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Digital Visual Grammar Concept Map Facilitated EFL Holistic Grammar Comprehension

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Abstract

Form-focused deductive grammar learning approach is an effective way to facilitate language learners to memorize atomistic grammatical rules. However, beyond retaining isolated grammar rules, learners can benefit from using web based concept map, a visualized utility, to overlap grammar rules and achieve holistic comprehension. Therefore, this research looks into detail (total nodes, depth, and breadth) of how visual grammar concept map affects student's examination score and aims to assist students to gain a holistic visual grammar learning through utilizing an online concept map software (CoCoing.info). One hundred and thirty-two college students were involved in this study for 18 weeks. The quantitative results revealed that students who created a more developed and holistic visual grammar concept map gained a better understanding of the grammatical rules. This was however not true for low achieving students. Therefore, more detailed analysis showed students with deeper depth and wider breadth achieved higher score. However, the high achieving students and low achieving students' comparison study indicated that the depth of the visual grammar concept map is harder for students to construct and is a better indicator of achievement compared to breadth. The findings show that visual grammar concept map can facilitate traditional form-focused classroom.

Keywords: *improving classroom teaching; pedagogy issues; English as a foreign language; teaching/learning strategies; English grammar learning.*

INTRODUCTION

Before addressing how constructing visual grammar concept map is beneficial for students and teachers, and closes the gap from atomistic learning to holistic learning, clearly identifying the importance of ELF grammar learning and previous/current methods of grammar instruction is necessary. Whilst learning a language, grammar is an essential component. Even with the use of technology in a language classroom, four strands of language learning can be categorized into meaning-focused input, meaning-focused output, language-focused learning,

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and fluency development (Nation & Newton, 2009). Other than recognizing that grammar is a rudimentary part of a language, there are many benefits in learning grammar or being more proficient in grammar (Al-khresheh & Orak, 2021). According to Rutherford (2014), it is possible to expect that one of the main benefits of learning English grammar is to have the ability to connect the relationship between vocabulary words to the sentence—forming meaning; therefore, allowing the second language (L2) learner to produce English in a semantically correct and coherent discourse. Perhaps, for novice L2 English learners, it seems more important to simply generate grammatically accurate sentences; however, for expert L2 learners or even native English speakers, having grammatical accuracy would be beneficial in conveying his/her thought without any ambiguity (Richards & Rodgers, 2014; Al-khresheh & Orak, 2021). Hence, whether it is an advanced or novice English as a foreign language (EFL) or English as a second language (ESL) learner, the connection of words and sentences, and utilizing it in any given environment is essential.

Aforementioned, grammar learning can bring benefits to L2 learners, it is important for educators to understand the methods of grammar instruction. As defined by Ellis (2006), "*Grammar Teaching* involves any instructional technique that draws learners' attention to some specific grammatical form in such a way that it helps them either to understand it metalinguistically and/or process it in comprehension and/or production so that they can internalize it" (p. 84). Ellis (2006) lists out a few common grammar pedagogies, but in grammar learning, two main approaches are worth mentioning—the deductive approach and inductive approach. Under the deductive and inductive approach, there are many methods of instruction such as grammar translation, direct method, task-based instruction, etc. (Larsen-Freeman & Anderson, 2013; Cortez & Genisan, 2021). Shaffer (1989) points out that students who learn English grammar through the deductive approach are unable to find the connection between the grammatical rules learned and actual usage (p. 396). This could be because the deductive approach teaches English grammatical rules through the atomistic ideology rather than the holistic. Hence, it is worth exploring an interactive approach with a mixture of deductive and inductive instruction as the primary goal, but focusing on holistic instruction through the construct of web based visual grammar concept map learning.

The method of learning through visual English grammar learning allows students to fill in the gap between the deductive and inductive approach by visually realizing how grammatical rules can be/are related to each other and what roles the grammatical rules play in a sentence. Visual grammar learning approach is significant for English language learners to achieve holistic grammar understanding. Therefore, the aim of this study is to understand whether drawing visual grammar concept maps allow students to have a better understanding of the relationship between grammatical rules. We believe the visualization of English grammatical rules could enhance retention and holistic understanding. In a broader sense, could visual grammar concept map be a good supplement to English grammar education? Therefore, two studies were conducted to answer the following research questions:

1. What is the correlation between detailed visual grammar concept map construction and form-focused deductive grammar examination score?
2. Is there a difference in association for high achieving students (HAS) and low achieving students (LAS) when constructing visual grammar concept map?

English Grammar Learning Gap

The traditional method of learning through the presenting of grammar and completing grammar practices is simple to implement in a large classroom (often seen in Asian classrooms); however, this may not be the most beneficial method for students to apprehend English grammar (Sawir, 2005; Ur, 2012; Hedge, 2000; Hassan, Kasan, Alawawda, & Soliman, 2022). According to Thornbury (1999), grammar instruction can been seen on a

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scale of natural learning to heavy grammar instruction such as translation. Currently, many EFL learners memorize grammatical rules but struggle to make grammatically correct sentences. This could be because "L2 learners, learning grammatical rules often means learning the rules of grammar and having an intellectual knowledge" (Al-Mekhlafi & Nagaratnam, 2011, p. 70). Having intellectual knowledge of grammar does not mean that the language learner can use the language; it merely means that the learner can understand the grammatical rules. Doff (2000) suggested that understanding grammar would allow for meaningful output. Meaningful output can derive from form-focused intensive grammar instruction (Ellis, 2006; Azizpour & Alavinia, 2021; Sun & Zhang, 2021). However, L2 learners seem to have difficulties connecting the grammatical rules and real-life applications.

For language learners, the ultimate objective is to be able to use the language native like. Some achieve the language goal through acquisition while some achieve it through various learning method. For first-language (L1) learners, according to Chomsky's universal grammar theory, grammar is innate and can be acquired with ease (Sauerland & Gärtner, 2007). However, L2 learners might not share the same privilege; especially, if the L2 learner is an EFL learner—learning English where English is not the local language—compared to an ESL learner—learning English where English is the primary national language. Moreover, scholars are interested in the different types of learning/acquisition—formal or informal (Mitchell & Myles, 2004). It is important to clearly apprehend that learned language is usually the formal learning of a language, while acquisition is the informal, unstructured innateness of language. This study focuses on learning a language in a formal environment.

In the past few decades, various approaches similar to the inductive approach such as audiolingual approach (Fries, 1945) and communicative language teaching approaches (Halliday, 1973) have been advocated as an ideal method of instruction; however, the instruction method should also match the purpose of learning (Nunan, 1988), which would vary between countries. Considering how inductive instruction can affect acquisition (Fotos & Ellis, 1991; Obeidat & Alomari, 2020), the implementation of task-based instruction in a grammar course would be ideal (Skehan, 1998; Ellis, 2006; Broszkiewicz, 2011; Liu & Ren, 2021; Ellis, 2019); conversely, most grammar courses taught in Asia follow a mathematics like instruction syllabus by giving students formulas for grammatical rules. In additions, the classes are usually teacher-centered with a large class size (Wu, Lin, & Yang, 2013; Yunus, Hudriati, & Abdollah, 2020). Ergo, task-based instruction may not be an effective learning method when following a strict curriculum with pressure to pass the form-focused examinations.

Scholars argue that some form-focused grammar should still be applied in language instruction (Long, 1983; Xu & Li, 2022), but grammar should be taught only after the difficulty level is realized by the teacher's understanding of the student's levels (Shaffer, 1989). The assumption was that the teaching of the extremely easy or difficult grammar theories was not effective (Scheffler, 2009). Therefore, the pedagogical design of integrating visual grammar concept map will allow students to apprehend grammatical rules through the incorporation of a non-verbal or form-focused visual illustration of grammar rules—similar to Winitz's comprehension approach of instruction (Winitz, 1981) to look closely at the student's point of view and needs.

Concept Map in Language Learning

While audiolingual approach and communicative language teaching approach have been thoroughly discussed (Fries, 1945; Halliday, 1973; Khan, 2011; Ahmed & Alamin, 2012), we will explore an online concept map as a tool for acquiring/learning English grammar (Oluikpe, 2014). Novak and Gowing (1984) was the first to introduce concept mapping as a learning tool and it was used in various fields (Liu P.-L. , 2011; Liu C.-C. , Chen, Shih, Huang, & Liu, 2011; Machado & Carvalho, 2020). Hanf (1971) developed the notion of concept

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mapping for students to improve studying skills which lead to future studies on the usage of concept in learning. More specifically, concept map has been used in language learning (Tuan & Thuan, 2011). This study further pursues the idea of utilizing the concept map structure to allow students to visualize the association between English grammar rules in order to connect language form and meaning.

In EFL classrooms, concept map has been utilized for students to learn different areas of English. Most commonly concept map is seen to improve L2 learners' vocabulary, storytelling, reading and/or writing ability (Liu P.-L. , 2016; Andoko, Hayashi, Hirashima, & Asri, 2020; Liu C.-C. , Chen, Shih, Huang, & Liu, 2011). In addition, many courses utilize paper-based concept map, but with the advancement of technology, there are many benefits to constructing concept maps using computers (Erdogan, 2009; Chang, Sung, & Chen, 2001). However, from literature, a lack of research understanding the use of computerized concept map in grammar learning is present especially in holistic grammar comprehension. With the advantage of computerized concept map and concept map as a constructive learning (Duffy, Lowyck, & Jonassen, 1993; Machado & Carvalho, 2020), students are able to construct his/her meaning of grammatical rules into nodes and connect each node with links to generate meaning and connection between each grammatical rule. Moreover, research such as Son (2007) recommend that technology learning can also allow students to find more authentic material and become a more autonomous learner (Son, 2007). In addition, research suggests that Asian students believe technology can assist language learning and creativity which could increase motivation (Lee, Yeung, & Cheung, 2019).

Through concept map, students can be assessed in a holistic method that allows students to complete a cognitively demanding task of reorganizing grammatical rules into a visual concept map. As Canning-Wilson (1999) believes, "visuals can aid in the learning and eventually the acquiring of a second language if used properly and that visuals can serve to enhance the learning processes" (p. 10). Certainly, in an ideal course of many language teachers, grammar should be acquired in a social interaction, but due to the geographic and environmental limitations, and learning culture in Asia, the possibility of using social interaction as a tool is challenging; therefore, concept map as a supplementary tool can possibly alleviate the atomistic method of instruction and move towards a more holistic education. Rather than repetition practice to memorize grammatical rules, the concept map could provide a visual understanding of the material learned while self-realizing or organizing the rules—hoping to achieve a sense of acquisition.

METHODS

Participants

The base for participant selection is that students need to have had many years of English as a foreign language education where basic vocabulary is not a factor that might affect grammar learning. If students do not have basic vocabulary, grammar learning will not be isolated in the sense that students' attention of grammar rules might not be focused when also trying to understand the vocabulary presented in example sentences. In addition, it is clear that grammar is innate and can be naturally acquired by children (Chomsky, 1965; Carnie, 2012), but due to the environment in a non-English country, students cannot acquire English naturally at a young age. This study believes that language can still be learned at a later age with proper instruction. Therefore, we selected adolescences for our research to understand more about formal grammar learning at a later age.

The subjects sampled were students from three separate English grammar classes—including one hundred and thirty-two EFL college students in Taiwan. The sampled students participated in the research mainly to fulfill the course requirement and achieve holistic understanding of grammar. The age of the participants ranges from 18 to 24 years old with 74

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male and 58 female. The participants are mainly intermediate advanced English proficiency students who scored an average of approximately 13 out of 15 on the College Entrance English Proficiency Examination administered by the Ministry of Education in Taiwan. Moreover, the participants have been learning English for more than ten years.

Visual Grammar Concept Map Manipulation Instrument

This study employs visual grammar concept map as a visualization tool to learn English grammar rules more holistically. Visual here is defined as an illustration of learners' knowledge of the connection between various English grammatical rules through the construct of an online concept map. In the research, pictures are not considered as visuals; rather the concept mapping diagram is the visual because "text and graphics alike, in order to be informative, must be diagrams rather than images" (Amare & Manning, 2007, p. 57), and concept maps are similar to a diagram. In this study, students would link rules that are related together to have visual awareness of how each English grammatical rule is related. As mentioned, students can use pictures or color to engage more visual awareness of how atomistic rules are holistically related to each other. Through the construction of visual grammar concept map, students can see the grammatical rules holistically in a large picture. The goal is to connect atomistic rules into a holistic visual grammar concept map. Therefore, students constructed an initial holistic visual grammar concept map at the beginning of the course and continued to edit the concept map throughout the course.

The implementation of online concept map as a pedagogical supplement has to be well designed to ensure maximum efficiency; especially while applying technology. Schmid (2007) states that there are many challenges that students and teachers will face when implementing technology in a traditional classroom. Hence, it is crucial to ensure that the development of the concept map is a not a factor that could hinder student's ability to construct a well-generated visual grammar concept map. As seen in Figure 1 (the figure has been edited from the original to maximize the word clarity for displaying in this paper), using CoCoing.info (Chang, Shih, & Lu, 2018), students are able to construct a personal visual grammar concept map with clear functions. Students can add nodes with the add icon to generate depth and breadth, delete a node using the delete icon in the specified node, change the color of a specific node by selecting the change color icon to make connections between grammar rules or concept, and move a node or sections of nodes by directly selecting the node with the cursor to make modification effortlessly. Creating breadth shows the student's ability in finding the main categories of grammar while depth shows whether the students can dig deep into the rules of grammar and find the connection between each category. During the construction of the visual grammar concept map, students can categorize rules based on colors, and they can attach pictures, document, or websites. With the additional color label and extra resources, students can visualize grammar as a picture with content. Therefore, with proper preparation, form focused grammar instruction would be able to coexist with the comprehensive approach of grammar instruction.

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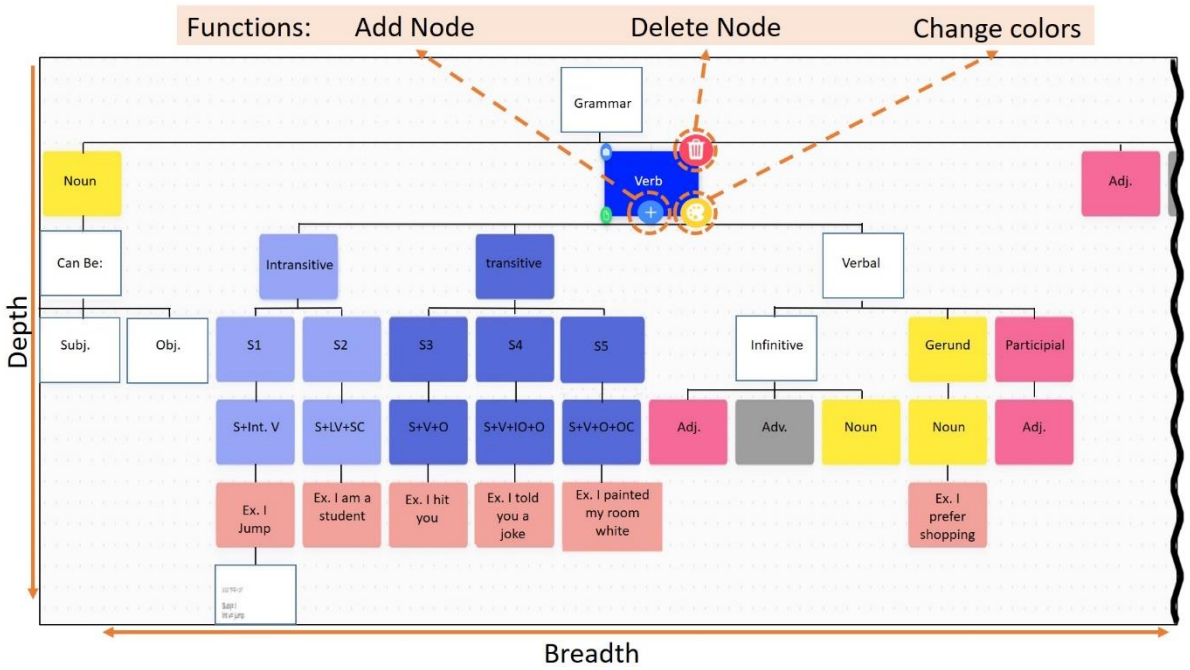
Figure 1. Visual grammar concept map sample (modified for presentation purposes)



Research Design

The construction of visual grammar concept map was part of a college level grammar class taught in a traditional grammar classroom. Figure 2 shows the stages and procedure of conducting the visual grammar concept map in class. As seen, there are three main stages in this study.

Stage 1. Prior to class, we surveyed the students' English Entrance Examination Score as proficiency level indicator and for us to ensure a good distribution of the population. Once the semester started, before constructing individual visual grammar concept maps, the instructor explained how to construct a concept map as a warm-up/pre-activity. In three class periods, the instructor modeled a concept map and allowed students to form groups and create a concept not related to grammar to ensure understanding of concept maps.

Stage 2. Students then had two weeks to construct an initial visual grammar concept map. During the semester, after a grammatical rule had been introduced and discussed, the students would modify by adding new information into his/her visual grammar concept map, and after gaining deeper understanding of the relations of all the rules taught to date, he/she would continue to edit his/her visual grammar concept map. This allowed the students to review the material while re-confirming his/her knowledge of a certain rule.

Stage 3. At the end of the course, the students completed a comprehensive concept map of grammar from the lecture, personal knowledge and related materials. At last, students were given a comprehensive final examination to assess whether students understood the grammatical rules taught. After students completed the course and assignment, we then compiled the data to conduct the analysis.

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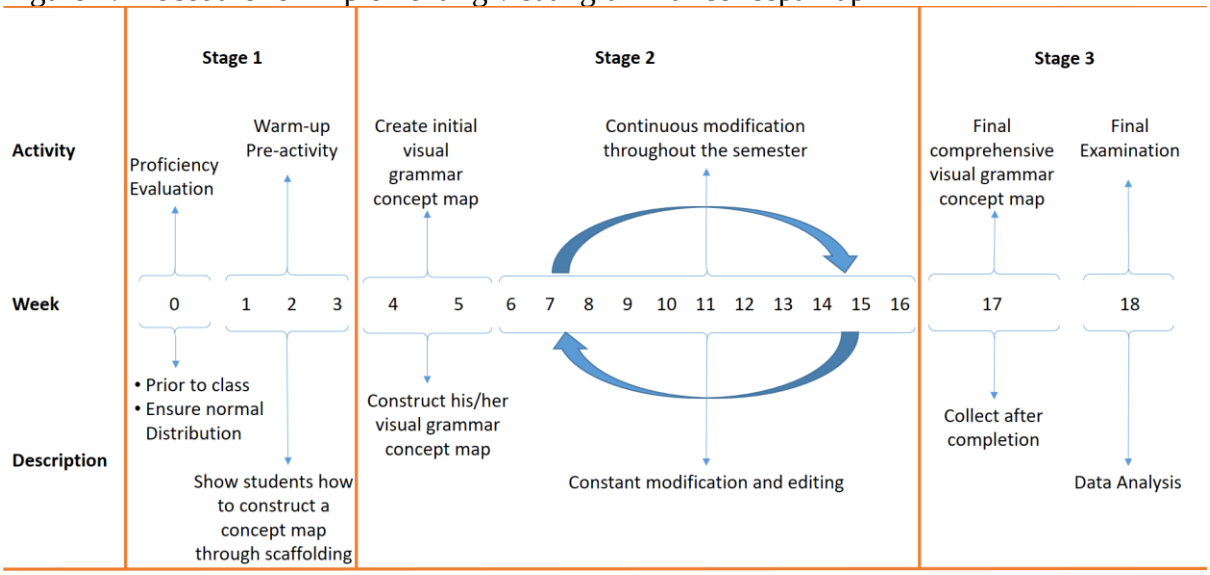
Figure 2. Procedure for implementing visual grammar concept map



Data Collection

The purpose of this study is to explore whether students can link grammatical rules into a holistic understanding through visual grammar concept map as a supplement in a traditional grammar teaching classroom. The two key data collected are students' final visual grammar concept map and final comprehension exam (similar to grammar questions presented in standardized English proficiency exams). To achieve our goal, student's final examination score (hereafter referred as score) was compared in relation to his/her own ability to draw a proficient concept map. Final visual grammar concept maps have been given to experts for evaluation through a criteria point system (Novak & Gowin, 1984). However, to simplify for this research, the rating of the concept was evaluated through counting the amounts of node/links, the depth, and the breadth of the visual grammar concept map. If the visual grammar concept map had more nodes, depth, and breadth, the concept map would be considered as more advanced. In this research, two main studies/analysis were conducted. First, students' achievement was compared to the overall complexity of the visual grammar concept map (total amounts of nodes regardless of the depth and breadth). Then an analysis of high achieving students (HAS) and low achieving students (LAS) in regards to total amount of nodes in the visual grammar concept map was conducted. Second, students' achievement was evaluated in relations to the depth and breadth of the visual grammar concept map, because depth and breadth can give us more insight on how different variations of visual grammar concept map can affect students' achievement. Subsequently, we conducted an analysis of HAS and LAS in terms of depth, and breadth of visual grammar concept map.

FINDINGS AND DISCUSSION

As shown in Figure 3, an evaluation framework was proposed to clarify the result. The evaluation framework consists of two main studies with each including two branching studies. Study I can be categorized as an understanding of the role of the total nodes in constructing a visual grammar concept map, while Study II is interested in more detailed interpretation of depth and breadth.

Study I (a) was an analysis to determine whether the total number of nodes/links is correlated to student's scores. The input variables were total nodes of visual grammar concept map and student's score. The results will show the correlation between total nodes and student's score. Furthermore, Study I (b) was carried out to see the associative effect of HAS and LAS to total nodes. The input was HAS and total nodes, and LAS and total nodes.

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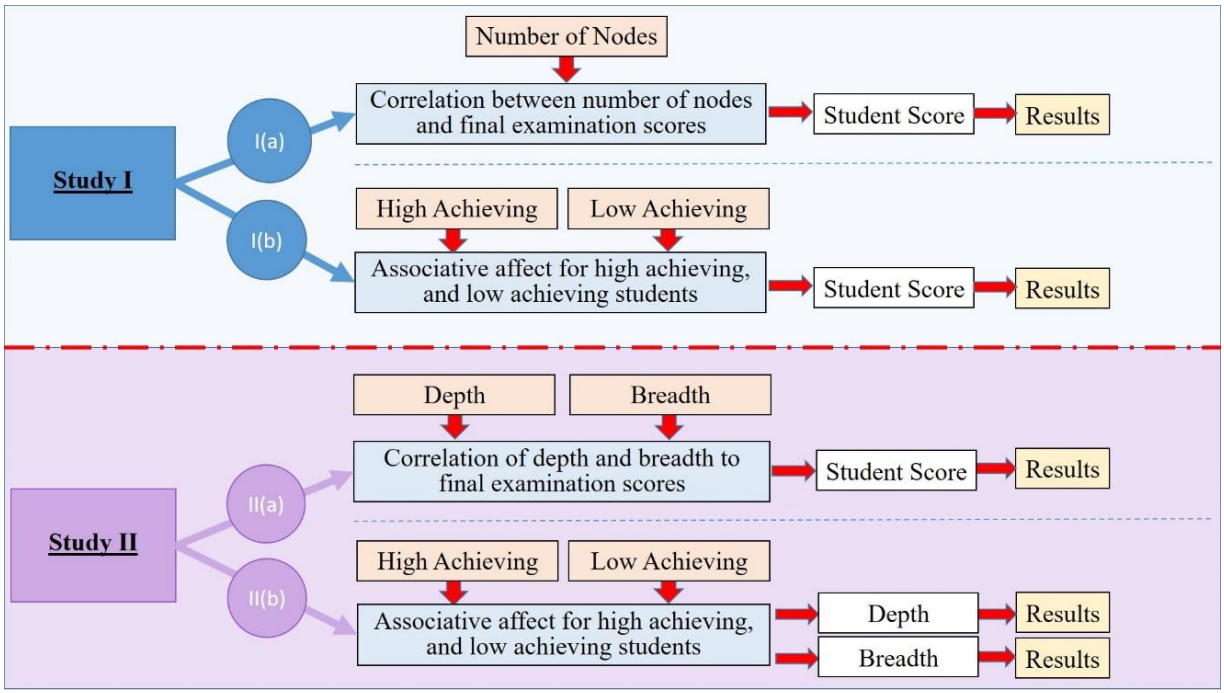
After conducting Study I, a further study—Study II (a)—was conducted to understand whether the depth and breadth of the visual grammar concept map could individually show correlation to student's score. The input of depth and breadth respectively was compared with student score to realize the result. At last, Study II (b) was carried out to see the associative effect of HAS and LAS to visual grammar concept map depth and breadth. The input was HAS and LAS compared to depth and breadth individually to yield a result.

Figure 3. Research evaluation framework



A. Study I: The Effect of Total Nodes in Visual Grammar Concept Map

Study I (a): Visual Grammar Concept Map (Total Nodes) vs. Examination Score

As mentioned, Study I was conducted to understand the effects of total nodes drawn on the visual grammar concept map in relations to the final examination score. The input for analysis is number of concept nodes and students' score. The method of analysis was by Pearson correlation, linear regression, and independent t-test. Moreover, the statistics null hypothesis is that there is no correlation and difference in individual performance on the final examination for students who drew an advanced visual grammar concept map. Certainly, the research hypothesis is that there is a positive correlation and a significant difference between total nodes amount and student's score.

The result of Pearson correlation analysis indicated a positive relationship between student's score and the number of total nodes ($rs(132) = .225$, $p < .01$). The finding confirms that the students who constructed more nodes achieved higher scores. The positive correlation result of the two variables is illustrated in the scatter plot with a liner regression line (Figure 4). Student's final examination score (y) can be predicted by total node amount (x) according to the equation $y = 66.27 + .07x + error$. Consequently, we can propose that students who can draw a complex visual grammar concept map (more nodes) will be able to score higher on the comprehensive final examination.

After confirming a positive correlation, the data was sorted into two variables—Concept Map Aptitude (b_1) and Final Examination Score (b_2). The data was sorted by total

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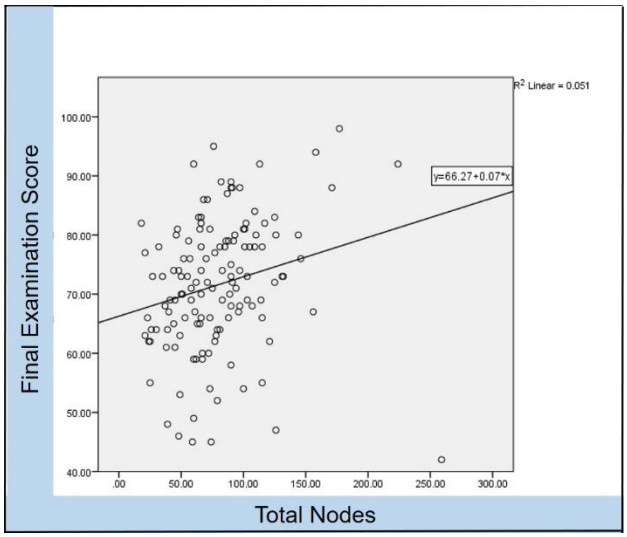
number of nodes—but taking only the top 25 percentile (superior group) and the bottom 25 percentile (inferior group)—to compare superior concept map with inferior concept map and its relation to final examination score. A two-tailed independent t-test was implemented and the results was $F(64) = 2.909$, $p = .093$, $t(64) = -2.898$, $p = .005$. The finding suggests that there is a significant difference between the superior group and the inferior group on student's score. As a result, the null hypothesis should be rejected and visual grammar concept map with a higher number of total nodes is in relation to good grades.

Figure 4. Visual grammar concept map number of nodes in correlation to student's final examination score



Study I (b): HAS and LAS vs. Visual Grammar Concept Map Total Nodes

The aim of Study I (b) is to evaluate how HAS and LAS different when construction a visual grammar concept map. The data was sorted by student achievement and classified into two groups—HAS (top 25 percentile) and LAS (bottom 25 percentile). To see the difference, the average of the total population, HAS, and LAS for total number of nodes of the visual grammar concept map was calculated. Furthermore, an independent t-test and linear regression was conducted to compare the total number of nodes of HAS and LAS.

As shown in Table 1, significant differences were found between the comparisons amongst groups (HAS and LAS) and visual grammar concept map total nodes. First, the average of the total nodes for the total population is 79.73 nodes while the average for HAS is 97.79 nodes and 68.39 nodes for LAS. The difference from the average for HAS is 18.06 nodes and for LAS is -11.34 nodes. From the data, there is a larger difference in number of nodes for HAS compared to LAS. Furthermore, a two-tailed independent t-test was conducted to compare HAS and LAS. The result was $F(64) = .109$ $p = .742$, $t(64) = -2.77$, $p = .007$ which indicates a significant difference between HAS and LAS.

Table 1 A comparison of average (total population, HAS, and LAS) for total nodes

	Total Nodes
Total Population	79.73
HAS	97.79
LAS	68.39
High & Low Sig.	-2.77**

*$p < .05$, **$p < .01$, ***$p < .001$

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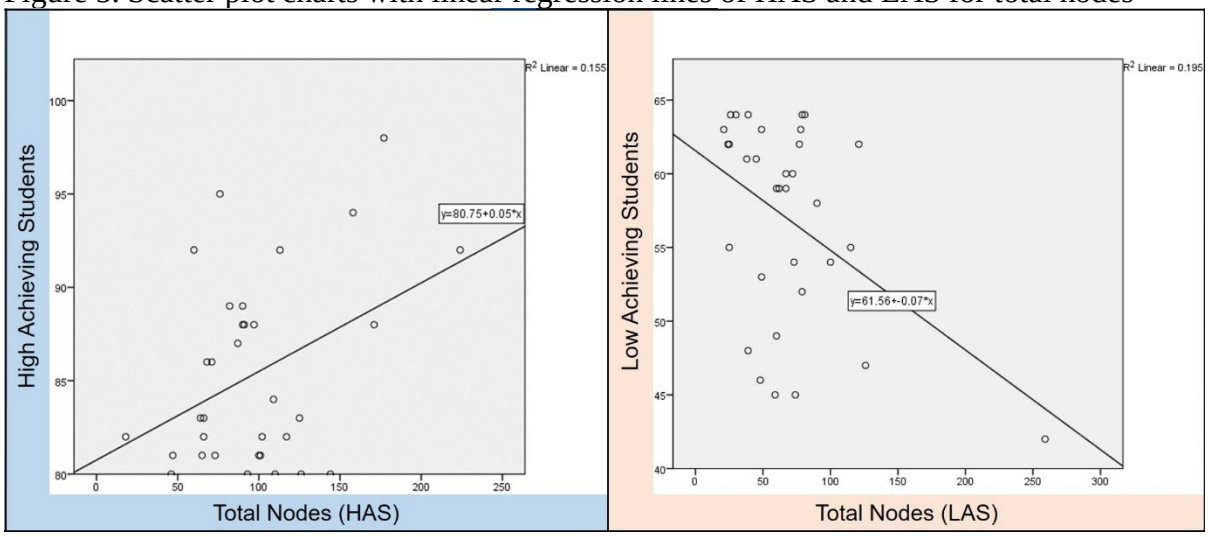
In addition, as seen in the scatter plot chart (Figure 5), after running a linear regression analysis, it is confirmed that there is a correlation between student achievement and total number of nodes. However, for LAS a negative correlation was realized which means for LAS, the more nodes inserted the worst the examination score. This suggests that we need to look further into what created this occurrence.

Figure 5. Scatter plot charts with linear regression lines of HAS and LAS for total nodes



B. Study II: The Effect of Depth and Breadth in Visual Grammar Concept Map

Study II (a): Visual Grammar Concept Map (Depth and Breadth) vs. Examination Score

In addition to study I, a more detailed analysis was conducted, because only understanding the number of nodes in relation to examination scores did not give insight on whether all nodes are equal; especially after conduction Study I (b). From the result of Study I (b), a negative correlation was realized for LAS and total nodes; therefore, understanding not only total nodes but depth and breadth of the visual grammar concept map in association to scores could bring more clarity to how visual grammar concept map affects students. Understanding whether both depth and breadth effect the score or if only one variable influences the outcome score would be necessary.

The null hypothesis for Study II (a) is (1) there is no difference in individual performance on the final examination for students who drew a visual grammar concept map with more depth, and (2) there is no difference in individual performance on the final examination for students who drew a concept map with more breadth. Therefore, the research hypothesis is that students who can draw a visualize grammar concept map with more depth and/or breadth would do better on the final examination, and students who have shallow or narrow visualize grammar concept map would not score highly on the final examination.

We started by conducting a Pearson correlation analysis. The result showed a positive correlation ($rs(132) = .213$, $p < .01$) between the amount of visual grammar concept map level (depth) and student's score. Also, the scatter plot chart for depth vs. final examination score (Figure 6) displayed a positive correlation with a linear line equation of $y = 62.52 + 2.21x + error$. The finding indicates that students who constructed more levels (depth) on his/her visual grammar concept map achieved higher scores. After confirming a positive correlation, the data was sorted into two variables—Concept Map Depth (b_1) and Final Examination Score (b_2). We then took the top 25 percentile (superior group) and the bottom 25 percentile (inferior group) based on the amount of level (depth) of the visual grammar concept map to assess

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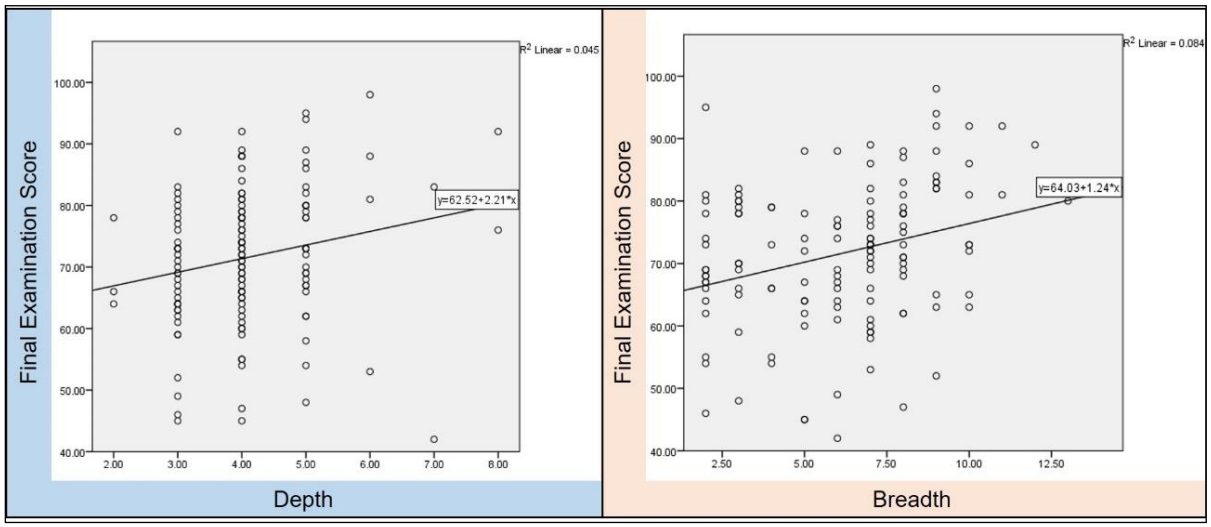
whether more depth of the concept map was correlated to high score. Based on the grouping, a two-tailed independent t-test was implemented, and the result shows a significant difference ($F(64) = 2.711$, $p = .105$, $t(64) = 2.423$, $p = .018$) on the score between the superior group and inferior group. Accordingly, the null hypothesis should be rejected, which means more depth in the visual grammar concept map is in relation to high scores.

Figure 6. Depth vs. Breadth of visual grammar concept map in Correlation to Students' Final Examination Score



Furthermore, we compared visual grammar concept map breadth in association to final examination score. The result of Pearson correlation analysis shows a positive relationship ($rs(132) = .289$, $p < .01$) between the amount of breadth and student's score. The scatter plot chart (Figure 6) for breadth vs. final examination score also revealed a positive correlation with a linear regression line equation of $y = 64.03 + 1.24x + error$. After confirming the positive relationship between the two variables, the data was sorted into two variables—Concept Map Breadth (b_1) and Final Examination Score (b_2). We took the top 25 percentile (superior group) and the bottom 25 percentile (inferior group) based on the breadth of the visual grammar concept map to assess whether a wider visual grammar concept map was correlated to high score. A two-tailed independent t-test was implemented and the result was $F(64) = .425$, $p = .517$, $t(64) = 3.361$, $p = 0.001$ which suggests a significant difference so the null hypothesis should be rejected and the breadth of the visual concept map is in relation to high scores. Therefore, students who have the ability to draw a visual grammar concept map with more breadth will be able to score higher on the comprehensive final examination.

Study II (b): HAS and LAS vs. Visual Grammar Concept Map Depth and Breadth

After completing Study II (a), it is clear that the depth and breadth have a positive relation to students' score; however, it was necessary to understand how the visual grammar concept map's depth and breadth were different for HAS and LAS. When looking at the data of HAS and LAS in comparison to depth (Table 2), the average of depth for the total population is 4.11 levels while the average for HAS is 4.67 levels and 3.85 levels for LAS. The difference between the average of depth for the total population and HAS is .56 levels and -0.26 levels for LAS. The t-test results shows $F(64) = 1.317$, $p = .255$, $t(64) = -2.84$, $p = .006$ which indicates a significant difference between HAS and LAS. Moreover, Table 2 indicates that the average breadth of the total population is 6.11 while the average for HAS is 7.48 wide and 5.61 wide for LAS. The difference of breadth amongst the average of the total population, HAS, and LAS is 1.37 wide and -0.5 wide, respectively. Similarly, the independent t-test shows $F(64) = 2.706$,

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p = .105, $t(64)$ = -2.859, p = .006 which also indicates a significant difference between HAS and LAS.

Table 2 A comparison of average (total population, HAS, and LAS) for depth and breadth

	Depth	Breadth
Total Population	4.11	6.11
HAS	4.67	7.48
LAS	3.85	5.61
High & Low Sig.	-2.84**	-2.86**

*p < .05, **p < .01, ***p < .001

The results of the average differences and independent t-tests support the statistics analysis from Study I; however, the data indicates that not only the total amount of nodes is important. From comparing the average and differences for each category, we can see that it is more difficult to have more depth than breadth. Nevertheless, students have more difficulty constructing more depth. Figure 7 shows scatter plot charts from the linear regression analysis for HAS and LAS in each category—total nodes, depth, and breadth. From the scatter plot chart we can see that for HAS, all the categories are good indicators for achievement; however, for LAS, we realize negative relationships which may suggest the more students drew, the worse the scores were. Interestingly, the only positive correlation for LAS is breadth which indicates that LAS have the ability of outlining English grammar on a wide scale; however, he/she does not have the ability of connecting ideas through depth. Moreover, drawing a visual grammar concept map with more depth is more difficult than depth as HAS only constructed an average of 4.67 levels while LAS constructed 3.85 levels, which is relatively close. Hence, if students can complete a visual grammar concept map with more depth, he/she might be able to have a deeper holistic understanding of the grammatical rules.

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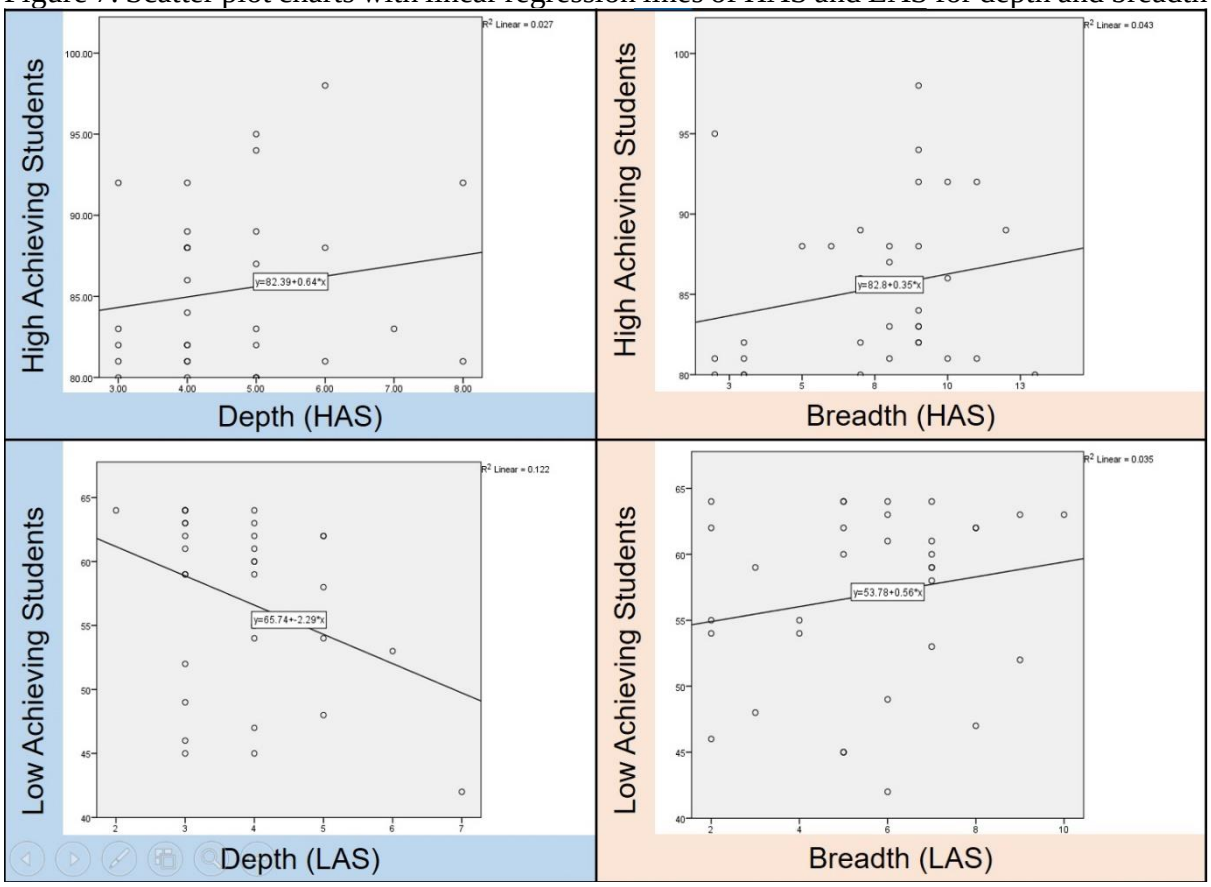
Figure 7. Scatter plot charts with linear regression lines of HAS and LAS for depth and breadth



Discussion

Visual Grammar Concept Map in Relation to Examination Score

As stated in research question one, the main purpose of this research is to identify whether students' benefited grammatical academic achievement from applying the supplementary tool of constructing a holistic visual grammar concept map. After conducting Study I (a) and Study II (a), the statistical analysis results show that students with high complexity visual grammar concept map accomplished higher score. Thus, students who were able to construct a visual grammar concept map with a higher amount of nodes/links, deeper depth, and broader breadth were able to understand the grammatical rules better since they achieved a higher score. The reason is because of the nature of visual grammar concept map; students are able to create his/her knowledge of grammar rules in a holistic visual grammar map and link the connection between rules which allowed for a deeper understanding. This shows that there is a strong relation between understanding grammatical concept as a whole in a well-constructed holistic visual grammar concept map.

Associative Effects of HAS and LAS

Research question two is to recognize the associative effects of total nodes, depth, and breath to HAS and LAS. From the results of Study I (b) and Study II (b), we can conclude that HAS will construct a more complex visual grammar concept map since HAS drew more total nodes, more depth, and/or more breadth, while LAS struggled to construct a visual grammar concept map with more nodes, more depth, and/or more breadth. Moreover, from the study, we can see that HAS have the ability of constructing visual concept maps with depth and breadth. However, LAS do not benefit from constructing more depth of breadth, because for LAS, the

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links amongst concepts are not significant which shows a lack of understanding of the grammatical rules. For example, a LAS might only have two nodes linked to verbs (transitive and intransitive) because the student cannot relate verbs to anything else other than as a part of speech. Conversely, HAS would connect more nodes (gerunds, the position of verbs, linking verbs, etc.) and would be able to understand that verbs are part of a sentence structure and not only a part of speech. Consequently, depth of visual grammar concept map is a good indication of student achievement since depth is more demanding for students to construct. Student who constructed more sophisticated visual grammar concept maps were able to link different grammatical rules together (depth) rather than just noticing the different parts of speeches (breadth). Thus, it is evident that students who understand the grammatical rules taught in class—whether nouns, verbs, adjective, adverb, etc.—can draw a more sophisticated visual grammar concept map and achieve a higher score. Visual grammar concept map is a viable supplementary tool in a traditional form-focused classroom to move towards a more holistic understanding.

Visual Grammar Concept Map as a Holistic Supplement

Visual grammar concept map allowed students not only listening to the instructor explain English grammatical rules in an atomistic way, but also obtained a chance to have a hands-on experience constructing a holistic visual of his/her connection between the rules. In addition, the platform provided convenient accessibility since students were able to connect to the internet and construct the visual grammar concept at anytime and anywhere. In addition, due to the nature of the platform being online, it allowed the instructor to give instant feedback or answer and questions (if necessary). Furthermore, editing the visual grammar concept map throughout the semester was easy enough for students to focus on the grammar rules rather than having to make various drafts since students could simply move a node and link it to another with ease. In a paper-based concept map, students have to erase a whole section/level just to move a middle node to another node. Lastly, based on the result of the two studies and related subsidiary studies, it is clear that there is an effect on students learning achievement through the construction of a holistic visual grammar concept map. Therefore, this visual grammar concept map can be an suitable supplementary instrument in a form focused traditional classroom as it allows students to bring forth external motivation through hands-on application, to gain a graphical understanding of grammar, and to have a convenient virtual location to learn at any time.

CONCLUSION

The motivation for this study is to understand the effect of student's English grammar learning or acquisition through the use of web based visual grammar concept map. Through the construction of visual grammar concept map, students can sway away from form focused atomistic grammar education to a more holistic perception of grammar. Rather than memorizing atomistic grammatical rules, having a holistic understanding of English grammatical rules allows students to see English grammar as whole which help students use the language. We suggest that visual grammar concept map increases grammar learning at a holistic level and has the potential of being an applicable supplement for grammar instruction.

Through the study, the authors found that students who spent time constructing a sophisticated visual grammar concept map (more total nodes, depth, and breadth) generally did better on the final examination. For all students, constructing a wide (breadth) visual grammar concept map seems to be fairly undemanding and increases examination scores. However, it is more difficult to have more depth than breadth. If students only memorize the atomistic grammatical rules, the students would only be able to construct a basic visual grammar concept map with little or no association of different grammatical rules—as seen in LAS. In the LAS

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group, the more depth nodes attempted, the lower the exam score indicates that LAS only understand minimal atomistic rules and are inserting insignificant nodes. Conversely, HAS have the ability of making modifications to match his/her understanding of the grammatical rules as a whole, which could mean for a greater understanding of the grammatical rules as a whole. From the result, in the classroom, visual grammar concept map can allow instructors to closely monitor how LAS student are constructing the depth nodes and help student realize how the nodes are interrelated in a deeper meaning.

Moreover, we argue that web based visual grammar concept map can be implement in a traditional form-focused deductive classroom to close the gap between atomistic and holistic grammar understanding. This supplement is not to be mistaken as a middle ground for form-focused and meaning-focused instruction; rather it is a supplement utilizing technology to make students have a better visual and holistic understanding on how the form-focused atomistic grammar rules are interrelated. The visual grammar concept map construction can be used in a traditional grammar learning classroom to give students a further understanding that grammar rules are not independent but are actually holistically dependent to each other. Also, it is an easy and useful method for instructors to monitor what areas of grammar students may have difficulty connecting together. Hence, the use of visual grammar concept map can possibly be applied in various classroom settings or approach.

During the study, we encountered two main limitations. First, we found a lack of literature on visual grammar concept maps as a tool for English grammar learning, teaching, or assessment. Concept maps have been studied for various English learning areas but few have addressed concept maps as a holistic visual aid to grammar comprehension. The use of concept map as a supplement in EFL grammar learning should be discussed. Second, time constraint. It took four semesters to finish obtaining the current sample size and analyse the data. The research could be more accurate with an even larger sample size; however due to COVID-19, some of the data had to be discarded due to the inconsistency of online and physical class instruction. After identifying the research limitation, more aspects of this topic that could be studied in the future. Future research can be conducted to include a more comprehensive assessment of grammar proficiency which could be present to realize which grammatical rule(s) can be learned/acquired more effectively through visual grammar concept map. In addition, a more detailed analysis of the final assessment examination items in relations to the concepts constructed in the visual grammar concept might be able to explain the benefit further. This would also allow instructors to evaluate students' learning process and what rules may be unclear or not seen holistically. Nevertheless, from the current study, visual grammar concept map is an appropriate supplement to the traditional English grammar classroom.

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