

Dual Coding and Language Learning: Drawing as Cognitive Support

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ABSTRACT

As artificial intelligence in language teaching rapidly develops, there is a definitive necessity for reconsideration of the manner in which students operate with the newly appearing vocabulary and build meaning. This paper applies the dual coding theory and wider concepts of human cognition to determine the specification of drawing as a teaching approach. Even though AI tools can help one to become more efficient and personalised, they promote superficial engagement with the language as well. In comparison, drawing asks the learner to actively interpret and give meaning to the work, making connections between the systems of the verbal and the visual in a manner that enhances the role of form and meaning. Based on studies of the development of cognitive psychology, second language acquisition, and education, this paper summarises both theoretical and classroom-based constructs that drawing is a teaching and learning strategy based on conceptual analysis as its major approach. The paper explains that drawing is far beyond a technique of memorisation. Students are recomposing linguistic information when engaged in constructing their own visual images, and they make deliberate personal decisions concerning meaning. This further involvement promotes semantic encoding and more retention in the long run. Text planning, lexical retrieval, and language production in general are also supported by drawing. Instead of considering drawing as a substitute for technological innovation, this paper proposes that it is complementary in a digitally mediated classroom. Cognitive processes of humans will remain key in second language acquisition into the twenty-first century; thus, drawing remains an instrumental process of second language education in a world where automation effects become more prominent.

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I. INTRODUCTION

The language education environment is changing at a very fast pace. The applications of artificial intelligence currently provide each learner with a tailored learning experience, immediate assessment, and access to superior-quality authentic language resources as never before. But in this technological fly-up, there remains a basic question, and that is, are students really learning, or are they merely processing information on very shallow levels? With language teaching professionals striving to incorporate the use of digital tools in the classroom, an equal concern arises to look at how students will build on meaning that results in retentionable, retrievable knowledge.

The paper will answer this question, exploring the concept of drawing as a cognitive support of second language vocabulary acquisition. As a pedagogical method, drawing has received an increasing amount of attention and research that has been conducted within various theoretical frameworks. The overall point of this argument is that by students forming drawings of their target vocabulary, they will be using their cognitive capacities to generate form-meaning relationships that no passive exposure, be it through conventional memorisation or electronic devices, can match. Drawing involves learners making deliberate decisions regarding the manner in which they can represent their meanings verbally as well as graphically, and combining the verbal and the visual with the help of dual-coding systems.

The relevance of this investigation has to do with the time. With the advancing sophistication of educational technologies, human cognitive strategies are faced with the temptation to either be considered redundant or complementary to technological responses. This paper will refute the assumption that drawing is unnecessary by demonstrating that it activates distinct cognitive mechanisms essential for deep learning. Instead of presenting drawing as an alternative to technology, the paper suggests using drawing and digital technology as complementary tools, as drawing may provide processing richness that technologically mediated learning sometimes lacks.

After a review of the literature, the paper will be structured as follows. First, it specifies the theoretical steps that are used to support the idea of drawing as a learning strategy and especially

introduces dual coding theory and the involvement load hypothesis. Second, it synthesises empirical research on the attraction of language learning contexts, based on studies in a variety of educational environments. Third, it also looks at the cognitive processes by which drawing aids vocabulary acquisition, such as the semantic encoding process, the elaborative processing process, and the multimodal integration process. Fourth, it discusses the implications of these findings on the practice of language teaching, especially when using digitally mediated classrooms. Lastly, it provides conclusions and recommendations for future research.

II. LITERATURE REVIEW

Drawing has emerged as a promising cognitive strategy for second language vocabulary acquisition. Researchers have approached this phenomenon through multiple theoretical lenses, including dual coding theory, which proposes that verbal and visual information are processed through distinct but interconnected channels, and the Involvement Load Hypothesis, which emphasises that deeper cognitive engagement during encoding leads to stronger retention. When learners create visual representations of target vocabulary, they generate enriched memory traces that strengthen form-meaning connections. This convergence of theoretical perspectives has prompted researchers to investigate drawing-based interventions across diverse L2 learning contexts.

Several quasi-experimental studies have demonstrated the efficacy of drawing for vocabulary learning among young EFL learners. Shoari (2015), grounding her work in the Involvement Load Hypothesis, examined Iranian young learners and found that students who drew pictures of target words significantly outperformed a control group using traditional memorisation. She attributed this advantage to deeper cognitive engagement, noting that drawing facilitates processing at deeper rather than shallow levels while also creating a relaxed, low-anxiety learning environment, particularly beneficial for young learners. Building on this work, Shahnaei (2021) replicated these findings with a similar population, reporting substantial vocabulary gains for the drawing group while the control group showed negligible progress. Both studies emphasise that

drawing not only enhances retention but also increases learner self-confidence and autonomy.

Research extending beyond elementary contexts has yielded consistent results. Teemueangsai (2025) investigated drawing games with Thai EFL learners, explicitly testing dual coding theory's prediction that visual-verbal pairing strengthens form-meaning connections. The study found significant advantages across all vocabulary test types, including passive and active recognition and recall. Notably, delayed post-tests revealed that the experimental group maintained superior performance over time, and students reported highly positive perceptions of the drawing activities, suggesting that the approach is both effective and motivating.

Drawing has also been explored as a support for broader language production through different theoretical frameworks. Adoniou (2013), working within a social interactionist perspective, examined drawing as a pre-writing strategy for English as an Additional Language/Dialect learners. Students who drew before writing produced longer texts of higher quality, with drawings serving as memory prompts and planning tools that helped learners organise text structure, include accurate details, and access specialist vocabulary. This research positions drawing not merely as a vocabulary strategy but as a semiotic bridge supporting overall language development.

Collectively, these studies suggest that drawing-based activities offer robust benefits for L2 vocabulary acquisition across age groups, proficiency levels, and target languages. Despite employing different theoretical frameworks, the consistent findings across Iranian, Thai, and Australian learning contexts indicate that drawing engages learners in deeper processing that enhances both immediate learning and long-term retention.

III. THEORETICAL FRAMEWORK

Dual Coding Theory

Dual coding theory, which was first hypothesised by Allan Paivio, is the foundational theory behind the rationale of the attribute of drawing benefits from memory and learning. According to the theory, human cognition has two systems, which are different yet related to each other: a verbal system (specialised to process

language) and a nonverbal (imagery) system (specialised to process visual information). These systems are autonomous but may operate simultaneously to produce so-called additive effects with the encoding of information via the two channels.

Application of dual coding theory to learning through drawing is basic. Drawing a representation of a target word involves simultaneous activation of both processing systems when learners draw a representation. The word is processed; its phonological form, orthographic, and semantic associations are processed by the verbal system. At the same time, the image being created is processed by the visual system with its spatial aspects, visual detail, and conceptual interaction. Importantly, the learner should also be able to form a relationship between these two representations, between the verbal name and the visual object.

Kassim (2018) explicitly applied the dual coding theory in a study on second language vocabulary learning. In an experimental research study in which he compared animated and stationary images together with L1 translations when learning vocabulary among the English learners, the researcher observed that the group that received animated images coupled with translations scored high in the immediate and delayed tests. The animated pictures group performed better than the control group on the immediate posttest ($p=0.000914$), and it also had an upper hand after one week ($p=0.007095$). This research allows for the finding of empirical support of the idea that dual-coded input supports vocabulary retention and proposes that motion of visuals can result in better vocabulary retention by generating more of what Schmidt terms the "Noticing Hypothesis."

The Drawing Effect

The drawing effect is a strong conclusion that states that by drawing words when encoding, one can obtain better memory performance than with writing or other encoding risks. Wammes et al. (2016) offered groundbreaking empirical support to this effect by publishing seven experiments in the *Quarterly Journal of Experimental Psychology*. Drawing was all-around better than alternative encoding strategies. The recall of drawn words was found to occur about twice the frequency of written words and was repeated among different encoding time durations (between 4 and 40

seconds) and list lengths (between 30 and 66 words).

Primarily, Wammes et al. (2016) eliminated other possible explanations for the drawing effect. Experiment 3 proved that drawing was better than deep-level semantic processing; listing physical characteristics of words proved to be equally beneficial to writing. Experiment 4 determined that there was marginally better performance in drawing compared to the outcome with visual imagery alone, and this implies that the advantage is not wholly explained by the use of mental imagery alone without a motor result. Experiment 5 indicated that drawing was better than picture superiority viewing, which eliminates picture superiority as the major process. Experiment 7 established that the drawing effect was present in between-subjects pure-list designs, and thus, distinctiveness cannot be used to fully account for the effect. The authors conclude that drawing promotes memory as a result of synergy between four elements: elaboration (choice of how to represent an item), visual imagery (mental representation of the item), motor action (performing a drawing), and pictorial representation (looking at the final image). This combination forms a coherent and stronger memory trace than any individual part would give alone.

Involvement Load Hypothesis

Another theoretical perspective that can be used to determine the effectiveness of drawing is the Involvement Load Hypothesis by Laufer and Hulstijn. According to this hypothesis, retention of vocabulary hinges on the complexity of encoding, which is operationalised into three variables, namely, need (motivational dimension), search (finding the meaning), and evaluation (comparing word meanings and contextual applications). Tasks that involve a higher load should produce a higher level of retention. Shoari & Asl (2015) clearly related drawing to the Involvement Load Hypothesis in research with a reference group of young Iranian EFL learners. The researcher proposed that when using picture techniques, learners are also obligated to the deeper thinking process than normal memorization due to the fact that learners are expected to judge how to depict word meanings visually and search for the right visual representations. The experimental findings reinforced this argument: the drawing group achieved far better results than the control group, with a mean of 4.67, greater than insignificant gains

in the control group ($t(29) = 24.46, p < .001$). Shoari and Asl came to the conclusion that drawing helps students to process information on deeper levels than superficially and get into a low-anxiety, relaxed learning environment that is needed by young students in particular.

Generative Learning Theory

Generative Learning Theory, which is connected with Wittrock and was further developed by Fiorella and Mayer, is based on the idea that the process of learning is improved when the learners themselves create the linkages between the fresh information and preexisting knowledge. Visual representations created by learners form a type of generative learning since they have students restructuring information, choosing the information that is meaningful, and combining words and images.

A literature review by Peterson (2021) of the United States Army Research Institute summarised the literature on the effect of externalisation of thoughts via drawing on improving cognitive load and decoding complex information, recognising that the research literature on this topic was impactful across a wide range of subjects. The review discovered that diagrams made by learners lead to a better understanding of expository text, and external representations help in cognitive offloading, leading to less working memory. It is worth noting that the advantage of shopping does escalate according to the complexity of the task, implying that the benefits of drawing could be notable among difficult learning resources.

Methodology

The methodology used in this paper is conceptual analysis. Conceptual analysis encompasses the logical study and synthesis of available theoretical and empirical literature towards the generation of integrated insights into a phenomenon. The approach suits this study especially well since the body of research about drawing in language learning concerns research domains across several areas—cognition research, second language acquisition, educational research, and so on—as well as demands for research synthesis across those areas.

Empirical studies investigating the topic of drawing in language learning were subjected to systematic review to identify sources covered by this paper. The selection of studies was performed

according to the following criteria: (1) relevance to drawing as a learning strategy; (2) empirical study of the impact of drawing on language results; (3) theoretical justification in the context of appropriate frameworks; and (4) publication in peer-reviewed journals. The resulting corpus consists of the studies based on different contexts: The resulting corpus includes studies involving Thai EFL learners (Teemueangsai et al., 2025), Iranian young learners (Shoari and Asl, 2015; Shahnaei, 2021), German as a Foreign Language learners (Alhachami, 2025), English as an Additional Language learners in Australia (Adoniou, 2013), and experiments in cognitive psychology related to the drawing effect (Wammes et al., 2016).

The analysis was carried out in several steps. First, the theoretical basis, methods, and major findings of each study were analysed. Second, they included studies based on thematic interest when acquiring vocabulary, writing development, and cognitive mechanisms to affirm patterns between contexts. Third, the synthesis of findings was used to come up with integrated claims regarding the effectiveness of drawing and its mechanisms. Fourth, synthesised evidence was used to derive implications for teaching practices.

IV. FINDINGS: DRAWING IN LANGUAGE LEARNING CONTEXTS

Drawing for Vocabulary Acquisition

Several quasi-experimental studies have established the effectiveness of drawing in vocabulary acquisition in various learner populations. The study of Teemueangsai et al. (2025) focused on drawing games in Thai EFL students in a way that directly compared the hypothesis of the dual coding theory of visual-verbal matches yielding stronger form-meaning relationships. The research adopted the quasi-experimental design and involved 40 learners, and evaluated both immediate vocabulary learning and delayed retention. Findings revealed that the experimental group performed better than the control group in all types of vocabulary tests involving passive recognition, active recognition, passive recall, and active recall. Most importantly, post-tests (fundamentally, with delayed post-tests) showed that the experimental group scored better with time (experimental $M=39.71$ vs. control $M=22.16$, $p<0.05$), which confirms the idea that drawing can support long-term retention but not only

immediate learning. Students have a high positive perception of the drawing activities ($M=4.30/5$, 86 per cent approval), which indicates that the approach is not only efficient but also inspirational.

Shahnaei (2021) investigated drawing as a learning vocabulary strategy among EFL Iranian elementary students in a quasi-experimental study contrasting IR drawing pictures with the traditional memorisation approach. The experimental group increased in $M=12.17$ to $M=16.73$ (4.57 points of growth), whereas the control group showed insignificant growth in $M=12.03$ to $M=12.83$ (0.80 points of growth). The posttest difference between groups was significant ($t(58)=18.181$, $p < .001$). Shahnaei concluded that drawing facilitates more profound processing of vocabulary—learners process words at deeper levels than at shallow ones—and that drawing enhances learner self-confidence and self-reliance.

Following the Involvement Load Hypothesis, Shoari and Asl (2015) also discovered that the performance of young learners in Iran who were provided pictures of the target words much improved compared to that of a control group. Pretest scores were homogeneous (experimental $M=12.17$, control $M=12.44$) and contrasted sharply in posttest scores (experimental $M=16.67$, $SD=0.75$; control $M=12.53$, $SD=0.94$). Their study highlighted that drawing provided relaxed, low-anxious learning conditions, and it was especially effective with young learners and students with learning disabilities to enable them to make associations between words and concepts.

Alhachami (2025) has applied the same study to the context of German as a Foreign Language, whereby painting and drawing activities were conducted on 180 learners in a large-scale quasi-experimental design. The experiment clearly referenced Wammes et al. (2016) and tested vocabulary as well as speaking proficiency. Findings revealed that the experimental group got much higher in both of these measures compared to the control group: vocabulary acquisition (experimental $M=72.14$, control $M = 65.51$; $t(170.98) = 2.37$, $p=.019$, Cohen $d=0.40$) and speaking proficiency (experimental $M=66.10$, control $M=59.73$; $t(178)=2.37$, $p=.019$, Cohen $d=0.35$). Significant differences were established by Mann-Whitney U tests ($U=3053.5$, $Z=-2.86$, $p=.004$). Alhachami reached the conclusion that painting tasks provide better cognitive interest in learning material and emotional access to material, as well as less anxiety about

mistakes and fear of mistakes, and support vocabulary retention in long-term memory through visual pictures.

Drawing for Writing Development

Adoniou (2013) investigated drawing in an alternative theoretical approach, operating under a social interactionist/Vygotskian framework as opposed to dual coding theory. The article examined drawing as a pre-writing intervention in English as an additional language/dialect for students and oriented drawing and writing as parallel semiotic systems (intersemiosis). Drawing and writing before writing created longer and better-quality texts, using drawings as memory aids and planning tools. Sketches assisted the learners to structure text, to add correct details, to draw on professional vocabulary (e.g., buttermilk), and to attain proper tenor. Adoniou explained that drawing allowed testing out, evaluation, revision, and integration of ideas before one started writing. In drawings, which were the product of a visual medium, visual tools (numerals, arrows, and quantifiers) matched corresponding language tools required in writing, and drawing offers a semiotic foreground to writing. The value of this finding lies in its expansion of the benefits of drawing beyond vocabulary acquisition to larger language production. Pre-writing seems to activate conceptual organisation, which in turn eases lexical retrieval and text building. The visual job aids work as external stores of memory, which lessen cognitive burden in writing and permit students to concentrate on linguistic composition and drawing to offer content and structure.

Cognitive Mechanisms Underlying Drawing's Effectiveness

The literature that has been reviewed in cognitive psychology gives us an understanding of the reasons behind such strong learning advantages associated with drawing. Wammes et al. (2016) hypothesised that the mnemonic benefit of drawing is because it combines several elements: elaboration, visual image, motor gesture, and pictorial expression. The components play a unique role in the formation of memory, and a combination of these elements provides synergistic effects that are greater than each component.

Wammes (2018) also discerned the elaborative aspect of the drawing effect upon the basis of a prepare but leave undone paradigm. In

two independent samples, the authors established that when subjects prepared to draw for 1–2 seconds (expenses not drawn), they generated much better memory compared to when they wrote for 15 seconds (Sample A: $d=0.79$, $p<.001$; Sample B: $d=0.62$, $p=.004$). The prep time contributed nearly half of the sum of the drawing gains (0.107 accuracy increase during the period of preparing to draw, rather than 0.235 accuracy increase during the period of drawing) when compared to writing. This observation clearly shows that elaborative processing, the mental planning of what and how to draw, is an essential contributor to drawing efficacy and provides support to the generative drawing principle, according to which a visual representation learned by the learner can increase memory construction by intensively reading between the lines of meaning.

In one case study applying to a patient with severe anterograde amnesia following damage to the fornix, Matorina et al. (2024) were able to supply neuropsychological evidence of the efficacy of drawing. Although undeniably severely impaired on memory, comparison of CT demonstrated an equal drawing effect to both control-age unsleepy and sleepy conditions. The written words memory of CT was reliably weak compared to the controls, but the drawn words memory is in the lower control range following a 12-hour waking delay and above chance following a sleep delay. Surprisingly, the initial empirical evidence of episodic memory retrieval (a "Remember" response) of a drawn word, when awake, was observed in this patient post-sleep; this was the first time in his life.

Matorina et al. (2024) concluded that this may be due to the benefit of drawing; recruits retained portions of the brain that are not part of the damaged system of the hippocampus, primary visual cortex, lateral occipital cortex, motor areas, and cerebellum, which formed multiple integrated memory traces that were found to be more resistant to damage. This result has far-reaching implications for language learning: if drawing can aid memory even in participants with serious hippocampal damage, it would be especially beneficial for individuals facing memory challenges, such as learners with learning disabilities or those acquiring language under adverse conditions.

Peterson (2021) generalized more learning mechanisms of drawing. External representation helps in offloading the cognitive load of working theory so that the cognitive resources are free to

proceed with higher-order processing. Bidirectional coded information (verbal and visual) is easier to remember and recall since it has more retrieval paths. The benefits of externalisation increase as the complexity of the task rises, indicating that more challenging learning materials enhance the value of drawing.

Learner Perceptions and Affective Outcomes

In various studies, there were positive perceptions of drawing activities conducted by the learners. The results of Teemueangsai et al. (2025) indicate that the positive perceptions were high among students ($M=4.30/5$, 86% approval). Both Shoari and Asl (2015) and Shahnaei (2021) focused on the fact that they should attract more self-confidence and autonomy on the part of learners. Alhachami (2025) observed that drawing is less anxiety- and fear-inducing of errors, particularly among timid learners, which enhances cognitive and emotional growth as well as team-building and communication skills.

Such effective results have an educational implication. Learning spaces that lower the levels of anxiety and build confidence have high chances of maintaining learner engagement in the long term. As the learners feel successful and in control, they tend to keep using learning activities or to at least tend to have good attitudes about language learning overall.

V. DISCUSSION: IMPLICATIONS FOR LANGUAGE TEACHING

Drawing as Deep Processing in the Age of AI

The synthesised findings presented in this paper are of specific interest to modern language teaching. The potential of the increasing use of AI tools in the educational sector is that students will employ language shallowly. Reproduction AI translation, quick vocabulary search, and automated feedback can replace deep learning activity. The opposite of this trend needs meaning-making, rather than passive computer consumption. Drawing a word can only require meaning for students. They need to decide what meanings they want to focus on, the ways to visualise complex objects, and the ways to connect the visual image with the word. Cognitive psychology suggests that deep learning requires elaborative involvement, which this generation process provides by allowing students to engage

with the material through visualisation and personal interpretation of concepts. Technology should not be substituted for sketching. Drawing may be used in digitally mediated classrooms to a greater extent. Students can access online materials to obtain pronunciations, sample sentences, and actual applications of vocabulary and sketches to unify and prepare personally. Input through technology and output through visual input by the learner may work.

Practical Applications for Classroom Teaching

The study discussed in the given paper recommends several applications in the teaching of languages. First, the exercises to be drawn should promote elaboration. Requesting students to draw pictures might not be as productive as asking them to plan out how they will be depicting meaning before drawing. Wammes (2018) has suggested that planning should be promoted by drawing certain plans, as it enhances the memory of learners. The skills can be applied by drawing. The majority of the research has involved vocabulary acquisition, yet Adoniou (2013) discovered that prewriting improves the quality of text. Drawing may be used to stimulate oral descriptions or stories of teachers before they start to speak. Comprehension may also be tested by drawing what students understand as they read passages or hear them.

Third, drawing ought to be of universal access to students. Students can be afraid that they do not know how to draw. It is important to note that drawing as a way of learning is one of meaning representation rather than art, as teachers ought to point out. Stick figures, graphs, and symbols suffice to enhance cognition. No longer aesthetic excellence, but depiction.

Fourth, drawing helps to make it different. Drawing can be used to assist students with memory issues or learning disabilities (Shoari and Asl, 2015; Matorina et al., 2024). Advanced learners can use more complex vocabulary in explaining and describing their drawings with the help of drawing. Young learners respond best to the abstract vocabulary by being drawn.

Drawing and Multimodal Pedagogy

The research findings favour multimodal language learning teaching. Adoniou (2013) contrasted drawing and writing by inferring that both systems of semiotics could provide learners with the benefits of switching the representations.

This multimodal view is in alignment with recent literacy research that encompasses many systems of meaning-making other than written ones.

Multimodal pedagogy perceives drawing as a legitimate source of meaning-making besides language acquisition. Metalinguistic awareness is attained when the students compare the verbal and visual meaning construction. They find out that certain meanings are more easily realised through images and others through sounds, and the most effective messages contain many media.

Limitations and Future Research Directions

Although the results have been consistent in studies conducted, it is important to note that there are a number of limitations. The vast majority of studies involved the evaluation of sketching without relating it to other instructional methods. The study of the effect of drawing on evidence-based practices such as spaced repetition, retrieval practice, and technology-mediated learning should be studied further. The majority of the studies targeted primary students. Teemueangsai et al. (2025) and Alhachami (2025) further extended research to older learners, but further research in adult learners, particularly at the university and professional levels, is required. The answer to the question of whether the drawing influence is universal in target languages and writing systems or not can only be found through research. Drawing benefits should be learned over the course of time to find out whether they are persistent and whether they develop cognitive abilities that could be practised in other learning assignments. The variation in drawing benefits is related to each student, and consequently, research can be done as to what the predictors are. Lastly, research is to be done on how to optimally combine sketching with digital tools because AI can help the learner to draw rather than to supplant them.

VI. CONCLUSION

As a cognitive support strategy in learning the vocabulary of a second language, the current paper has explored drawing through the lenses of dual coding theory and the drawing effect. The following points synthesise the findings:

- **Cognitive and Theoretical Foundations:** Drawing facilitates elaborative processing, helping learners enhance form-meaning associations and create integrated memory traces. Well-known frameworks like Dual Coding Theory and the Involvement Load Hypothesis (Shoari & Asl, 2015) elucidate how the simultaneous use of verbal and visual systems leads to more profound processing than traditional writing or passive imagery.
- **Empirical and Neurological Evidence:** Research into the drawing effect (Wammes et al., 2016) demonstrates that the motoric and pictorial nature of sketching creates robust memory traces. These traces are supported by multiple brain regions and have been shown to withstand severe memory impairment. Furthermore, practical applications in Thai, Iranian, German, and Australian contexts confirm that drawing significantly improves writing performance and student participation.
- **Affective Benefits and Human Agency:** Beyond cognition, drawing fosters confidence, autonomy, and anxiety reduction. In an increasingly AI-driven education system, drawing serves as a vital reminder of the role of human cognition. While technology facilitates information access, deep and flexible learning ultimately requires the learner to be the proactive producer of meaning.

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