/handwash 11. Toothpaste	1. Add 3 drops of vinegar to the spotting plate's well. 2. To the vinegar, add 1 drop of the universal indicator. 3. Check the color of the solution to the color on the swatch chart. 4. Add the pH and color information to the results table. 5. Repetition of steps 1 through 5 with various household items 6. Photograph the outcome and post it to Google Classroom.

Record the color and pH in the result table;

Result		
Household substance	**Color of the solution**	**pH of the solution**
Coke/fizzing drink		
Dishwashing detergent		
Baking power		
Water		
Vinegar		
Lemon juice		
Tea		
Salt solution		
Soap/handwash		
Toothpaste		

3. Make a homemade pH indicator solution

Materials	Method
1. Red cabbage 2. Food processor or blender 3. Water (boiling) 4. Large glass beaker or other glass container 5. Six 250ml beakers or other small glass containers 6. Filter paper or coffee filter	1. Prepare 2 cups of chopped cabbage by chopping it into small pieces using a food processor. 2. Add enough boiling water to cover the chopped cabbage in a large beaker or other glass container. Give the cabbage at least 10 minutes to lose its color. (Alternatively, you can put approximately 2 cups of cabbage in a blender, add boiling water to the top, and puree it.) 3. To create a purple liquid, filter off the plant matter. The pH of your red cabbage is around 7, according to this pH indicator. (The hue is influenced by the water's pH.) 4. Fill each of the 250 mL beakers with 50 to 100 mL of the red cabbage indicator. 5. Add different home solutions, one drop at a time, to your indicator until you see a color change to determine the pH of the solution. Do not combine household solutions; use separate containers for each. 6. Find the pH of the tested household solutions using the chart below as a guide. 7. Photograph the outcome and post it to Google Classroom.

Testing pH of substances

• Analyze the pH of common home items.

• Make notes and inform another group of your observations.

4. Test the pH of common household substances. The red cabbage indicator, pH paper, and pH meter were used to test various chemicals and household items.

Substance	Color of red cabbage indicator	Color of pH paper	pH meter	strong acids or weak	strong base or weak
Pineapple					
Washing soda					
Wine					
Apple					
Banana					
Cabbage					
Cucumber					
Lemon					
Milk					
Coke/fizzing drink					
Dishwashing detergent					
Baking power					
Water					
Vinegar					
Lemon juice					
Tea					
Salt solution					
Soap/handwash					
Toothpaste					

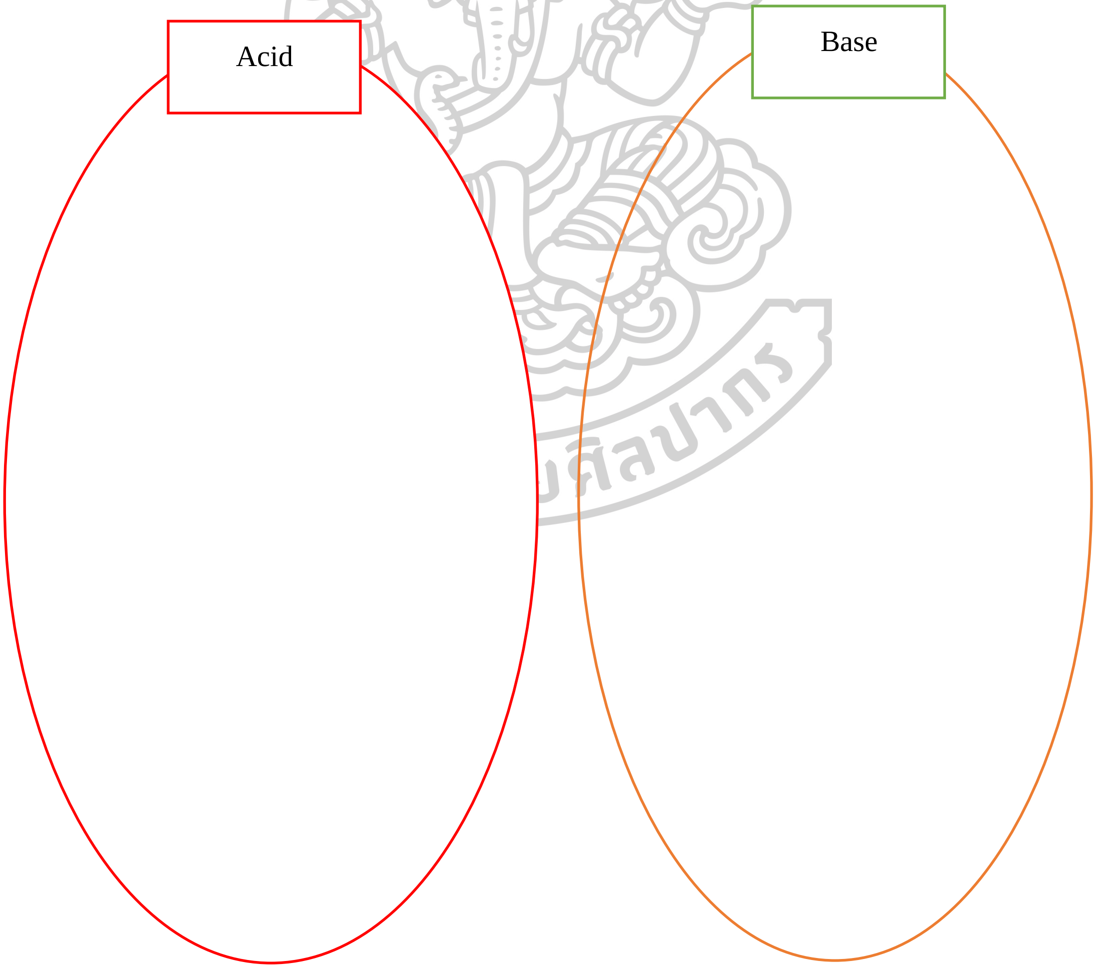
Activity sheet 9.3: identify different between acid and base

Student's name: ____________________Section____________________ Score ____________

[LO9.3: the student will be able identify different between acid and bases]

Sort the following notes into the diagram according to their category.

Sour taste	Fruits and juices	pH less than 7	Cleaning products
Bitter	Feels slippery	pH greater than 7	
Blue litmus paper turns red	Red litmus paper turns blue	Conducts electricity	



Kahoot 9

Choose the correct answer

1) Acid's taste
   b. sweet c. bitter
   c. sour d. salty
2) Acids make litmus paper turn
   a. red c. blue
   b. yellow d. black
3) Basic solution feels
   a. rough c. slippery
   b. moist d. dry
4) Which type of solution is one with a pH of 8?
   a. acidic c. neutral
   b. basic d. all
5) Which one is correctly matched?
   a. acids pH range above 7 c. acids pH range 7 (neutral)
   b. acids pH range below 7 d. acids pH range 8-9

   Explanation: Acids have a pH range less than 7, Water is the only solvent that has a pH of 7 (neutral).
6) Which property best describes the lemon?
   a. sour c. spicy
   b. sweet d. salty
7) The pH of human urine is
   a. 3-5 c. 7-9
   b. 5-7 d. 9-10
8) A strong acid is same as concentrated acid?
   a. false b. true

   Explanation: An acid's concentration is influenced by its water content, whereas its strength is influenced by its dissociation power.
9) Bases taste bitter, while acids taste sour
   a. false b. true
10) The back of the tongue detects bitter tastes
   a. false b. true

Answer key lesson 9

Kahoot 9

Questionnaire	Answer	Questionnaire	Answer
1	c	6	a
2	a	7	b
3	c	8	a
4	b	9	b
5	b	10	b

Authentic assessment of lesson 9: Acids and bases

Authentic assessments
Activity sheet 9.1 form
Activity sheet 9.2 report of experiment and presentation
Activity sheet 9.3 form
Kahoot app 9

Rubric of assessment for observing

Student's name: ____________________Section_____________ Score __________

Direction: Use this rubric to evaluation a student's observing skill. Assign a score to student for each section.

Skill	Criteria				
	5	4	3	2	1
Observing	Uses appropriate senses to describe objects, events, and/or experiment that are accurate in items step by step correctly.	Uses appropriate senses to accurately describe objects, events, and/or experiment step by step.	Uses appropriate senses to accurately describe objects, events, and/or experiment but not completely.	Limited to describe objects, events, and/or experiment	Unable to describe objects, events, and/or experiment

Quality Criteria

Scores	**Criteria**
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………./…………/……

Rubric of assessment for measuring

Student's name: ____________________Section__________________ Score ________

Direction: Use this rubric to evaluation a student's measuring skill. Assign a score to student for each section.

Skill	Criteria				
	5	4	3	2	1
Measuring	Chooses and uses appropriate tools/unit measurements are specific, accurate, and supported by evidence.	Choose and uses measuring tools/units correctly.	Choose and use the correct measuring tools/units but not completely	Choose and use measuring tools/units most incorrect.	Unable to choose and/or use measuring tools/units.

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………../…………./……

Rubric of assessment for classifying

Student's name: ____________________Section______________ Score _______________

Direction: Assign a score to student's classifying skill for each section.

Skill	Criteria				
	5	4	3	2	1
Classifying	Separate or classer what's study interest that conform to the criteria used correctly and completely	Separate or classer what's study interest that conform to most of the criteria used	Separate or classer what's study interest that conform to some of the criteria used	Separate or classer what's study interest that is not conform to some of the criteria used.	Unable to sorting, grouping, and/or arranging based similarities and difference.

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

……………………………….

Date………./…………./……

Rubric of assessment for predicting

Student's name: ____________________________ Section___________ Score ___________

Direction: Assign a score to student's predicting skill for each section.

Skill	Criteria				
	5	4	3	2	1
Predicting	Use previous data to predict what might be happen as correctly.	Use previous data to predict what might be happen	Use previous data to predict what might be happen but not completely.	Use previous data to predict what might be happen but some are incorrect.	Unable use previous data to predict what might be happen

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………../…………./……

Rubric of assessment for Communicating

Student's name: ______________________ Section_____________ Score ___________

Direction: Use this rubric to evaluation a student's communicating skill. For each area, give the student a grade. Next, tally together all of the student scores for each section, and divide that total by the number of students to get the sample mean for each section. Less desirable results point to areas where pupils need to develop.

Skill	Criteria				
	5	4	3	2	1
Communicating	Describes objects and/or events using a variety of methods, expanding on details clearly (orally, pictorially, and/or written)	Describes objects and/or events using a variety of methods, expanding on details (orally, pictorially, and/or written)	Describes objects and/or events using a variety of methods (orally, pictorially, and/or written)	Describes objects and/or events limited	Unable record or describe observations

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Teacher's signature

…………………………………

Date………/…………/……….

Student's basic science process skill assessment list

Direction: The teacher/instructors put the total scores of student's science process skill assessments in the column items.

No	Student's name	Sex	Observing	Measuring	Classifying	Predicting	Communicating	Total scores
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Lesson plan 10: Salts

1. Learning outcomes

By the end of this lesson the students will be able;

- Explain the uses of different salts in daily life
- Identify the acidic salts, basic salts, and neutral salts
- Explain the neuralization reaction

2. Learning objectives

- The student will be able to explain the uses of different salts in daily life
- The student will be able to identify the acidic salts, basic salts, and neutral salts
- The student will be able to explain the neuralization reaction

3. Learner's competencies

3.1. Knowledge

- The student will be able to use pH meter and pH papper and explain the uses of different salts in daily life and identify the acidic salts, basic salts, and neutral salts
- The student will be able to observe neutralization reaction of vinegar and explain of neuralization reaction.

3.2. Skill/process

- Observing
- Measuring
- Classifying
- Predicting
- Communicating

4. Tasks

4.1. Write the uses of different salts in daily life (Activity sheet 10.1: write the use of different salts in daily life)

4.2. Identify salts as acidic salts, basic salts, or neutral salts (Activity sheet 10.2: identify salts)

4.3. Observation neutralization reaction of vinegar (acetic acid) and baking soda (sodium bicarbonate). (Activity sheet 10.3: neutralization reaction)

5. Procedures (Based on the development of Eisenkraft, (2003) 7E learning cycle Models)

Phase of Instructions	Learning and teaching activities	
	Teacher	**Students**
1. Elicit (15min)	➢ Revise student's prior knowledge by asking question; what dose salt taste like? what are sources of salt? ➢ The teacher tries to capture the students' attention and examine students 'prior knowledge by let them watch YouTube: salts and it's use	➢ Discussion together in the classroom. ➢ Divide 3 or 5 students into group working. ➢ The students studied and note important thing from YouTube
2. Engage (15min)	➢ The teacher showed neutralization reaction on YouTube and post activity sheet 10.1 to the student on google classroom.	➢ The student observes of neutralization reaction on YouTube and note what the seen ➢ All the group answer by predict of uses salt in daily life.
3. Explore (35min)	➢ The teacher post and provide the activity sheet10.2 to the student on google classroom.	➢ The student is observing the pH of (washing soda, baking soda, and salt with water), classifying the salts, and communicating from their experiment. ➢ Each group tries to experiments and note what they done. ➢ The student take care with their experiment and note all the process and how to use (measuring) common tools.
4. Explain (20min)	➢ Let the student interpret what they have learned from experiment.	➢ The student presentation about experiment of (washing soda, baking soda, and salt with water), melting ice with salt, use different of salt in daily life and share their knowledge to other groups. ➢ The student showed their result to another group.
5. Elaborate (25min)	➢ The teacher recommends and post activity sheet 9.3 to google classroom.	➢ The student is observing and predicting of the combination of vinegar and baking soda about chemical reaction (acid with base). ➢ Each group tries note what they done. ➢ The student completed all the activity sheet and take the result post on the google classroom.

Phase of Instructions	Learning and teaching activities	
	Teacher	**Students**
6. Evaluate (5min)	➢ The teacher lets the students to check their understanding and review what they have learned by play game kahoot app or website.	➢ The student takes individual practice by play game (use kahoot app or website).
7. Extend (5min)	➢ The teacher let the student choose the topic (free) that related with the lesson.	➢ The students try the best to find the topic that related the lesson to extend their understand to daily life. And then post in google classroom after done.

6. Media and resources

Software:

➢ YouTube: salt and it's use (https://www.youtube. com/watch?v= lBjwMcH UyBY), neutralization reaction (https://www.youtube.com/watch?v=RmnT9jwX4gQ)

➢ Google classroom (activity sheet10.1, 10.2, and 10.3 form)

➢ Kahoot 10.1 form

Hardware:

➢ Activity sheet 10.1: write the uses of different salts in daily life

➢ Activity sheet 10.2: Identify salts as acidic salts, basic salts, or neutral salts

➢ Activity sheet 10.3: Observation neutralization reaction of vinegar (acetic acid) and baking soda (sodium bicarbonate).

➢ Equipment/tools for experiment (such as pH meter, pH paper, salt, baking soda, vinegar, washing soda, beaker, and materials)

➢ Computer/smart phone/iPad/ tablets with internet access

➢ Projector

➢ LCD

7. Assessments and evaluation

Objectives	Methods	Instruments	Criteria
➢ The student will be able to explain the uses of different salts in daily life	➢ Activity sheet 10.1	➢ Activity sheet 10.1 form	➢ Correct up to 80percents ➢ Science process skills as Observe, classifies, and predict.
➢ The student will be able to identify the acidic salts, basic salts, and neutral salts	➢ Activity sheet 10.2	➢ Activity sheet 10.2 form	➢ Correct up to 80percents ➢ Science process skills as observing, measuring and classifying
➢ The student will be able to explain of neuralization reaction	➢ Activity sheet 10.3 ➢ Presentation	➢ Activity sheet 10.3 form ➢ Kahoot 10.1	➢ Correct up to 80percents ➢ Science process skills as observing classifying, and communicating

8. Record after teaching

8.1. Problem/how to fit

………………………………………………………………………………………………

………………………………………………………………………………………………

8.2. Recommendation

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Excusive record

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………………………………………………………………………………………………

Teacher’s signature

……………………..

Date……....................

Academic department ’s signature

………………………..

Date…………...................

Activity sheet 10.1: write the uses of different salts in daily life

[LO 10.1: The student will be able to explain the uses of different salts in daily life]

Please, predicting and write the uses of salts in daily life.

Name of salts	Uses

Activities sheet 10.2 identify salt

[LO10.2: The student will be able to identify the acidic salts, basic salts, and neutral salts.]

Group student's name

1…………………………

2…………………………

3…………………………

4…………………………

Equipment

1. Washing soda
2. Baking soda
3. Salt
4. Beaker

Method

In a beaker A, combine washing soda (sodium carbonate) and water.

In a beaker B, combine baking soda (sodium bicarbonate) and water.

In a beaker C, mix common salt and water..

In all three solutions, dip pH paper..

Observe

1. Which of the three solutions causes the pH paper's color to change?
2. What kind of solutions are in Beaker A, Beaker B, and Beaker C?

Conclusions

Classifying salts

The following table give the information about the acidic salts, basic salts, and neutral salts. You can search on internet.

Acidic salts	Basic salts	Neutral salts

Mix and match to make salts by dragging the molecules to where they belong.

1) Sodium hydroxide (NaOH) reacting with hydrochloric acid (HCl)

The products would be;

Salt + water

The word equation would be;

Sodium hydroxide + Hydrochloric acid = ______ + ______

2) Potassium hydroxide (KOH) reacting with sulfuric acid (H_2SO_4)

The products would be;

Salt + water

The word equation would be;

Potassium hydroxide + Sulfuric acid = ______ + ______

3) Calcium hydroxide ($Ca(OH)_2$) reacting with nitric acid (HNO_2)

The products would be;

Salt + water

The word equation would be;

Calcium hydroxide + Nitric acid = ______ + ______

4) Calcium hydroxide + Sulfuric acid = ______ + water

5) Iron oxide + Nitric acid = ______ + water

6) Magnesium oxide + Hydrochloric acid = ______ + water

There are three other ways of making salts from acids. Complete the following equations to illustrate them.

7) acid + metal → salt + ____________

8) acid + ______________ → salt + water

9) acid + carbonate → salt + __________ + water

Fill in the missing the following equations for making salts

10) $2Na + Cl_2 \rightarrow$ _______ $NaCl$

11) $Al_2O_3 + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 +$ ________

12) $H_3PO_4 +$ ____ $KOH \rightarrow K_3PO_4 +$ ___ H_2O

13) $LiOH + HNO_3 \rightarrow LiNO +$ ____ $+ H_2O$

14) $Ba(OH)_2 + H_2SO_4 \rightarrow$ _______ $+ H_2O$

Complete the following equations in both words and formulae:

15) Hydrochloric Acid + Sodium Hydroxide → Sodium Chloride + Water

HCl + $NaOH$ → _______ + _______

16) Nitric Acid + Sodium Hydroxide → Sodium Nitrate + Water

HNO_3 + $NaOH$ → _______ + _______

17) Nitric Acid + Zinc Hydroxide → _______ + _______

HNO_3 + $Zn(OH)_2$ → _______ + _______

18) Sulphuric Acid + Calcium Hydroxide → _______ + _______

H_2SO_4 + $Ca(OH)_2$ → _______ + _______

19) Hydrochloric Acid + Calcium Hydroxide → _______ + _______

HCl + $Ca(OH)_2$ → _______ + _______

20) Sulphuric Acid + Ammonium Hydroxide → _______ + _______

H_2SO_4 + NH_4OH → _______ + _______

Kahoot 10

1. The substances which react with acids to form salt and water are known as_____
   a. acids
   b. bases
   c. salts
   d. indicators
2. Which of the following is a neutral solution but not salt solution?
   a. Sodium chloride
   b. Sodium sulfate
   c. Potassium nitrate
   d. Starch solution
3. When litmus paper touches acidic salts, then the color of litmus paper change from______color to_______ color
   a. orange, yellow
   b. blue, red
   c. red, blue
   d. yellow, orange
4. Which of the following best captures the concept of neutralization?
   a. acid + base ⟶ neutral solution
   b. acid + base ⟶ salt + water
   c. acid + base ⟶ basic solution
   d. acid + base ⟶ acidic solution
5. Complete the following reaction below
   $HCl + NaOH \rightarrow$ _______ + _______
   a. $NaCl$ and H_2
   b. $NaCl_2$ and H_2
   c. $NaCl_2$ and H_2O
   d. $NaCl$ and H_2O

Answer key 10

Activity sheet 10.1: list of the important salt and their uses;

Name of salts	Uses
Sodium Chloride or common salt **($NaCl$)**	1. Used for both cooking food and cooking gas. 2. Used to cure meat and fish and as a preservative in pickles. 3. Employed in the production of soap. 4. Employed in frigid countries to melt the ice during the winter. 5. Used in the production of chemicals like baking soda and washing soda.
Sodium Hydroxide ($NaOH$)	1. Employed to create soap and detergent 2. Used to create synthetic textile fiber (rayon) 3. Used in paper production 4. Used to clean bauxite ore 5. Used to make bleaches and colors, as well as to refine oil and degrease metals
Sodium Carbonate or Washing Soda ($Na_2CO_3.10H_2O$)	1. Employed as a cleaning agent 2. Used to remove water's enduring hardness 3. Used in the production of paper, soap, and glass
Baking Soda or Sodium bicarbonate ($NaHCO_3$)	1. Used as a balancing substance (antacid) 2. Used to make baking powder 3. Applied to extinguishers during fires
Bleaching Powder or Calcium Hypochlorite	1. Used as a bleaching agent for cotton, linen, and wood pulp, respectively, in the cotton business and the paper sector 2. Applies to water purification. 3. Used to produce chloroform ($CHCl_3$) 4. Used to prevent wool from shrinking
Plaster of Paris or Hemihydrate Calcium sulphate ($CaSO_4$ 1/2 H_2O)	1. Applied in medical facilities to set broken bones 2. Used to make toys, cheap ornamental material for decorations, or chalk. 3. Applied to materials that are fireproof. 4. Employed to smooth surfaces.

Activity sheet 10.2

Classifying salts

Salts that turn red litmus into blue are acidic salts, and those that turn blue litmus into red are basic salts. Red or blue litmus tests are unaffected by some salts. They are known as neutral salts.

The following table give the information about the acidic salts, basic salts, and neutral salts.

Acidic salts	Basic salts	Neutral salts
Aluminum chloride ($AlCl_3$)	Copper carbonate ($CuCO_3$)	Sodium chloride (NaCl)
Ammonium chloride (NH_4Cl)	Trisodium phosphate (Na_3PO_4)	Sodium sulfate (Na_2PO_4)
Ammonium sulfate ($(NH_4)_2SO_4$)	Caustic soda or sodium hydroxide (NaOH)	Potassium nitrate (HNO_3)
Sodium bisulphate ($NaHSO_4$)	Sodium acetate (CH_3COONa)	Sodium nitrate ($NaNO_3$)
Sodium bicarbonate ($NaHCO_3$)	Calcium acetate ($(CH_3COO)_2Ca$	Barium chloride ($BaCl_2$)
Magnesium hydrogen carbonate ($Mg(HCO_3)_2$		Potassium chloride (KCl)

Kahoot

1. b (Explain: in the process of neutralization, both acids and bases are mixed in define proportions produce salt and water.)
2. d (Explain: Sugar or starch solutions are neutral solutions, but they are not salt solutions, nor are any other neutral solutions.)
3. b (Explain: Salts that turn red litmus into blue are basic salts, while salts that turn blue litmus into red are acidic salts.)
4. b (Explain: It is called a neutralization reaction when an acid and a base combine to form salt and water.)

Authentic assessment of lesson 10: Salts

Authentic assessments
Activity sheet 10.1 form
Activity sheet 10.2 report of experiment and presentation
Activity sheet 10.3 form
Kahoot 10

Rubric of assessment for observing

Student's name: __________________Section______________ Score ___________

Direction: Use this rubric to evaluation a student's observing skill. Assign a score to student for each section.

Skill	Criteria				
	5	4	3	2	1
Observing	Uses appropriate senses to describe objects, events, and/or experiment that are accurate in items step by step correctly.	Uses appropriate senses to accurately describe objects, events, and/or experiment step by step.	Uses appropriate senses to accurately describe objects, events, and/or experiment but not completely.	Limited to describe objects, events, and/or experime nt	Unable to describe objects, events, and/or experiment

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………../…………./……

Rubric of assessment for measuring

Student's name: ____________________Section___________________ Score __________

Direction: Use this rubric to evaluation a student's measuring skill. Assign a score to student for each section.

Skill	Criteria				
	5	4	3	2	1
Measuring	Chooses and uses appropriate tools/unit measurements are specific, accurate, and supported by evidence.	Choose and uses measuring tools/units correctly.	Choose and use the correct measuring tools/units but not completely	Choose and use measuring tools/units most incorrect.	Unable to choose and/or use measuring tools/units.

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

…………………………………

Date………./…………./……

Rubric of assessment for classifying

Student's name: ____________________Section____________ Score _____________

Direction: Assign a score to student's classifying skill for each section.

Skill	Criteria				
	5	4	3	2	1
Classifying	Separate or classer what's study interest that conform to the criteria used correctly and completely	Separate or classer what's study interest that conform to most of the criteria used	Separate or classer what's study interest that conform to some of the criteria used	Separate or classer what's study interest that is not conform to some of the criteria used.	Unable to sorting, grouping, and/or arranging based similarities and difference.

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………../…………./……

Rubric of assessment for predicting

Student's name: ______________________ **Section**__________ **Score** __________

Direction: Assign a score to student's predicting skill for each section.

Skill	Criteria				
	5	4	3	2	1
Predicting	Use previous data to predict what might be happen as correctly.	Use previous data to predict what might be happen	Use previous data to predict what might be happen but not completely.	Use previous data to predict what might be happen but some are incorrect.	Unable use previous data to predict what might be happen

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Assessment's signature

………………………………

Date………./…………./……

Rubric of assessment for Communicating

Student's name: ______________________ Section______________ Score ___________

Direction: Use this rubric to evaluation a student's communicating skill. For each area, give the student a grade. Next, tally together all of the student scores for each section, and divide that total by the number of students to get the sample mean for each section. Less desirable results point to areas where pupils need to develop..

Skill	Criteria				
	5	4	3	2	1
Communicating	Describes objects and/or events using a variety of methods, expanding on details clearly (orally, pictorially, and/or written)	Describes objects and/or events using a variety of methods, expanding on details (orally, pictorially, and/or written)	Describes objects and/or events using a variety of methods (orally, pictorially, and/or written)	Describes objects and/or events limited	Unable record or describe observations

Quality Criteria

Scores	Criteria
5	Excellent
4	Very good
3	Good
2	Fairly
1	Poor

Teacher's signature

…………………………………

Date………./…………./……….

Student's basic science process skill assessment list

Direction: The teacher/instructors put the total scores of student's science process skill assessments in the column items.

No	Student's name	Sex	Observing	Measuring	Classifying	Predicting	Communicating	Total scores
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Science Process Skill Test (unit4)

<u>Duration: 50min</u>

Student's name: ________________Section________________Score_____________

This is a test on the Science Basic Process Skills.

A. Observing:

Directions: Collect the following solutions from the household items such as lemon, water, apple, pineapple, banana, baking soda, orange juice, egg, and hand soap. What change in color did you observe with red litmus and blue litmus for each of the solutions taken?

Solution of baking soda

Solution of orange juice

Solution of hand soap

Solution of banana

<u>Result</u>

No	Sample solution	Red litmus solution	Blue litmus solution
1	Baking soda		
2	Orange juice		
3	Hand soap		
4	Banana		

B. Measuring

Directions: calculate the following.

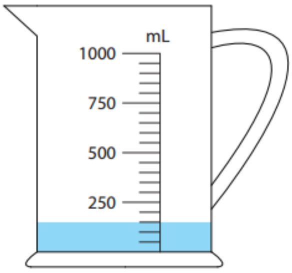
1. How many moles of hydrochloric acid (HCl) are present in 0.085 l of a 3 M solution?

....
....
....
....
....
....

2. Dissolving 20g of salt into 75g of water. Calculation mass of solution?

....
....
....
....
....

3. If you add 700 ml of water to each jug, what would the new reading be?



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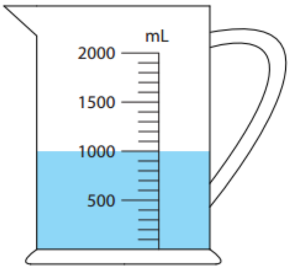
4. If you add 300 ml of water to each jug, what would the new reading be?



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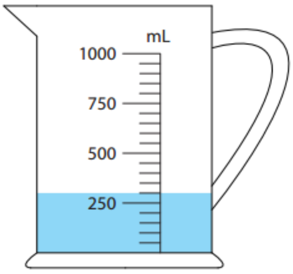
5. If you add 800 ml of water to each jug, what would the new reading be?



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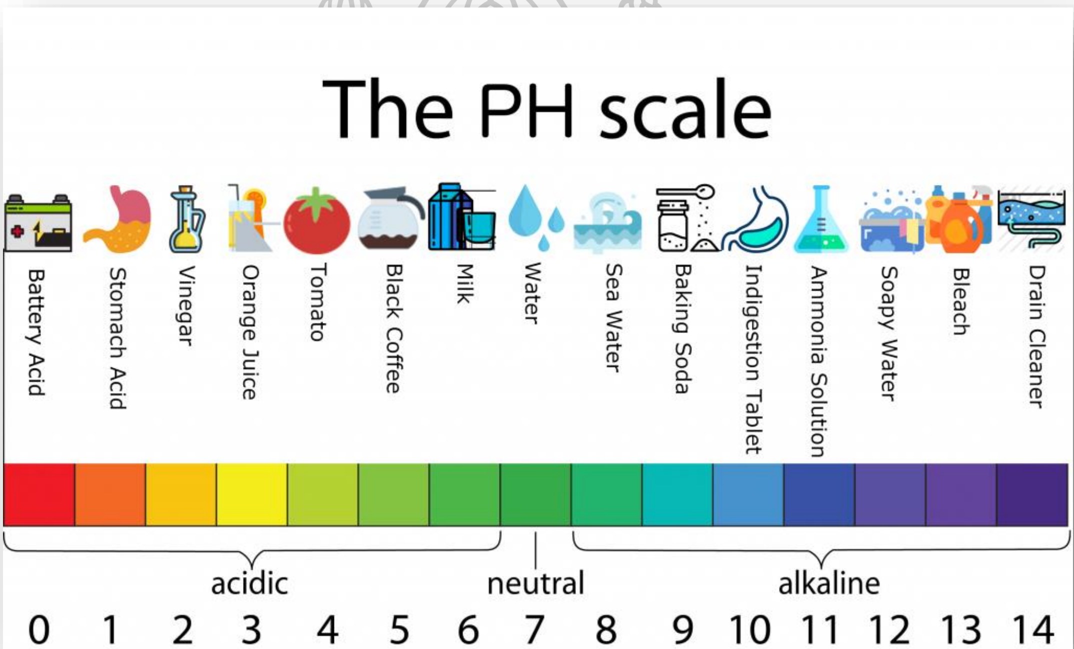
C. Classifying

Directions: classify the pH scale by write down the name illustrate on the table below;



Acid	Base	Neutral
………………………………………	………………………………………	………………………………………
………………………………………	………………………………………	………………………………………
………………………………………	………………………………………	………………………………………
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D. Predicting

Directions: Complete the following equations in both words and formular:

1) Hydrochloric Acid + Sodium Hydroxide → Sodium Chloride + Water

HCl + NaOH → _______ + _______

2) Nitric Acid + Sodium Hydroxide → Sodium Nitrate + Water

HNO_3 + NaOH → _______ + _______

3) Nitric Acid + Zinc Hydroxide →_______ + _______

HNO_3 + $Zn(OH)_2$ → _______ + _______

4) Hydrochloric Acid + Calcium Hydroxide → _______ + _______

HCl + $Ca(OH)_2$ →_______ + _______

5) Sulphuric Acid + Ammonium Hydroxide →_______ + _______

H_2SO_4 + NH_4OH → _______ + _______

E. Communicating

Directions: For each solution below, identify the solute and solvent


Chocolate milk


Salt water


Carbonated water


Sweet tea

Solution	Solute	Solvent
Chocolate milk		
Salt water		
Carbonated water		
Sweet tea		

Table of specification for science basic process skill test

Skill	Objective	Number of items	Item placement
Observing	Identify change in color did you observe with red litmus and blue litmus for each of the solutions taken	5	A1-5
Measuring	Calculate the following.	5	B1-5
Classifying	Classify the pH scale by write down the name illustrate on the table.	5	C1-5
Predicting	Complete the following equations in both words and formular.	5	D1-5
Communicating	Choose the correct prediction from the given situation.	5	E1-5

Achievement Test (Post- test)

(Duration: 50 min)

Student’s name or ID: ____________________Section _________Score_____/100___

Directions: carefully read and respond to each question. Please mark the right response with a circle. Don't leave any questions unanswered. There are 25 questionnaires. All the question as deductive (1question 2points)

1. Which chemical is used in swimming pools?
   a. F
   b. Cl
   c. Zn
   d. Pb
2. What element has a mass number of 19 protons, 19 electrons, and 20 neutrons?
   a. 19
   b. 39
   c. 20
   d. 58
3. Which is an element having in the shells and bones?
   a. Calcium
   b. Iron
   c. Aluminum
   d. Platinum
4. Which is an element having in the lights and signs?
   a. Potassium
   b. Neon
   c. Iron
   d. Hydrogen
5. Which the element chemical use in balloons?
   a. F
   b. Cl
   c. B
   d. Pb
6. Which of the following is physical change?
   a. Your bicycle rusts when left outside in the rain.
   b. Burning coal for a barbecue
   c. A marshmallow is toasted over a campfire
   d. A sugar cube dissolves

7. What's ingredients should be use in toothpaste to prevent tooth decay?
   a. Neon
   b. Iron
   c. Fluoride
   d. Aluminum
8. When a person wearing glasses comes inside from the cold of the outside into a warm environment, their glasses fog up because of;
   a. melting then boiling
   b. freezing then thawing
   c. vaporization then condensation
   d. condensation then vaporization
9. What happens when baking soda combined with vinegar?
   a. Possible answer may include formation of bubbles, balloon inflates rapidly.
   b. Possible answers may include that there is no reaction, balloon does not inflate.
   c. Possible answers may include formation of bubbles, balloons inflate very slowly.
   d. Possible answers may include formation of small bubbles, balloon inflates very slowly.
10. Which of the following as being false?
    a. A physical change is one that affects size or shape.
    b. A chemical transformation entails the formation of a new material with novel properties.
    c. When platinum is heated and then brought back to its initial temperature, we refer to this as a physical change.
    d. Since a change in the smell doesn't necessarily signify a chemical change, milk turning sour is a physical change.
11. The pH of human urine is
    a. 3-5
    b. 7-9
    c. 5-7
    d. 9-10
12. How will you separate the following of mustard seeds and common salt?
    a. sieving
    b. hand picking

c. hand storing

d. filtration

13. Of the following, which is heterogeneous matter?

a. Muddy water

b. Salt water

c. Orange juice

d. All of these

14. The equation provided depicts the interaction between vinegar (acetic acid) and baking soda (sodium bicarbonate). Which of the following chemical equations as product?

a. Sodium bicarbonate + acetic acid → Carbon dioxide

b. Sodium bicarbonate + acetic acid → Water

c. Sodium bicarbonate + acetic acid → Carbon oxide + Water

d. Sodium bicarbonate + acetic acid → Carbon dioxide + Water

15. Identify the reactant of this reaction: sodium bicarbonate + acetic acid → Carbon dioxide + water

a. Sodium bicarbonate and acetic acid

b. Carbon dioxide and water

c. Acetic acid

d. Carbon dioxide

16. Dissolving 28g of sugar into 100g of water. Calculation mass of solution.

a. 128g

b. 72g

c. 0.28

d. 3.57g

17. Identify X of this reaction: $C_3H_8 + 5O_2 \rightarrow 3CO_2 + x\ H_2O$.

a. 3

b. 4

c. 5

d. 6

18. Identify X of this reaction: $FeCl_3 + 3NaOH \rightarrow Fe\ (OH)_3 + x\ NaCl$.

a. 3

b. 4

c. 5

d. 6

19. Which of the following is a neutral solution but not salt solution?

a. Sodium chloride

b. Sodium sulfate
c. Potassium nitrate
d. Starch solution

20. The solution 10g of salt and 90g of water, how many percent of concentration?
 a. 5%
 b. 10%
 c. 20%
 d. 35%
21. In 0.75 l of solution, there are 0.42 moles of solution. Determine the solution's molarity.
 a. 0.56M
 b. 0.40M
 c. 2M
 d. 1.5M
22. Calculate concentration if 0.025 moles of HCl are present in 0.05 l.
 a. 0.5 mol/l
 b. 0.4 mol/l
 c. 0.3 mol/l
 d. 0.2 mol/l
23. What's the farmers put in the soil to neutralize acid?
 a. $Ca(NO_3)_2$
 b. Ca
 c. $CaCl_2$
 d. $Ca(OH)_2$
24. Acids react with certain substances to produce salt and water, which are referred to as _____
 a. Acids
 b. Bases
 c. Salts
 d. Indicators
25. Which substance is salt?
 a. $ZnCl_2$
 b. CO_2
 c. $Mg(OH)_2$
 d. Ca

Key answers

Questionnaire	Answer	Bloom's taxonomy
1	b	Understand
2	b	Understand
3	a	Understand
4	b	Understand
5	c	Understand
6	d	Understand
7	c	Understand
8	b	Understand
9	a	Understand
10	d	Understand
11	c	Remember
12	a	Understand
13	a	Understand
14	d	Understand
15	a	Understand
16	a	Understand
17	b	Understand
18	a	Understand
19	d	Remember
20	b	Understand
21	a	Understand
22	a	Understand
23	d	Remember
24	b	Understand
25	a	Remember

Bibliography

Name: Miss. TEL TAILOS

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Education: 2018 – 2020 getting a scholarship to study master degree of curriculum and instruction at Silpakorn University under the high royalty of the Princess of Thailand.

2016-2018 working as the accounting office at Polytechnic Institute of Banteay Meanchey province, Cambodia.

2014-2015 a teacher technique Training at National Technical Training Institute (NTTI), Cambodia

2010-2014 Bachelor Degree of Chemistry at Royal University of Phnom Penh (RUPP) under the scholarship of Enfants du Mékong.

VITA

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