Enhancing English Technical Report Writing for Engineering Students through a Constructivist-Based Program Using Docear Software

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ABSTRACT

This study examines the impact of a constructivist-based program using Docear Software on developing technical report writing skills of the second-year students of the electrical engineering department at the Faculty of Engineering in Shubra, Benha University (N=45) To evaluate the participants' proficiency, the study used a technical report writing skills checklist and a test as well as a list of electrical engineering terminology. Additionally, the researcher developed the constructivist-based program using Docear Software. The study adopted the quasi-experimental design with the pre-post one group design. The findings of this study show statistically significant difference in the technical report writing skills. The program clearly had a significant impact on students' writing skills, as shown by the considerable effect size (η^2 = 98) that verify these findings.

Keywords: Technical Report Writing Skills, Engineering Students, Constructivist-Based Program, Docear Software

Introduction

English, as a global lingua franca, holds unique advantages in terms of accessibility and utility. Learning English as a foreign language (EFL) in Egypt significantly diverges from the experience of learning it as a second language (ESL) in native English-speaking countries, where daily life is immersed in English. In contrast, in Egypt, where Arabic is the mother tongue,

English predominates as a foreign language, especially within academic and business contexts. Additionally, EFL differs substantially from English for Specific Purposes (ESP), particularly in non-specialized faculties like Engineering, Medicine, Law, Business, and Nursing. ESP's tailored curriculum is designed for specific audiences who require English in both academic and professional settings. For engineering students studying their coursework in English, mastering ESP is essential, extending beyond subject comprehension to engaging with specialized references, enriching their knowledge, and aiding academic task completion. This underscores the need for a nuanced approach to English language acquisition, focusing on improving reading comprehension and facilitating the production of academic and technical written work.

According to Paltridge and Starfield (2013, p. 2), ESP courses are distinct in that their content and objectives are tailored to the precise requirements of the learners. Woodrow (2022) similarly affirms that ESP programs are intricately designed to align with learner needs. In harmony with ESP's learner-centered approach, Kırkgöz and Dikilitas (2018, p. 2) observe that ESP is customized to address the unique requirements and expectations of its participants. More recently, Basturkmen (2021, p. 498) defines ESP as a field of inquiry grounded in theory and empirical evidence, aiming to identify the linguistic characteristics of specialized varieties of English, the essence of

ESP pedagogy, and the processes by which learners acquire specialized English in both instructed ESP and natural settings.

In the realm of ESP, the study of English is not primarily an end in itself but a means to accomplish specific objectives, whether they involve business (Business English/BE), pursuing academic goals (Academic English/EAP), or various other needs like travel, medicine, science, internet technology, and more. Each of these distinct objectives may entail specific vocabulary, grammar, and functions. However, as highlighted by Woodrow (2022), structuring programs solely around linguistic elements falls short. Therefore, proponents of English for Specific Purposes (ESP) emphasize that effective language learning necessitates considering how learners will ultimately use the target language. As Johns and Dudley-Evans (1991, p. 305) argue, English for Specific Purposes possesses "specialized or unique" attributes that differentiate it from other English language courses. According to these definitions, it's the focal point on purpose that distinguishes English for Specific Purposes from other English programs. Rather than direct emphasis on language development in isolation, ESP programs concentrate on the specific objectives for which the language is required. This approach provides immediate and practical motivation for language learning, even though language proficiency isn't overtly the central aim of the program.

Professional engineers are mandated to demonstrate effective communication skills, encompassing written forms such as technical reports (Engineering Council, 2014). While universities aim to equip students for the professional realm, numerous new engineering graduates fall short of the expected writing proficiency level, as indicated by Moore and Morton (2017). In a survey by the Institution of Engineering and Technology (2017), 71% of engineering employers encountered challenges where candidates possessed strong technical knowledge but lacked essential workplace skills.

The significance of writing is also underscored as a learning tool, compelling students to synthesize information. Poor writing skills may impede a student's capacity to learn effectively (Moses & Mohamad, 2019). This concern extends beyond engineering students, with reports indicating a decline in writing skills across various academic disciplines (Carter & Harper, 2013).

Beer and McMurrey (2009) posit that the issue of inadequate writing skills is partly attributed to engineering students' preference for mathematical and practical work over written tasks. Additionally, students might underestimate the importance of writing skills (Lievens, 2012), which can further dampen their motivation to develop these skills (Talib & Cheung, 2017). However, studies suggest that undergraduates do acknowledge the importance of communication skills in their future careers,

although to a lesser extent than technical skills (Itani & Srour, 2016).

The literature offers a wealth of insights into effective methods for enhancing written communication skills among engineering students in various higher education settings. Many of these interventions revolve around the integration of communication skills within engineering curricula or the inclusion of technical communication courses (Ford and Riley, 2003; Lord, 2009). A common approach involves collaboration between subject matter experts and writing specialists (Oakley, et al., 1999; Yalvac, et al., 2007; Craig, et al., 2008). Other strategies focus on making assessment tasks and criteria more explicit, providing practical, job-related writing assignments, implementing feedback cycles for written submissions, and clarifying learning outcomes for engineering students (Boyd & Hassett, 2000; Plumb & Scott, 2002; Chirwa, 2007; Yalvac, et al., 2007; Flateby & Fehr, 2008). Some of these methods have also been observed in civil engineering curricula (Wilkinson, 2005; Patton, 2008; Rhoulac & Crenshaw, 2006). These interventions draw from various pedagogical approaches, including situated learning, constructivist and knowledge transformation frameworks, and genre-based teaching methods (Walker, 2000; Paretti, 2008; Lord, 2009). Additionally, literature underscores the significance of writing in fostering scientific and technical thought development.

Therefore, teaching technical writing for engineering majors is important as it equips students with the fundamental skills required for composing a wide range of technical documents, including business correspondence, memos, resumes, proposals, reports, and manuals. Proficient technical writing ensures the effective and clear communication of ideas, data, and conclusions, making it an asset for students across various career paths (Loh, et al., 2015). In the field of engineering, report writing is an integral component of an engineer's professional journey, and thus, the primary emphasis of technical writing education is to prepare engineering students to excel in crafting technical reports. A well-crafted technical report not only reflects the quality of an engineer's written work but can also have a direct impact on their career advancement. Government and industry professionals expect engineers to produce comprehensive technical reports, proposals, and other meticulously structured documents to excel in their roles (Raus, et al., 2019).

In the field of engineering, one of the primary methods of communication involves crafting writing technical reports, which are intended for managers, clients, and fellow engineers. This format is conventionally used to present the outcomes of research, investigations, and design projects (Monash University, 2010). For engineering students, there is a need to create concise laboratory reports or more extensive research and project reports (Ryder, 2002). Some researchers suggest that professional

engineers allocate approximately 30% of their working time to write reports (Raus, et al., 2019). The process of composing these technical reports is commonly referred to as technical writing.

Research into the technical writing of engineers is an expanding area of study. Some research has centered on the writing practices of professional engineers with the goal of gaining insights to improve the teaching of technical writing to aspiring engineers. Others have explored pedagogical approaches like situated learning and genre in the design of technical writing courses. These approaches provide students with a context to develop rhetorical skills and strategies needed to integrate into a discipline-specific discourse community (Artemeva, et al., 1999). According to Furman and Robinson (2008), a culminating paper assignment offers a valuable opportunity to enhance self-directed learning and technical communication skills. Zhu (2004), based on interviews with ten faculty members in business and engineering, concluded that the most effective writing instruction is achieved when content course faculty and writing instructors collaborate. As such, to effectively assist engineering students in honing their report writing skills, it is imperative to comprehensively assess their writing strengths and weaknesses. Thus, a thorough analysis of the writing produced by engineering students is necessary to gain insights for more targeted teaching of report writing skills.

As technical report writing has many challenges in functioning grammar and language structure, using authentic terminology, formatting writing technics, applying report components and steps of writing. To accomplish all the previous, ESP students should be aware and master technical report writing skills. Being a good technical report writer is not a natural ability that we either have or do not have but it can be improved by acquiring writing skills and writing continuously (Rollinson, 2005).

Engineering students enrolled in technical report writing courses rely not solely on the information presented in their academic courses or documented references. In the second academic year of their engineering studies, ESP students are tasked with accessing a wide array of resources, primarily through online platforms, including journals, periodicals, papers, and e-books (Berardo, 2006). The utilization of technology aids these learners in collecting extensive data via the internet, various software, applications, and online platforms (Violante & Vezzetti, 2014). These technological tools streamline group collaborations, enabling students to convene with their peers at their convenience, negating the need to physically convene, thereby saving time, financial resources, and effort.

Furthermore, these various software, applications, and online platforms also serve as a means for students to interact with their instructors, facilitating the sharing of assignments and posing inquiries. It is imperative to underscore that students do not

exclusively rely on the collected data or information present in their course materials. They are encouraged to draw upon their own life experiences, effectively combining this knowledge with insights gleaned from various external sources to construct new understandings and knowledge (Eady & Lockyer, 2013). This pedagogical approach aligns with the tenets of constructivist learning theory, notably influenced by Jean Piaget.

Constructivist theorists contend that learners are most effective when they engage in hands-on experimentation and problem-solving rather than passive reception of information (Chambers, 2013). By drawing on their own experiences and prior knowledge, students can formulate inferences, make discoveries, and arrive at well-founded conclusions, fostering a deeper and more meaningful learning experience (Hoidn, 2016).

Constructivist theory posits that reality is not an objective entity existing independently but rather a subjective construct shaped by human perception. It asserts that the majority of reality is contingent on human interactions with situations, leading to the subjective interpretation and creation of meaning. The transition towards embracing constructivism in higher education has been driven by the rise of global connectivity facilitated by information and communication technologies (ICTs) as noted by Wims and Lawler (2007). This technological advancement has enabled widespread global communication and, significantly, access to a wealth of knowledge resources via the internet since

the 1990s. With this expanded access to diverse knowledge sources, contemporary thought suggests that collaborative learning represents the most effective approach to facilitate teaching and learning in digital learning environments (Phillips et al., 2008).

Therefore, helping engineering students to acquire the technical report writing skills might be aided by the use of this constructivist theory by using a software that help them have different models of writing in one place to act as models, in addition to different tools that would help them in the writing process might help them develop their skills in a scientific way. As such, the researcher proposed that using *Docear* software.

According to Beel, et al. (2011, p. 465), *Docear* is a comprehensive academic literature suite, reminiscent of office software suites like Microsoft Office but tailored specifically for researchers. Unlike traditional office suites that bundle various applications for general office tasks, Docear provides a set of tools designed to meet the specific needs of scientists. This suite encompasses a digital library containing an extensive collection of research articles, both in full-text and with essential metadata such as titles, authors, journals, and publication years. It further features a research module equipped with keyword search functionality and a recommendation system for articles within its library. Users can access a PDF viewer for reading and annotating electronic literature, enabling tasks like creating

bookmarks, comments, and text highlights. The suite also offers a mind mapping module for drafting new literature and efficiently managing various information, including files, document drafts, references, and annotations. In addition, Docear includes a word processing module for creating academic content, a reference manager to facilitate the generation of reference lists and bibliographies, and various filters, converters, and a RESTful Web Service for seamless data exchange with third-party applications. Consequently, this study aimed to explore the impact of a constructivist-based program using Docear software in developing engineering students' technical report writing skills.

Context of the Study

In Shoubra Engineering Faculty, where the researcher works as an English instructor, students specialize in different departments after completing a general year known as the Preparatory year, during which they study various foundational courses, including an English course. The English course in the Preparatory year serves as a comprehensive review of English grammar and phonetics, ensuring that students from diverse high school backgrounds are adequately prepared for the specialized English for Specific Purposes (ESP) discipline. Upon successful completion of the Preparatory year, students are categorized into five main departments based on their Preparatory year grades. Shoubra Engineering Faculty consists of five major departments: Civil, Architectural, Electrical, Surveying, and Mechanical

Engineering, with additional minor specializations available in some departments.

During their Preparatory and first academic years, engineering students focus on enhancing their reading skills, particularly reading comprehension, through an English course that exposes them to various technical passages relevant to their specific specializations. In their second academic year, students transition away from general English courses and delve into a related discipline known as "Technical Report Writing." This course is typically taught by their English instructor, who is often the researcher in some departments.

Based on the researcher’s observations throughout 12 years of teaching, ESP engineering students have never experienced writing technical reports before their second year in their faculty of engineering. The researcher noticed a gap between teaching the material of technical report writing course and actual implementation of this course. The students declared that they do not prefer assessment based on writing and prefer MCQ exams instead.

The researcher also noticed the students' lack of interest in the technical report writing material as it is not one of the basic subjects, although it is a course for three sequential years while studying at the faculty, because its total score is up to fifty marks only, and therefore they do not make any effort to raise the level of their written performance. They misuse the passive voice in

their writing, facing problems in using suit terminology according to their different specializations. They are poor in writing technical reports as their knowledge of the report steps and components are very limited. They should be enriched with many resources to model their writing. Language structure and writing strategies should be presented to them to improve their technical writing too.

ESP engineering students tend to be more inclined toward practical applications rather than written expression. Consequently, technical report writing is not typically their preferred course of study. The selection of technical report writing skills for engineering students should be guided by the specific text types pertinent to technical and academic writing, as well as the students' individual qualifications. The task of equipping students with both theoretical and practical competencies necessary for the production of accurate technical reports faces several obstacles that can detrimentally affect their writing performance, leading to writing apprehension. These obstacles include:

1. Inadequate language proficiency among students for technical report writing.
2. The demand for specialized writing skills, encompassing both general and technical report writing.
3. Limited familiarity with authentic terminologies among students.

4. Insufficient mastery of language structures, particularly in regard to passive voice usage.

Some previous studies have also indicated that there are some problems while writing technical reports, in particular, and academic writing in general among students at engineering colleges. For example, Mahan, et al. (2000) have mentioned that engineering students cannot clearly present ideas, struggle to connect five or six sentences into a well-structured, cohesive paragraph. Instead, they tend to create lengthy, meandering reports that lack a concise introduction, summary, or clear statement of purpose. Additionally, they frequently overuse specialized vocabulary, trendy terminology, and abbreviations, especially in electronic communication.

Yoritomo et al. (2018) also highlighted some challenges in enhancing the writing skills of undergraduate engineering students. They discovered that existing writing assignments often do not align effectively with professional writing genres. Moreover, the authors observed that current writing instruction often fails to incorporate best practices from the field of writing studies. Another noteworthy finding was that departmental curricula typically do not evenly incorporate writing components throughout the entirety of the four-year programs.

To get more insights into the problem of the study, the researcher interviewed the managers of some engineering offices (5 engineering offices). An individual interview was also set with 5

fresh graduates engineering in an engineering company. The semi-structured interviews aimed to identify their problems in technical report writing skills.

Most of the participants agreed that the majority of engineering graduates encounter difficulties when it comes to composing technical reports for projects based on their practical applications. While they have acquired a sound understanding of engineering terminology within their respective specializations due to practical experience, they often lack the necessary writing skills, knowledge of technical report structure and content, familiarity with grammatical rules, and proficiency in the language conventions essential for effective writing. Engineering office managers have affirmed their support for graduates of engineering colleges, encouraging them to pursue external courses in private institutes to enhance their technical report writing abilities, thus ensuring a smooth workflow without interruptions. The process of project implementation adheres to stringent timetables, and these reports are submitted to specialized technical institutions, including project departments and several ministries, such as the Ministry of Planning and Population, the Ministry of Communications, and other ministries responsible for project execution and supervision.

Statement of the Problem

Based on the context of the study, the statement of the problem can be stated that most Engineering students lack the adequate

technical report writing skills as they receive average to low grades in the Technical Report Writing Course, indicating a significant problem for their future career development.

In order to address this problem, the present study seeks to answer the following research question:

What is the impact of employing a constructivist-based program, utilizing Docear software, in developing technical report writing skills for second-year electrical department students at the Faculty of Engineering in Shubra, Benha University?

This main research question can be further broken down into the following sub-questions:

1. What specific technical report writing skills are essential for second-year electrical engineering students?
2. What is the impact of a constructivist-based program in enhancing the technical report writing of second-year electrical engineering students?

Hypothesis of the study

To answer the research questions, the study tested the following hypothesis:

There is a statistically significant difference between the mean scores of the study group on the pre and post administration of the technical report writing skills test in favor of the post administration.

Purpose of the Study

The present study aimed to:

1. Identify the specific technical report writing skills that are essential for second-year electrical engineering students from the viewpoints of specialists.
2. Investigate the impact of a constructivist-based program in enhancing the technical report writing of second-year electrical engineering students.

Significance of the study

The significance of the present study extends to multiple stakeholders, including second-year engineering students, language instructors, and curriculum designers. It offers valuable contributions to their respective domains:

For Second-Year Engineering Students:

1. **Enhancing Technical Report Writing Skills:** This study aims to equip second-year engineering students with effective technical report writing skills. It addresses the fundamental need for them to communicate their engineering knowledge effectively through written reports.
2. **Improving Grammar and Language Structure:** In addition to technical content, the study provides guidance on grammar and language structure. This will empower students to write technically sound reports that are also linguistically proficient.
3. **Constructivist-Based Program:** Through the implementation of a constructivist-based program, this

research seeks to enhance the students' technical report writing skills. This method not only imparts knowledge but also fosters active engagement and critical thinking, enhancing the overall learning experience.

For Language Instructors:

1. **Enhancing E-Program Design Skills:** Language instructors can benefit from this study by developing their abilities to design effective E-programs. It demonstrates how such programs can be successfully integrated into educational environments, facilitating the teaching of technical writing skills.
2. **Access to Online Databases:** The study provides language instructors with insights into different online databases that are suitable for engineering students, especially in the context of English for Specific Purposes (ESP). This knowledge is valuable for teaching technical report writing.

For Curriculum Designers:

1. **Improved Technical Report Writing Curricula:** Curriculum designers can use the findings to enhance the content of technical report writing courses. The study helps provide suitable terminology tailored to various engineering specializations, making the curriculum more relevant and effective.
2. **Importance of Grammar and Language Structure:** Curriculum designers should recognize the significance of incorporating essential grammar rules and language structure

into the technical report writing course. This awareness ensures that students not only convey technical information but also do so with linguistic precision.

Delimitations of the study

This study was delimited to the following:

1. **Second-Year Engineering Students:** The study will exclusively involve second-year engineering students within the Electric Department at Shoubra Engineering Faculty, Benha University. The findings and recommendations will pertain specifically to this cohort, and their experiences will be central to the research.
2. **Academic Year 2021/2022:** The research is delimited to the academic year 2021/2022, ensuring that the data collected, and conclusions drawn are time-bound, applicable only to the experiences and outcomes of students during this specific academic year.
3. **Technical Report Writing Skills:** The primary focus of this research is on technical report writing skills. While the study acknowledges the importance of other language and communication skills, it remains delimited to technical report writing as its central theme.
4. **Constructivist-Based Program and Docear Software:** The study is specifically concerned with the impact of employing a constructivist-based program, utilizing Docear software, on the development of technical report writing skills.

Design of the study

This study employed a quasi-experimental design, specifically adopting a pre-posttest one group design. The research participants in this study (n=45) were randomly assigned from second-year engineering students within the Electric Department at Shoubra Engineering Faculty, Benha University. The participants were first tested on their technical report writing skills, followed by training on the proposed program using Docear software, and finally they administered the technical report writing skills posttest.

Participants of the study

In this study, data was collected from a cohort of 45 participants who were second-year engineering students in the Electric Department at Shoubra Engineering Faculty, Benha University in the academic year 2021-2022. As second-year engineering students, they are at a critical stage in their academic journey where effective technical communication skills are essential for their future success. The technical report writing course is typically a fundamental part of their curriculum, making them an ideal group to assess the impact of the Constructivist-Based Program utilizing Docear Software on their skill development. Furthermore, the participants' selection within the Electric Department at Shoubra Engineering Faculty offers a degree of specialization. This focus allows for a more targeted and specific evaluation of the program's effectiveness within a

particular engineering discipline, ensuring that the research outcomes have direct relevance to their academic and professional pursuits.

Instruments of the Study

To fulfill the purpose of the study, the researcher developed the following instruments:

a. A checklist of technical report writing skills.

The list of technical report writing skills was used to identify the skills related to academic research writing required for second-year electrical power students. This list was developed in order to be used for designing a rubric that assesses the technical report writing skills among the study participants.

The checklist covers a range of skills, including the use of subordinate and coordinate sentences, appropriate use of discursive connectors, constructing passive form appropriately, accurate usage of scientific terminology, using appropriate vocabulary without spelling mistakes, employing technology in preparing technical report writing, constructing illustrative figures and tables, organizing information with appropriate documentation, and writing a comprehensive summary in brief.

The checklist was submitted to the jury members for its content validity, and they have approved the skills without modifications.

b. A list of electrical engineering terminology

The list of electrical engineering terminology was used as a reference guide for academic research writing among second-year electrical power students. This list was developed in order to identify the appropriate terminology for the second-year electrical engineering students and to be included in the test of technical report writing skills. The list was submitted to the jury members, and they validated its content.

c. A test of technical report writing skills.

The technical report writing skills test, used both as a pretest and post-test (see Appendix), served as a means to gauge the potential impact of the Constructivist-Based Program utilizing Docear Software on the development of technical report writing skills among second-year electrical engineering students at Banha University. The test comprises two sections, with the first section assessing scientific terminology through true or false questions, covering various technical terms. The second section focuses on technical report writing skills, with students reading a passage and responding to questions that require summarization, APA-style referencing, figure creation, and table design. Furthermore, students must write an essay on topics such as transistors or voltage regulators and discuss the technological tools they would use to enhance technical reports. The test evaluates students' language proficiency and technical report

writing abilities, contributing to an overall assessment of their technical report writing proficiency.

The scoring rubric provides a structured framework with specific subskills for evaluation. The rubric for the Technical Report Writing Skills Test evaluates the participants on the various language and technical report-related skills as in the checklist, ranging from language proficiency to the ability to effectively use technology for report enhancement. The rubric's four-point scale, ranging from "Expert" to "Novel," offers a detailed assessment of the participants' performance in each skill.

The test underwent a content validity assessment by a panel of experts, and internal consistency was evaluated using a pilot sample. The test showed high internal consistency and reliability (0.83). The estimated time for the test was calculated as 120 minutes. The reliability of the test was calculated using the inter-rater reliability method. Two specialized raters evaluated and examined how well the students performed on the test during the pilot administration. Using Holisty's technique for assessing reliability, the times of agreement and disagreement regarding the students' performance were calculated and statistically examined. The results of the analysis showed that the test reliability was 0.93, which means that the test was highly reliable and ready to be administered to the study participants.

The Constructivist-Based Program utilizing Docear Software

The Constructivist-Based Program utilizing Docear Sof

tware is a comprehensive training program designed to enhance the technical report writing skills of engineering students. This program is rooted in constructivist pedagogy, a student-centered approach that encourages active engagement, critical thinking, and hands-on learning. It employs Docear Software, a powerful academic literature suite that integrates reference management, PDF organization, mind mapping, and note-taking, to facilitate the learning process.

Program Components:

- **Interactive Workshops**: The program commences with interactive workshops where students are introduced to the principles of technical report writing. These workshops provide a foundational understanding of the structure and key components of technical reports, emphasizing clarity, precision, and effective communication.
- **Docear Software Training**: Students receive comprehensive training in Docear Software, equipping them with the skills needed to manage literature, organize research materials, create mind maps, and efficiently reference sources. Docear enhances their ability to handle extensive information and supports research-oriented writing.
- **Constructivist Learning Activities**: The core of the program consists of constructivist learning activities. Students engage in collaborative projects, problem-solving

exercises, and group discussions, encouraging active participation and the application of their newly acquired skills. This hands-on approach ensures that students are not passive recipients of information but active participants in their own learning process.

- **Peer Feedback and Revie**w: Students are encouraged to provide constructive feedback to their peers' technical reports. Peer review sessions foster critical thinking, collaboration, and the development of a supportive learning community. This peer-based evaluation helps students improve their writing skills and their ability to receive and act on feedback.
- **Individualized Coaching**: To address the unique needs of each student, the program includes individualized coaching sessions. In these sessions, students can receive personalized guidance on their technical report writing, identify areas for improvement, and work on enhancing their specific weaknesses.
- **Assessment and Evaluation:** Throughout the program, students' progress is assessed through various means, including written assignments, peer evaluations, and the quality of their technical reports. This multifaceted approach allows for a holistic evaluation of their technical report writing skills.

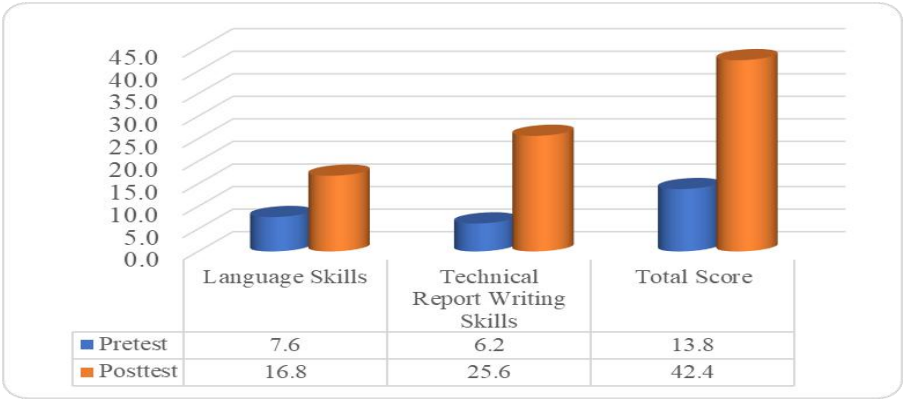
Results

To answer the study question stating, "*What is the impact of employing a constructivist-based program, utilizing Docear software, in developing technical report writing skills for second-year electrical department students at the Faculty of Engineering in Shubra, Benha University*?", the researcher tested the following hypothesis:

- There is a statistically significant difference between the mean scores of the study group on the pre and post administration of the technical report writing skills test in favor of the post administration.

The following figure and table show the results of descriptive statistics, i.e., means and standard deviations, and inferential statistics, i.e., the paired-samples t-test.

Figure 1: Mean scores of the experimental group students in the technical report writing skills pretest and posttest (N=45)



	Language Skills	Technical Report Writing Skills	Total Score
Pretest	7.6	6.2	13.8
Posttest	16.8	25.6	42.4

The figure above shows that there are differences among the mean scores attained by the experimental group students in the pretest and posttest of technical report writing skills in all subskills as well as the total score. To verify if such differences are statistically significant, a Paired Samples t-test was used.

Table 1.

Paired Samples t-test results of the technical report writing skills Test (Language Skills) (df=44)

Skills	Tests	Mean	SD	t	Sig.
1. Using subordinate and coordinate sentences	Pretest	1.67	0.48	14.646	0.000
	Posttest	3.24	0.57		
2. Using discursive connectors appropriately	Pretest	1.58	0.50	17.795	0.000
	Posttest	3.53	0.55		
3. Constructing passive form appropriately	Pretest	1.49	0.51	16.912	0.000
	Posttest	3.22	0.56		
4. Using scientific terminology accurately	Pretest	1.47	0.51	18.589	0.000
	Posttest	3.36	0.48		
5. Using appropriate vocabulary without spelling mistakes	Pretest	1.42	0.50	18.863	0.000
	Posttest	3.36	0.48		
Total of language skills	Pretest	7.62	1.95	24.983	0.000
	Posttest	16.78	1.52		

The results presented in the table above indicate significant improvements in all tested skills from the pretest to the posttest. The mean scores for each skill in the posttest are consistently higher than those in the pretest, indicating that the participants

have shown improvement in their technical report writing abilities across the board.

The t-values are quite large for each skill, and the associated p-values are all reported as 0.000, suggesting highly significant differences between the pretest and posttest scores. This indicates that the observed improvements in technical report writing skills are unlikely to have occurred by chance.

Furthermore, the "Total of language skills" row provides an overall summary of the participants' performance. The pretest mean score of 7.62 increases substantially to 16.78 in the posttest. This significant increase in the total score reinforces the notion that the participants' technical report writing skills have significantly improved over time.

Table 2

Paired Samples t-test results of the technical report writing skills Test (Technical Report Writing Skills) (df=44)

Skills	Tests	Mean	SD	t	Sig.
6. Employing technology in preparing technical report writing	Pretest	1.67	0.48	18.16	0.000
	Posttest	3.80	0.40		
7. Constructing illustrative figures and tables	Pretest	1.58	0.50	39.75	0.000
	Posttest	3.73	0.45		
8. Organizing information, including appropriate documentation	Pretest	1.49	0.51	24.35	0.000
	Posttest	3.56	0.69		

9. Writing a comprehensive summary in brief	Pretest	1.47	0.51	19.62	0.000
	Posttest	3.62	0.65		
Technical terminology	Pretest	1.22	1.36	18.47	0.000
	Posttest	10.91	1.49		
Total of report writing skills	Pretest	6.20	1.59	52.31	0.000
	Posttest	25.62	1.83		

The results in the table above demonstrate significant improvements in all tested skills from the pretest to the posttest. The mean scores for each skill in the posttest are consistently higher than those in the pretest, indicating substantial progress in technical report writing abilities.

The t-values for each skill are large, and the associated p-values are reported as 0.000, indicating highly significant differences between the pretest and posttest scores. This suggests that the observed improvements in technical report writing skills are unlikely to have occurred by chance.

The "Technical terminology" exhibits an interesting pattern. The mean score in the posttest is considerably higher (10.91) compared to the pretest (1.22). This substantial improvement indicates that participants have gained a much stronger understanding and command of technical terminology.

The "Total of report writing skills" row presents an overall summary of the participants' performance in technical report wri

ting. The pretest mean score of 6.20 dramatically increases to 25.62 in the posttest. This substantial increase further supports the notion that the participants' technical report writing skills have significantly improved overall.

Table 3

Paired Samples t-test results of the technical report writing skills Test (Total Score) (df=44)

Skills	Tests	Mean	SD	t	Sig.
Total Score of the test	Pretest	13.82	3.52	44.17	0.000
	Posttest	42.40	2.42		

The results indicate a significant improvement in the total score of the test from the pretest to the posttest. The mean score in the posttest (44.17) is substantially higher than the mean score in the pretest (13.82). This significant increase suggests that the participants' overall technical report writing skills have greatly improved.

The t-value of 3.52 suggests a significant difference between the pretest and posttest scores. The associated p-value of 0.000 indicates that this difference is highly statistically significant, suggesting that the observed improvement in the total score is unlikely to have occurred by chance. As such, the first hypothesis stating, “There is a statistically significant difference between the mean scores of the experimental group on the pre and post administration of the technical report writing skills test, in favor of the posttest” was accepted because of the results of data analysis.

To find out how much is the effectiveness of the constructivist-based program using Docear software in developing engineering students' English technical report writing, the effect size test was measured because the data analysis revealed statistically significant differences between the mean scores attained by the experimental group students on the pretest and posttest of writing skills. Using eta squared, the constructivist-based program using Docear software has the following effect size on fostering engineering students' English technical report writing:

Table 4

Effect size of the constructivist-based program using Docear software on students' technical report writing skills

Writing Skills	t	η^2
Language skills	24.98	0.93
Technical Report Writing Skills	52.31	0.98
Total Score	44.17	0.98

According to the table, the constructivist-based program using Docear software had a significant impact on students' technical report writing skills, as indicated by a high t-value of 52.31. This suggests that the program led to a significant improvement in students' abilities to write technical reports.

The effect size for technical report writing skills, represented by η^2, is 0.98. Effect sizes close to 1 indicate a

substantial impact of the program on the outcome variable. In this case, the high effect size suggests that the constructivist-based program had a large effect on enhancing students' technical report writing skills.

Comparing the effect size of technical report writing skills to language skills, we see that the effect size for technical report writing is slightly higher (0.98 vs. 0.93). This indicates that the constructivist-based program had a relatively stronger impact on improving technical report writing skills compared to general language skills.

The total score, which is likely to represent an aggregate measure of writing skills, also demonstrates a significant effect size of 0.98. This suggests that the constructivist-based program had a substantial influence on overall writing skills among the students.

Conclusions

At the Faculty of Engineering in Shubra, Benha University, second-year electrical department students were evaluated on their ability to write technical reports as a result of the use of a constructivist-based program that used the software Docear. The study's findings are consistent with the hypothesis that there is a statistically significant difference in the study group's mean scores on the technical report writing abilities test taken before and after the post administration, favoring the post administration. The descriptive and inferential data shown in Figure 1 and Tables

1, 2, and 3 show significant gains between the pretest and posttest in both language proficiency and technical report writing abilities. The posttest's mean scores routinely outperform the pretest's, demonstrating considerable improvement in the participants' technical report writing skills. All p-values are provided as 0.000, indicating extremely significant differences between the pretest and posttest scores, and the corresponding t-values are large. Furthermore, the constructivist-based program utilizing Docear software had a significant impact on students' technical report writing skills, as shown by high effect sizes for language skills (0.93), technical report writing skills (0.98), and the overall score (0.98), according to the effect size analysis using eta squared (2). These effect sizes show that the program's impact on enhancing technical report writing skills was greater and more substantial than its impact on general language skills.

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