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Types of Resources for Blended Learning Approach to Study High School Chemistry †

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Abstract: Blended learning is one of the 21st-century teaching and learning approaches used in classrooms. Many scholars have positively affected students' performances or motivation in their research on blended learning in school. The application of blended learning in the school requires an educator to prepare suitable resources to suit the subject content and the ambiguity of learners. The best practice is to utilize the resources proven to be effectively applied in blended learning, considering the subject content. Currently, no studies are conducted to review the resources an educator uses to teach high school chemistry. For these reasons, this study will address the types of resources used for blended learning in high school chemistry, its characteristics deemed suitable, and the effectiveness of blended learning in using these resources reported by the researchers.

Keywords: blended learning; chemistry; high school

1. Introduction

Blended learning is a 21st-century learning approach that is a combination of online and physical classes. The students learn by using technology, where more students control the pace of studying. In a traditional classroom, students try to understand what the teacher is saying, and students may need time to understand the subject being taught. When the students take longer to understand what is being taught, they might be left behind, as the first concept has not been understood. While in blended classroom learning, the teachers will try to detect errors in thinking, writing, reading, and listening. At the same time, they cooperate with the social constructivist theory by Vygotsky. The students learn from each other, which can promote active learning and help each other. The benefits of blended learning are that it saves time and resources, such as videos being reusable, so the teacher does not have to create resources repeatedly. Minor updates can be conducted in stages after the recording is done, and the students are in control of their learning processes. This benefits a myriad of learners, as not all students study at the same pace. Students can replay the lessons according to their studying methods. Blended learning allows students to clear misconceptions in class while studying at home.

Teachers can build a better student and teacher relationship; teachers are more focused on the students at the same time while fostering critical thinking skills. Since the students will watch the recorded class lesson as homework, the teacher may focus on individual students. Many scholars suggest that the positive outcome of a blended learning approach is aiding students' difficulty in learning chemistry. The abstractness of chemical concepts, teacher-imposed learning models, and lack of teacher support are why students find studying chemistry problematic [1,2]. The challenging factor of blended learning is combining the online and physical lessons run by teachers in classrooms [3].

For this reason, a guided approach toward implementing blended learning will be fruitful. Blended learning combines the right technologies in lessons and develops a feasible teaching and learning environment. Well-prepared teachers can create a successful

blended learning classroom [4]. By understanding blended learning, teachers will know how to choose suitable materials for the school [5]. Blended learning gives flexibility. Some variations include personalized learning, social interaction, and direct content learning in the school. In this research, reviewing the myriad of resources reported by different scholars in the past ten years will help teachers choose the best resource for blended learning in high school teaching and learning chemistry. This study investigates nine papers published in the *Scopus Journal* after filtering 28 articles from 2018 to 2021.

2. Methodology

2.1. Resource

The purpose of this research is to investigate the published papers obtained from the Scopus database from 2008 to 2021 by implementing a filtration search using keywords "blended" and "learning", "chemistry", and "high school". Thirty-seven papers in Scopus were suitable for this study. Twenty-two articles were non-related documents unrelated to chemistry and did not involve high school students, six were non-available pieces, and only eight were used in this research. Figure 1 displays the fundamental steps of searching using the Scopus database searching steps.
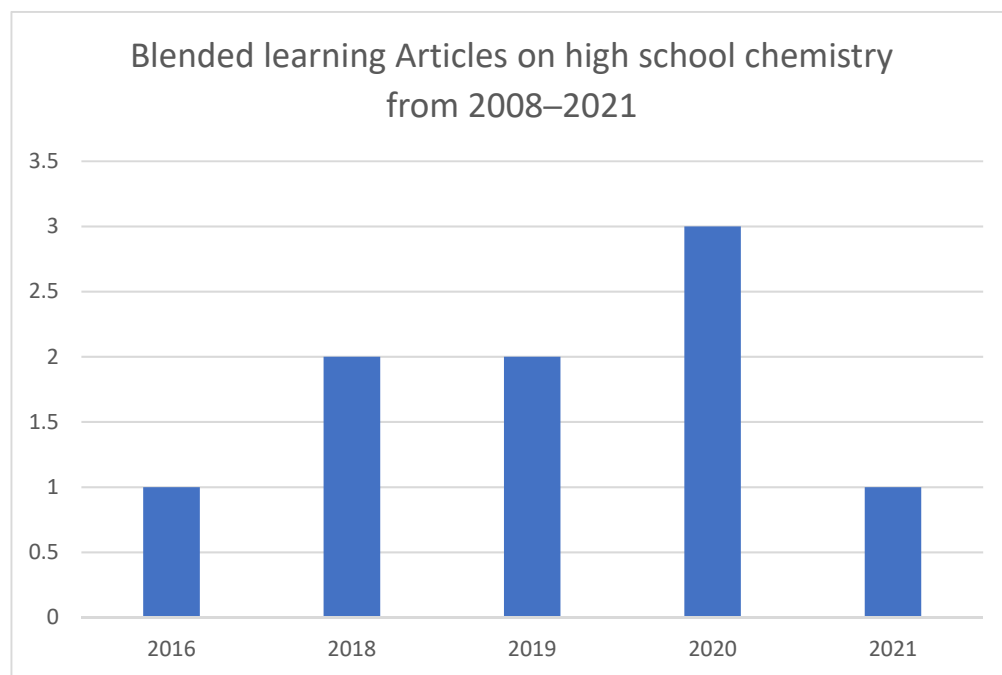

Figure 1. Blended learning articles on high school chemistry from 2018 to 2021.

2.2. Data Distribution

Based on the analysis of the search results, this research paper on blended learning resources in high school chemistry from 2008 to 2021 was analyzed based on the topic, resources, method of teaching, samples of findings, and country of origin. Five articles were published every two years, from 2016 to 2021. Before 2016, there was no research contribution to the literature on blended learning resources in chemistry. Since 2016, researchers have been keen to investigate the research topic of blended learning, with two papers published every two years. There were more papers published at the beginning of 2020. In addition, there was one piece published in 2016. In 2018 and 2019, two papers were published and peaked to reach the topmost publication number of three articles in 2020. After peaking at three articles, the Figure 2 dropped to one document in 2021. The number of publications' dramatic growth was in 2020, with three pieces.
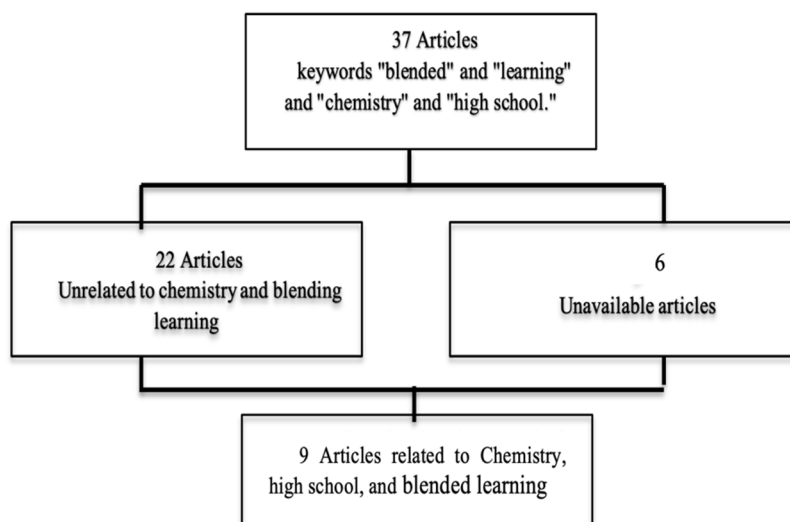
Figure 2. The fundamental steps of searching using Scopus.

3. Results

From 2008 to 2013, the topic of interest was oxygen preparation experiments, formation of hydrogen bonds and titration, redox reaction, and thermochemistry. Apart from that, there were hydrocarbon, salt, mole, and learning of organic chemistry. All these topics were the topics taught in high school chemistry. The methods of teaching are divided into experimental teaching, inquiry-based learning, self-developed four-dimensional model, modules, gamification, offline and traditional, followed by online learning.

3.1. Experimental Teaching

Based on the research from China and the United States, using experimental learning suggests using virtual and real experiments, as both approaches complement each other. Both types of research indicate the effectiveness of combining learning activities that can improve students' conceptual ideas [6,7].

3.2. Gamification

Research shows that using gamification in the teaching and learning of hydrocarbon is only effective when combined with android-based games and blended learning, compared to android games alone [8]. Based on the research, educational games with hands-on laboratory experiments will coherently explain scientific phenomena together with authentic scientific inquiry [9].

3.3. Learning Management System (LMS)

The use of modules by scholars in blended learning to teach thermochemistry using LMS [10]. The use of LMS attracted the student's attention to chemistry and improved their metacognition skills. LMS provides the resources for education to prepare more creative material for blended learning. In Malaysia, further support for LMS and its composite learning resources has improved students' understanding [11].

3.4. Video, Self-Developed Device, Assigned Task

Research from the United States found that using video for blended learning could improve students' understanding of studying chemistry [12]. The self-developed device from Indonesia suggested that blended learning promotes critical thinking [13]. A study from Vietnam presented the assigned task used in project-based learning and further proposed the need to investigate the other learning conditions appropriate before incorporating blended learning [14].

4. Limitation

This research is only limited from 2008 to 2013, and the articles searched were limited to chemistry in high school and blended learning. The article searches were limited to only using the *Scopus Index* journal. There should be further research on more resources related to blended learning, as it is a 21st-century classroom approach.

5. Conclusions

Blended learning resources are similarly served by or available through a system, especially a computer or telecommunications system (such as the internet). The resources used in high school chemistry include video games, modules, learning materials in LMS, and virtual experiments. Two studies state that the use of virtual experiments as resources for blended learning involves experiments accompanied by actual experiments. Scholars have noted that blended learning resources will be more effective if not limited to one type of resource and can always be a string of resources or materials, including assessment.

Blended learning has increased students' understanding, achievements, motivation, metacognitive, and critical thinking skills. Blended learning is more prevalent in the current decade because it contributes to 21st-century learning skills. Chemistry is one of the STEM subjects that require the understanding of many abstract concepts and needs an educator, particularly those teaching high school chemistry, to be creative in their teaching methods to foster interest in learning among the students before moving to the more complex part of the subjects in higher education.

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