

The Effect of Mobile Search Retrieval Types on Self-Regulated Learning Among Middle School Students

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Abstract

The accessibility and retrieval of digital images via search engines on mobile devices have increasingly gained momentum among learners, attributed to the presence of various user-friendly search options. Several strategies do exist for the retrieval of digital images through search engines. The initial approach is Text Based Image Retrieval (TBIR), while the alternative is Graphical Based Image Retrieval (GBIR). Research examining the effects of different retrieval styles on learning outcomes within educational settings is notably limited. This study seeks to identify the most effective retrieval technique for improving self-regulated learning (SRL) skills in middle school students. The study employed a quasi-experimental design to evaluate the two research groups, with the first experimental group utilising TBIR and the second experimental group utilising GBIR. The sample for this study comprised 60 middle school students, who were assigned at random to the two distinct groups for analysis. A scale for the detection of self-regulated learning has been developed in the present study, comprising 30 items. The findings indicated that the experimental group utilising GBIR demonstrated a higher level of self-regulated learning compared to the TBIR group. Expanding guidance for learners in utilising GBIR for accessing digital images is essential.

Keywords: *Mobile Retrieval, Text Based Image Retrieval (TBIR), Graphical Based Image Retrieval (GBIR), Self-Regulated Learning(SRL)*

Introduction

Mobile search applications represent a coherent and rational progression that has emerged as a consequence of advancements in digital image accessibility. These engines and applications have undergone a significant transformation, emerging as pivotal sources for accessing digital image content (De-Arteaga et al., 2015). The advent of image search engines and applications has afforded users a significant opportunity for interactive exploration (Dong et al., 2017). Mobile search applications represent an advanced iteration of e-learning environments, facilitating the management of learning contexts that are grounded in the principles of research-based learning. This approach requires an environment that is equipped with research tools that encourage users to engage with the construction of their knowledge through the exploration of a range of sources (Zhou, Hao & Duval, 2016). Mobile search applications facilitate the creation and management of content grounded in digital visualisations (Karczmarczyk, Jankowski, & Salabun, 2017). A plethora of applications is available for download from online sources (Guo et al., 2017). The efficacy of digital image-based applications has been examined across a range of educational contexts, with significant effectiveness being demonstrated (Alhalafawy & Tawfiq, 2014; Zaki, 2019; Kim, Seely, & Jung, 2017). Mobile image applications serve as an effective mechanism for enhancing the presentation of digital visualisations, thereby rendering them more adaptable and interchangeable across various systems (Guo et al., 2017).

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Mobile search applications retrieve digital images based on two main patterns (Cui, Lin, Nie, Yin, & Zhu, 2017; Liu, Zhang, Lu, & Ma, 2007; Squire, Müller, Müller, & Pun, 2000; Wu, Feng, Liu, & Sun, 2017):

TBIR: It is alternatively referred to as Annotation-Based Image Retrieval (ABIR), is discussed in the work of Vani and Raju (2010). In TBIR, the user inputs a collection of textual keywords pertinent to an image, its specifications, or its components into the search engine, and the application subsequently retrieves digital images that correspond to these textual entries. It is imperative for the user to exercise precision in the selection of terminology and semantic descriptions pertaining to the subject matter to achieve more accurate results (Raheja & Gupta, 2011).

GBIR: This retrieval method involves a search based on the graphic characteristics of an image, eschewing textual input. It identifies a specific image that has been previously stored and subsequently seeks out similar images, a process referred to as Search by Similar. Additionally, it can locate images that share common graphic components with the selected image, including attributes such as texture, colour, size, or shape. This method is recognised by various terminologies, such as Content-Based Image Retrieval (CBIR), which pertains to the graphic content of the image, Query by Image Content (QBIC), and Content-Based Visual Information Retrieval (CBVIR) (Islam, Banerjee, Bhattacharyya, & Chakraborty, 2017; Vani & Raju, 2010).

The present investigation seeks to ascertain the retrieval patterns that are most conducive to learner engagement, particularly in the context of empirical studies suggesting that each retrieval pattern possesses distinct characteristics that may promote its adoption as the primary research methodology (Zhu, Yan, & Ma, 2010). Furthermore, each modality of visual retrieval is underpinned by its own theoretical framework, with textual retrieval being grounded in the Dual Coding Theory. This theory posits that digital image search applications function as integrated environments, necessitating the inclusion of variables that engage both verbal and visual channels. A reliance solely on visual stimuli may exacerbate the cognitive load on the iconic memory system (Yen, Lee, & Chen, 2012). The dual coding theory posits that memory is comprised of two distinct information processing systems: the Iconic System, which is responsible for the representation and encoding of non-verbal stimuli, and the Symbolic System, which handles the representation and encoding of verbal stimuli (Paivio, 1991). Consequently, textual recall synthesises and harmonises both verbal and visual modalities within the mobile learning framework. This aligns with the Cognitive Theory of Multimedia Learning (CTML), which posits that the representation of knowledge through both text and images is superior to that of text alone, as it constitutes a principle aimed at enhancing the information transfer process (Mayer, 2005; Santos et al., 2014).

The graphical retrieval pattern provides support for the Conjoint Retention Theory. The theory posits that initiating learning with verbal stimuli may result in the depletion of working memory; conversely, commencing with visual stimuli does not incur the same cognitive load associated with verbal encoding. This implies that the process of searching for digital images that bear resemblance to a given image or possess certain graphic characteristics may confer a distinct advantage, facilitating easier verbal encoding at subsequent stages. may confer an advantage and facilitate verbal encoding at a subsequent stage, whereas the process of retrieving verbal vocabulary to locate digital images through a search engine may deplete a significant portion of cognitive resources in the effort to identify the appropriate keywords (Morett, Clegg, Blalock, & Mong, 2009).

This research investigates the influence of retrieval patterns on enhancing the self-regulated learning capabilities of middle school students. The significance of self-regulated learning is underscored by its status as a fundamental skill deemed essential for students in contemporary educational contexts (Alhalafawy & Zaki, 2022). Self-regulated learning, as an educational methodology, encompasses the process whereby students proactively recognise their learning requirements, establish their objectives, and determine suitable strategies, thereby enabling them to attain their learning goals independently, without the constraints of a predetermined time frame (Yasmin & Sohail, 2017). Learners who exhibit self-regulated learning characteristics are characterised by a high level of motivation, as they demonstrate a greater willingness to engage in and persist with learning tasks over extended periods. These individuals invest more effort compared to their non-self-regulated counterparts, efficiently practise their learning experiences

through diverse methods, and possess a broad array of strategies at their disposal. The individuals in question possess an extensive array of cognitive and metacognitive strategies. They demonstrate the ability to reorganise and structure their approaches, establish and persist in the pursuit of their educational objectives, and exhibit proficiency in monitoring their progress. Furthermore, they display intrinsic motivation, autonomy, and engage in metacognitive activities throughout their personal learning processes (Zimmerman, 1995). The promotion of self-regulated learning as a learner behaviour plays a crucial role in facilitating students' engagement in effective and meaningful learning experiences (Alhalafawy & Zaki, 2022). Self-regulated learning constitutes an educational approach that engages the learner in the active reorganisation of learning materials, the construction of knowledge inherent in these materials, and the integration of this knowledge with the learner's prior understanding. This process enhances the stability and longevity of their knowledge structure (Hudaifah, 2020). A considerable body of literature has emphasised the necessity of investigating the influence of contemporary and emerging technologies on the enhancement of self-regulated learning skills (Alhalafawy & Zaki, 2024; Alsayed, Al-Hafdi, & Alhalafawy, 2024; Ibrahim, Al-Hafdi, & Alhalafawy, 2024; Najmi, Alameer, & Alhalafawy, 2024; Najmi, Alhalafawy, & Zaki, 2023; Saleem, Zaki, & Alhalafawy, 2024; Zaki et al., 2024; Zeidan, Alhalafawy, & Tawfiq, 2017; Zeidan, Alhalafawy, Tawfiq, & Abdelhameed, 2015; Zohdi, Al-Hafdi, & Alhalafawy, 2024).

Self-organised learning skills are founded upon four fundamental competencies, which can be delineated as follows (Dignath, Buettner, & Langfeldt, 2008; Uka & Uka, 2020):

Goal Setting and Planning: This component pertains to the student's capacity to establish both general and specific objectives, devise a strategy for their attainment within a designated timeframe, and execute activities pertinent to the realisation of those objectives.

Keeping Records and Monitoring: This component pertains to the student's capacity to systematically monitor, document, and archive the activities undertaken to attain their objectives, as well as to meticulously record their findings.

Rehearsing and Memorising: This concept pertains to the student's capacity to internalise scientific material through auditory and silent modalities, thereby enhancing retention and comprehension.

Seeking Social Assistance: This refers to the learner's engagement with individuals in their environment, including educators and peers, to acquire diverse forms of support aimed at enhancing their comprehension of educational content or fulfilling assigned responsibilities

Building upon the preceding argument, the existing research identifies a gap pertaining to the resolution of the discourse surrounding the preference for textual versus graphical retrieval, particularly given that each modality possesses its distinct theoretical cognitive framework. Furthermore, given the significance of self-regulated learning as a critical competency in contemporary society, it is imperative to seek developmental strategies that can enhance self-regulated learning abilities. This assertion aligns with a substantial body of literature that emphasises the necessity of focussing on the fundamental skills of learners in the contemporary context, particularly regarding planning and self-regulated learning skills (Al-Hafdi & Alhalafawy, 2024; Al-Nasheri & Alhalafawy, 2023; Alanzi & Alhalafawy, 2022a, 2022b; Alhalafawy, 2018; Alhalafawy, Najmi, Zaki, & Alharthi, 2021; Alhalafawy & Zaki, 2019; Alnimran & Alhalafawy, 2024; Alrashedi, Alsulami, et al., 2024; Alrashedi, Najmi, et al., 2024; Alshammmary & Alhalafawy, 2022, 2023; Alzahrani & Alhalafawy, 2023; Alzahrani & Alhalafawy, 2022; Alzahrani, Alhalafawy, & Alshammmary, 2023; Alzahrani, Alshammmary, & Alhalafawy, 2022). Consequently, the study seeks to address the subsequent primary inquiry: What is the influence of mobile research retrieval methodologies (TBIR versus GBIR) on the self-regulated learning competencies of middle school students? The forthcoming inquiry will be addressed through the validation of the subsequent hypothesis:

The analysis reveals that there is no statistically significant difference at the 0.05 level between the mean scores of the first experimental group (TBIR) and the second experimental group (GBIR) regarding the enhancement of self-regulated learning levels.

Methods

Approach

The present study employed a quasi-experimental design, deemed the most suitable approach for examining the correlation relationship indicated by the effects of varying levels of the independent variables TBIR and GBIR on the dependent variable SRL. The present study employed a descriptive method during the phases of study, analysis, and design, facilitating an examination of retrieval patterns via mobile search applications and the identification of indicators associated with self-regulated learning.

Experimental Design

A two-group experimental design was employed, wherein the first experimental group employed TBIR, while the second group employed GBIR. Figure 1 illustrates the experimental design of the study.

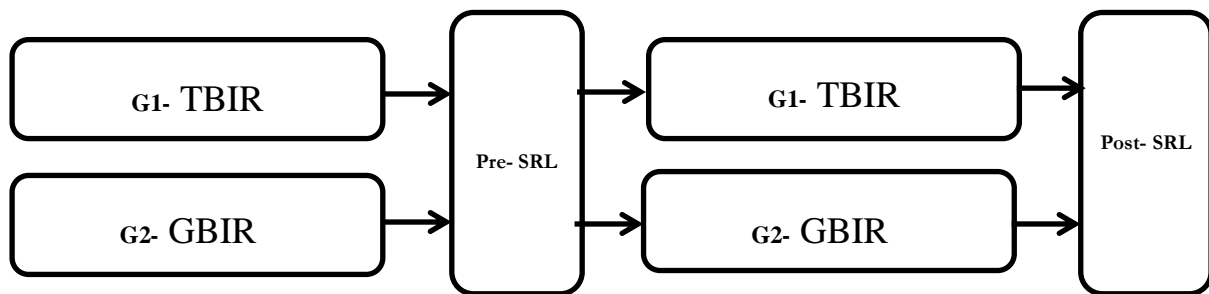


Figure 1 Illustrates the Experimental Design of the Study

The present study employed a quasi-experimental design to elucidate the relationship between the variables, with TBIR and GBIR serving as the independent variables and SRL as the dependent variable.

Sample

The research sample comprised (60) students from the Jeddah Educational Department, who were randomly selected from the ninth-grade cohort enrolled in the digital skills course. These students were categorised into two experimental groups: the first experimental group consisted of (30) students utilising TBIR, while the second experimental group also included (30) students employing GBIR.

SRL Scale

In the process of developing the SRL scale, an extensive review of various scales related to self-regulated learning was conducted, as evidenced by the works of Alhalafawy and Zaki (2022), Lombaerts et al. (2009), Purdie et al. (1996), and Usher and Pajares (2008). In alignment with the characteristics of the self-regulated learning dimensions that informed the prior scales, as well as the attributes of the learning environment facilitated by mobile research applications, the self-regulated learning skills scale was constructed around four key dimensions: Goal Setting and Planning, Monitoring, Rehearsing and Memorising, and Seeking Social Assistance. Each of the four themes comprised seven (7) vocabulary items, resulting in a cumulative total of twenty-eight (28) items. Participants were instructed to evaluate each item utilising a five-point scale (always - often - sometimes - rarely - never). The stability of the scale was verified prior to its application, yielding a Cronbach's α coefficient of 0.844 (Cronbach's $\alpha = 0.844$). The mean reliability of the re-application was calculated to be 0.82.

Procedures

The mobile research environment delineated in the present study is predicated upon the utilisation of the GOOGLE search engine through mobile devices during situational learning activities conducted with

students within the classroom setting. The TBIR and GBIR tools facilitate access to digital images of the robot sensor models incorporated within the third unit of the digital skills curriculum designed for third-grade intermediate students in Jeddah, Saudi Arabia.

The activities were developed based on the cognitive journeys model, which encompasses six components: introduction, objectives, tasks, processes, applications and resources, and evaluation. The subsequent activities are delineated as follows:

“Introduction”: This section offers a comprehensive overview of the sensors utilised in robotics, aiming to engage and inspire students to utilise the GOOGLE search engine on their mobile devices for further exploration.

“Objectives”: Explicitly delineate the specific objectives that will be attained for each robotic sensor upon the conclusion of the learning scenario.

The term "time limit" pertains to the duration designated for the execution of the learning scenario and its associated GOOGLE-based activities.

The “processes” involved encompass a comprehensive delineation of the sequential steps undertaken by the student, alongside the searches conducted via the search engine. This includes the application of TBIR and GBIR retrieval tools to fulfil the assigned task. Furthermore, it entails the formulation of strategies, engagement in various activities, and the allocation of a designated timeframe for the execution of the learning tasks.

“Applications and resources”: The section delineates a comprehensive overview of the retrieval instruments available for the execution of the specified activities, alongside a precise elucidation of the application of these instruments.

“Evaluation”: This section of the model delineates the criteria that will be employed to assess the components of the reports and essays to ensure comprehensive coverage of the fundamental aspects of robot sensors.

The TBIR tools were employed to systematically manage a complex array of concepts and topics pertinent to robot sensor subjects, enabling the student to discern keywords, sentences, and phrases that direct attention to specific information regarding the images that may emerge in the search results, as illustrated in Figure 2.



Figure 2. GOOGLE Search Engine-TBIR

In the process of image acquisition, tools associated with GBIR that utilise the retrieval of analogous images or employ parameters such as colour, size, shape, temporal aspects, or licensing rights were implemented, as delineated in Figure 3.



Figure 3. GBIR of the GOOGLE Search Engine

Result

To address the primary research question and to substantiate the hypothesis, a comparison will be conducted between the first experimental group utilising TBIR and the second experimental group employing GBIR. The t-test was employed to ascertain the significance of the differences observed between the first and second experimental groups, with the results of the t-test for the members of the two research groups presented in Table 1.

Table 1. The Arithmetic Mean, Standard Deviation, And T-Value for The Levels of Self-Regulated Learning Observed in Both the Experimental and Control Groups.

Group	N	Mean	SD	t	df	sig
G1- TBIR	30	100.60	1.35	69.73	58	0.000
G2- GBIR	30	129.40	1.81			

The analysis of the data presented in Table 1 indicates a distinct advantage for the second experimental group utilising GBIR in comparison to the second experimental group employing TBIR. Figure 4 presents a comparative analysis of the average total scores of self-regulated learning between the experimental and control groups.

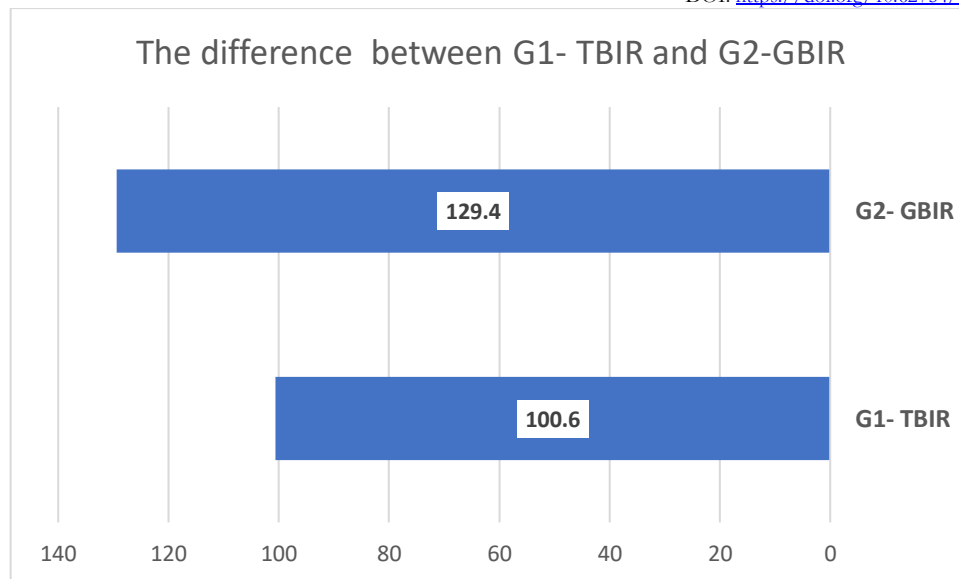


Figure 4. Difference Between the First Experimental Group and The Second Experimental Group in The Level of Self-Regulated Learning

Discussions

The findings of the research indicate a notable advantage for the second experimental group utilising GBIR in comparison to the first group employing TBIR. This superiority can be ascribed to the substantial role that pictorial material plays in the overall development of consciousness. Consequently, engaging students through retrieval patterns that emphasise graphic characteristics—such as colour, size, type, or analogous images—may facilitate the enhancement of the learner's cognitive structure, thereby providing multiple options that assist in the planning of their learning process. The engagement of the learner in the practice of diverse cognitive processes regarding learning materials can be facilitated by the comparison of visual elements chosen as inputs in the search engine with the images displayed on the results page. This comparative analysis encourages the learner to contemplate various alternatives, thereby enhancing the effectiveness of their learning planning (Alsmadi, 2017). This concept is also connected to the Conjoint Retention Theory, which posits that the encoding of information is facilitated when visual stimuli are utilised, thereby enhancing the subsequent association with verbal information. Conversely, initiating the learning process with verbal stimuli may result in cognitive overload, leading to difficulties in associating visual stimuli with verbal information (Morett et al., 2009).

The paramount attribute of GBIR lies in the regulation of search inputs, enabling the learner to specify the graphical characteristics that facilitate the attainment of particular outcomes. Furthermore, learners possess the capability to manage the search results and reorganise them based on these graphical attributes. Research indicates that an increase in control afforded to a learner correlating positively with their capacity for planning, as evidenced by their self-regulated learning competencies (Alhalafawy & Zaki, 2022). The graphical features provide learners with the flexibility to access a diverse array of digital images. The multitude of search options available enables learners to effectively monitor and manage their learning process and retrieval through GBIR, thereby enhancing their self-regulated learning skills, particularly in the domains of monitoring and control.

The GBIR initiative has encouraged students to engage in the practice of monitoring skills, as participants seek to evaluate their performance to ensure that the digital images they produce possess the precise graphic characteristics they have delineated. Consequently, numerous students exhibited a propensity to reiterate their efforts due to the rigorous oversight of their performance, aiming to attain the intended outcomes with precision. The GBIR system encouraged students to engage in personal strategies for analysing their

performance, as well as the underlying factors contributing to both success and failure. This approach empowers students to exert comprehensive control over the various opportunities available to achieve the desired educational outcomes by managing the inputs and graphical attributes effectively.

Visual information demonstrates a greater ease of retrieval compared to verbal information (Alhalafawy & Tawfiq, 2014). Consequently, the incorporation of graphic features via GBIR significantly augments learners' capacities to retrieve information linked to digital images. This enhancement is evident in learners' proficiency in memorisation and recall, which constitutes a fundamental aspect of self-regulated learning competencies.

GBIR facilitates the retrieval of digital images characterised by easily controllable graphic properties, thereby encouraging students to share these images with their peers. This sharing fosters discussions regarding graphic alternatives that can be utilised to generate improved suggestions and options. Such interactions contribute to the development of social help-seeking skills, which are fundamental components of self-regulated learning (Alhalafawy & Tawfiq, 2014).

GBIR is closely associated with situational learning processes, wherein the learner primarily seeks visual materials characterised by specific visual attributes (Alhalafawy & Tawfiq, 2014). Consequently, the retrieval and search for such materials must align with these attributes, which may prove challenging to articulate in textual form. Textual expression often lacks the necessary conceptual clarity, resulting in mere words that fail to convey the intended content with precision. Consequently, based on the principles of situational learning theory, the superiority of GBIR in comparison to TBIR can be substantiated.

According to the constructivist theory, which conceptualises learning as an ongoing process wherein the learner engages in various endeavours to construct knowledge (Zeidan et al., 2015), the benefits of GBIR can be elucidated by the learner's engagement in multiple activities that facilitate the analysis of graphic features and the subsequent extraction of similarities. These diverse processes, aimed at identifying images pertinent to the learning topic, enable the learner to traverse several stages of learning, thereby fostering the development of cognitive dimensions associated with the subject matter and ultimately enhancing the learner's capacity for self-regulation in their educational pursuits. The present findings align with numerous studies that have emphasised the significance of GBIR (Ahmad, Mehmood, Rho, Chilamkurti, & Baik, 2017; Alsmadi, 2017; Neven Sr, 2013; Rao, Rao, & Govardhan, 2011; Sakhare & Nasre, 2011; Yen et al., 2012).

Limitations

The influence of GBIR on SRL was examined within the framework of situational learning activities conducted in the classroom environment. The SRL skills scale was associated with the domain of mobile learning, and generalising the findings necessitates an examination of the scale's applicability in alternative contexts and with a more extensive sample of learners to facilitate factor analyses. The retrieval patterns were implemented through Google, which is recognised as the most prevalent and extensively utilised search engine among students. Consequently, the educational implications of these retrieval patterns may be extrapolated to encompass other mobile search engines and applications.

Conclusion

The purpose of this research aimed at clarifying the impact of retrieval patterns of digital images accessed through mobile devices on the enhancement of SRL. Two distinct retrieval patterns were identified: TBIR and GBIR. The comparative analysis of TBIR and GBIR was conducted to ascertain which method demonstrates greater efficacy in enhancing SRL. The findings indicate that GBIR demonstrates greater

efficacy than TBIR in enhancing SRL. The findings of the present study may be utilised to design situational learning activities that incorporate searches, thereby enhancing their focus on GBIR principles. Search engines within platforms and Learning Management Systems (LMSs) can be designed in alignment with the findings of contemporary research, thereby enhancing their foundation in GBIR methodologies. Subsequent research endeavours may focus on examining the influence of the interplay between retrieval patterns and learners' cognitive styles on educational outcomes. The examination of the processes involved in graphical retrieval via generative AI tools is of significant importance. Furthermore, it is essential to undertake research aimed at the development of digital image search engines tailored for digital platforms and learning management systems.

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