

Supporting information

## Project-based Teaching in Organic Chemistry through Blended Learning Model to Develop Self- study Capacity of High School Students in Vietnam

**Table S1.** Criteria and level of assessment of students' self-study competency in project teaching according to the blended learning model.

Tiêu chí	Level		
	Level 1 (1,0 points)	Level 2 (2,0 points)	Level 3 (3,0 points)
1. Setting learning goals	The student set goals and identified research problems for the project, but these goals and research problems were not reasonable and unclear	The students set goals and identified the project's problems logically, clearly but incompletely	The students set goals and identified the project's problems logically, clearly, and completely
2. Identifying what is known to be relevant to the learning objective	The student had not identified or clearly identified what is known to be relevant to the project	The student clearly identified a part of things that were known to be relevant to the project	The students clearly and fully identified what is known related to the project
3. Determining the means and ways of performing the learning tasks.	The student identified the means and ways of performing the learning tasks but these means and ways were not suitable.	The student identified appropriate means and ways of performing certain tasks.	The student identified appropriate means and ways of performing all tasks
4. Scheduling the implementation time and predicting achieved results.	The timetable was set up, but it was not clear or reasonable. The student had not yet predicted achieved results in the project.	The student created a clear and reasonable timetable and predicted some of the project's results.	The student created a clear, reasonable timetable or regularly adjusted to reasonable and predicted achieved results of all tasks in the project.
5. Collecting information	The student collected information for the project via the Internet and other sources, but this information was inaccurate or appropriate.	The student collected information for the project via the Internet and other sources. This information was	The student collected information for the project via the Internet and other sources. This information was accurate, relevant, and complete

		accurate, relevant but incomplete.	
6. Processing received information and solving learning problems.	The student did not know how to process received information or process it, but not accurate. The student has not yet concluded the problem of the project.	The student processed some information accurately and scientifically. The student drew appropriate but incomplete conclusions for the project's problems.	The student processed some information accurately and scientifically. The student drew completely appropriate conclusions for the project's problems
7. Cooperating with teachers and other classmates.	The student was not active, did not often cooperate with teachers and classmates to support or seek support.	The student actively cooperated with teachers and classmates to support/seek support, but it was not very effective.	The student actively cooperated with teachers and classmates to effectively support/seek support.
8. Presenting and defending learning outcomes.	The student presented the results of the project without logic and clarity. The student has not answered the questions or problems posed for the project.	The student presented project results logically, clearly but not creatively. The student could answer some questions or problems posed for the project.	The student presented products logically, clearly, and creatively. The student thoroughly answered the questions or problems posed for the project.
9. Assessing learning outcomes.	The student assessed the obtained results from the project but not objectively, precisely. The student had not shown evidence to demonstrate the level of achievement of the goal.	The student assessed the obtained results from the project objectively, precisely. The student pointed out some evidence that proves the level of achievement but was not very appropriate.	The student objectively and accurately evaluated the obtained results from the project. The student could show enough appropriate evidence to demonstrate the level of achievement, build a project profile.
10. Learning from experience and adjusting	The student mentioned some limitations and errors, but the student had not found solutions to overcome	The student mentioned most of the limitations and errors. The student found a solution, but it was not suitable.	The student fully stated the limitations and errors; the student found appropriate measures to overcome those limitations and errors.

**Table S2.** KWL diagram of a student participating in the experiment.

Project title: Great use of vinegar.		
K	W	L
What you already know related to the project topic	Problems to be solved of the selected project topic	What you learn after the project)
<ul style="list-style-type: none"> <li>- Vinegar is used in the preparation of dishes and dipping sauces.</li> <li>- Vinegar contains acetic acid.</li> <li>- Vinegar is a white, sour taste.</li> <li>- Vinegar is made from the fermentation of ethyl alcohol.</li> </ul>	<ul style="list-style-type: none"> <li>- What is the composition of vinegar? What gives vinegar the sour taste?</li> <li>- What uses does vinegar have in food, and what benefits does it bring to human health?</li> <li>- What are the ingredients and the process of making vinegar according to the traditional method?</li> <li>- What is fake vinegar? What harm does using fake vinegar cause to human health? How to distinguish between rice vinegar and fake vinegar?</li> <li>- What other uses does vinegar have in life?</li> </ul>	
What did you do well in the project? What did you do not doing well? How to fix it?.....		

**Table S3.** Project implementation plan of a group of students participating in the experiment.

Group 1- topic: Making yogurt at home.					
Objective: Make yogurt at home and introduce the product in front of the class.					
Problems to be solved:					
TT	Task	Means and how to proceed	Time	Expected products	Performer
1	Study the nutrition compositions and benefits of yogurt.	Find information in books and the Internet, save the search address. Find information from marketed yogurt products.	12-15/5/2020	- Text and illustrations.	Thanh Dat, Anh Hao

2	Study about the fermentation mechanism and the chemical reactions that occur in the yogurt making	Find information in books and the Internet, save the search address.	12-15/5/2020	- Texts and illustrations	Tung Lam, Nhat Anh
3	Study the ingredients, process, and notes when making yogurt.	Find information in books and the Internet, save the search address.	12-15/5/2020	- Texts and illustrations	Ngoc Sang, My Phuong
4	Learn how to preserve homemade yogurt.	Find information in books and the Internet, save the search address.	12-15/5/2020	- Texts and illustrations	Huu Loc, Minh Tam
5	Making yogurt at home	Prepare ingredients, tools and proceed to make yogurt.	17/5/2020 at Ngoc Sang's home	- Yoghurt	Group
6	Prepare a presentation of homemade yogurt products.	Laptop, papers, pens.	17/5/2020 at Ngoc Sang's home	- Plan (3-5 phút).	Group

Table S4. Criteria for evaluating project products.

Evaluation Criteria	Levels of evaluation criteria			Points achieved
	Level 1 (1,0 points)	Level 2 (2,0 points)	Level 3 (3,0 points)	
<b>1. Scientific content</b>				
1. Project goals and problems to be solved	Shown not clearly and reasonably project's goals and problems to be solved.	Shown clearly and reasonably goals and problems to be solved but not full	Shown clearly, reasonably, and fully the goals and problems to be solved.	
2. Collect information for the project.	Collect information that is not accurate, not relevant for the problem to be solved. There is not a clear source citation.	Collect information that is accurate, relevant to the problem to be solved, but incomplete. There is a clear source citation.	Collect information that is accurate, relevant and complete to solve project problems. There is a clear source citation.	
3. Process information and draw conclusions for the project.	Unprocessed or incorrectly processed information, not draw logical conclusions to the project's problems.	Process accurately, scientifically some information; draw some reasonable conclusions to the project's problems but are not complete.	Process information accurately, scientifically, draw reasonable and complete conclusions for the project's problems.	
<b>2. Present products</b>				

4. Layout	The layout is not clear, not logical; the main content has not been clarified.	The layout is clear and logical, but the main content is not highlighted	The layout is clear, logical; the main content is prominent, easy to follow.	
5. The form and language used to present the product	The presentation is not beautiful; the colors are not harmonious, the illustrations are not suitable. The language is confusing and inaccurate.	Beautiful presentation, harmonious colors, appropriate illustrations. Expressive language is not very accurate.	Beautiful presentation, harmonious colors, suitable vivid images. The language is accurate and scientific.	
6. Product report	The reported idea is familiar; the content is sketchy, the expression is not fluent.	New report ideas. Expression is relatively fluent, attractive to listeners.	Unique, creative report ideas. Expressing fluently, confidently, creating excitement for listeners.	
7. Collaboration in product reporting	There is no coordination among team members when reporting products	There is coordination among team members but not effective.	There is effective and close coordination among team members but not effective.	
8. Answer related questions	Answer incorrect questions related to the project.	Answer correctly and clearly to a few related questions.	Answer accurately, clearly, fully to all related questions.	