Utilizing A Strategy Based on EDJA Model to Develop EFL Technical Writing and Critical Thinking Skills of Higher Institute of Transport Technology Students

Dr. Mohamed A. Aboulfotoh
A lecturer of English, English Department
Management Sciences Academy (MSA), Beni-Suef, EGYPT

Abstract

The research aimed at utilizing a strategy based on EDJA Model to develop EFL technical writing and critical thinking skills of Higher Institute of Transport Technology (HITT) students**.** Participants were the fourth-year students at the HITT, Wardan, Giza governorate, Egypt, in the first term of the academic year 2023/2024. The researcher adopted a pre-post experimental one group design. The sample included a group of (37) students selected randomly. Instruments were as follows: a needs analysis questionnaire, a questionnaire of EFL technical writing and critical thinking skills, a pre-posttest of EFL technical writing skill and a rubric to score it, a pre-posttest of EFL critical thinking skills and a rubric to score it, and a Can-Do Checklist. The intervention included (14) sessions for seven weeks (90-minute per session). Results showed that utilizing the strategy based on EDJA model could develop the EFL technical writing and critical thinking skills. Thus, it was highly recommended to implement cooperative learning models, e.g. EDJA in English for Specific Purposes (ESP) programs. Critical thinking instruction should be incorporated in academic study especially technical study field.

Keywords: Critical, EDJA, Technical, Thinking, Writing

استخدام استراتيجية قائمة على نموذج إيدجا لتنمية مهارتي الكتابة الفنية والتفكير النقدي في اللغة الإنجليزية كلغة أجنبية لدى طلاب المعهد العالي لتكنولوجيا النقل

الملخص باللغة العربية

هدف البحث إلى استخدام استراتيجية قائمة على نموذج إيدجا لتنمية مهارتي الكتابة الفنية والتفكير النقدي لدى طلاب المعهد العالي لتكنولوجيا النقل. وتمثلت عينة المشاركين في الدراسة من الفرقة الرابعة (37) طالباً بالمعهد العالي لتكنولوجيا النقل، وردان، الجيزة، وذلك في الفصل الدراسي الأول من العام الأكاديمي 2024/2023، وقد تبنى الباحث التصميم التجريبي لمجموعة تجريبية واحدة تم اختيارها بطريقة عشوائية. وتضمنت أدوات الدراسة: استبانة تحليل الاحتياجات، واختبار مهارة الكتابة الفنية قبلي بعدى ومقياس لتصحيحه، واختبار مهارة التفكير النقدي قبلي بعدى ومقياس لتصحيحه، وبطاقة أستطيع أن أفعل-للملاحظة لتقييم مهارة التفكير النقدي لدى المشاركين بالدراسة، واشتملت المعالجة على (14) جلسة لمدة سبعة أسابيع (90 دقيقة للجلسة)، وأوضحت النتائج أن استخدام استراتيجية قائمة على نموذج إيدجا قد ساعد في تنمية مهارتي الكتابة الفنية والتفكير النقدي؛ ولذا يوصى بأن يتم تضمين نماذج التعلم التعاوني مثل نموذج إيدجا في برامج اللغة الإنجليزية لأغراض خاصة، وكذا يجب تضمين تعليم مهارات التفكير النقدي في الدراسة الأكاديمية خاصة المجال التقني.

الكلمات المفتاحية: إيدجا، التفكير النقدي، الكتابة، الفنية

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1.1 Introduction

The usage of English language in professional communication settings ranks as the first indicator among an employer's expectations from his/her employees. Technical writing, as a form of professional communication, is crucial for both study and career development. The technologists who can express themselves and present their ideas well in English, derives a great deal of personal satisfaction from their ability. They need to report a formal written message about manuals, projects, and work problems. Since a report can be no clearer than the thoughts upon which it is based, those who learn to write clearly will of necessity train themselves to think more critically too.

In so doing, EFL technical writing primarily results in an ability to think critically about technical problems. To gain a deeper understanding of a problem and formulate new ideas from old ones, writing tasks make the students think critically for deeper understanding (Al Maghreby, 2013: 29). Hence, technical writing affects both students' academic progress and future career success (Farag, 2012: 9). Essentially, it is a way to convey meaning, communicate professionally (Al Maghreby, 2013: 26) and one of the main requirements in the general or technical educational system but technological students have low level in it (Eisa, 2022: 2).

Rus (2015: 1109) has found that technical writing isn't students' favorite activity. Farag (2012: 10) has revealed some weakness

points, related to technical content, writing style, grammar, mechanics of writing, such as:

1. missing the use of illustrations and formal expressions
2. having spelling and punctuation errors
3. missing the needed details for clarity. The questionnaire results have shown that most of students (65%) have negative attitudes towards technical writing.

The technology students' reports are badly constructed and poorly expressed. They are unable to organize the layout and structure of a report. Most of them are not aware of the elements of technical reports, figures description; find difficulties in edition and revision. They need an innovative model to produce readable reports (Haggag, 2024: 366). Additionally, they lack competence in grammar and vocabulary. They want more time to discuss their technical problems and practice writing tasks related to their own field (Zaki 2008: 154).

To produce readable technical texts is hindered by several obstacles, indicated by Rus, (2014: 1110) as follows:

1.Students' language proficiency is insufficient for the task. They don't have sufficient knowledge of the topic they approach in writing.

2.Writing in general and technical writing in particular is a complex and laborious process requiring commitment and specialized skills.

Unfortunately, many Egyptian technological institutes emphasize on technical courses, taking no notice of the fact that communication is the only bridge for knowledge delivery and technical writing should go hand in hand with technical courses. Zaki (2008: 10) has assured that the students are not even trained in forms of technical writing. English courses should not be separated from real life situations. Conducting interviews with 2nd year students (142) at Ismailia Faculty of Computer and Informatics,

Abu El-Magd (2022:103) has revealed that there is dissatisfaction with the way they practice EFL technical writing skills. Additionally, Bendary, (2018: 8) has found that they have linguistic problems e.g., shallowness of ideas, lack vocabulary, and grammatical errors. Due to Haggag, (2024: 374), these challenges may be due to the nature of technical writing which requires the production and use of coherent and highly technical language.

The task of equipping them with both theoretical and practical competencies necessary to produce accurate technical reports faces several obstacles, identified by El-Naggar, Yehya and Abdel-Aziz, (2023:273) as follows:

1. Inadequate language proficiency among students for technical report writing.
2. Limited familiarity with authentic terminologies among students.
3. Insufficient mastery of structure, particularly passive voice usage.

Referring to the findings of Alaraj's study (2022: 229), Saudi university students really have a big problem in technical writing as they have felt that:

1. Spelling, technical terminology and coherence are the most difficult areas. Grammar and vocabulary are moderately difficult; and cohesion and mechanics are the least difficult.
2. Writing practice deficiency, lack of terminology and deficiency in mechanisms, lack of motivation and weak prior knowledge are minor causes.

Developing technical writing skill is not an easy task. The instructor ought to provide motivation to write technical documents in real situations or professional contexts. By ensuring that students can constantly exercise their writing skills in a variety of real contexts, starting from guided writing (note completion, summaries, fill-in, closes) to more complicated tasks requiring them to produce full paragraphs/texts, they will acquire the experience which will

enable them to function adequately in a professional environment (Rus, 2015: 1109).

Critical thinking (CT) is an indispensable part of human life as well as in accomplishing writing tasks at work. Before making any decision, a technician should be able to gather, analyze, evaluate, and synthesize the information, as well as envision the consequences of the course of each alternative (Mohammed, 2020:107). Critical thinking is analyzing, reasoning, and evaluating, according to proven standards. This stimulates a higher level of thinking and enables students to take rational decisions analyzing different contexts (Rana, 2012: 51).

Stepanivna, et al. (2023: 352) have recommended educators in technical universities fostering critical thinking skill through foreign language instruction and preparing the students as analytical thinkers in both technical knowledge and cross-disciplinary collaboration. To address the challenge of integrating critical thinking within technical disciplines, it has delved into the nuances of contextualization. Drawing on educational theories and research, analytical skills should be seamlessly interwoven with technical content in foreign language classes. Hence, using pedagogical models is required to bridge the gap between critical thinking development and subject expertise, ensuring that students acquire cognitive tools relevant to their future careers.

Despite the importance of critical thinking skill, it's the least implemented and the most neglected one in the Egyptian curricula so most of students are not educated as critical thinkers. It is suggested using the cooperative learning models for developing it (Bendary, 2018: 6). EFL instructors ought to weave creative activities into the curriculua to create a balance that mirrors the real-world integration with thinking critically. The students can't benefit

from their knowledge into their learning and apply what they acquire when they think critically (Mohammed, 2020**:**148).

Nearly all employers surveyed (95%) agree that 'a candidate's demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than their undergraduate major' (Goldsmith, 2013: 10). EFL instructors should not only concentrate on the students' accuracy of language, but how they express the ideas (Mohammed, 2020:150). Hence, Al-Ghadouni (2021:5) has recommended fostering critical thinking skill in EFL learning.

Consequently, it has been noticed a gap in integrating critical thinking into EFL instruction, especially in the technical fields. This evokes the need to conduct this study which attempts to pay attention to the correlational relationship between technical writing and critical thinking. To prepare the well-rounded graduates, critical thinking should be integrated in EFL courses.

Emphasizing the significance of critical thinking in technical careers, Stepanivna, et al. (2023: 344) have assured the need for cooperative learning models. One of them is the EDJA model. The researcher has utilized a strategy based on EDJA model to develop EFL technical writing and critical thinking skills. This in turn highlights the significance of this study. To the best knowledge of the researcher, there isn't any study that has dealt with technical writing and critical thinking on the Egyptian context.

1.2 Context of the Problem

The Higher Institute of Transport Technology (HITT) is considered as the only institute specialized in the field of transport technology in Egypt and the Middle East. It is established by the Ministry of Transport and is under the supervision of Higher Ministry of Education in Egypt. The HITT program has two sections: mechanical units and signals. It is committed to preparing technicians (2 years) or technologists (4 years) who should be able

to practice their job requirements effectively in the field of transport means, especially train. To promote such an opportunity, the fourth-year students need to develop their EFL technical writing performance by acquiring technical writing skills necessary for their future jobs after graduation. The technologist is also required to think critically about the technical problems and construct their written work accordingly.

The main aim of technical English course in the fourth year is to develop the ability to write a structurally correct technical report. By the end of this course, HITT fourth-year students should be able to:

1. write step-by-step clear procedures or instructions or manuals.
2. describe a project through figures, graphs and lines.
3. use technical vocabulary and expressions.
4. summarize and analyze technical texts.
5. use the simple, compound, and complex sentence.
6. acquire problem solving, critical and creative thinking skills.
7. **identify a problem, and how it can be solved in a technical report.**

From the researcher's teaching experience (two years) as a part-time lecturer of English at HITT, it was noticed that most of the fourth-year students can't express the content clearly, write grammatically correct sentences, and lack the mechanics of writing. The problem has been indicated by many studies, e.g. Abu El-Magd, 2022; Eisa, 2022; Farag, 2012; Haggag, 2024; Mitry, 2009; Rus, 2015 & Zaki, 2008) who have concluded that the students need to relate what they have learned to what they are going to experience in their real life, which is widely absent from the program and the instruction of EFL technical writing need more practice through a cooperative learning model.

The researcher conducted a pilot study on the first week of October 2023 to ensure that there was a problem concerning the technical writing level of the HITT fourth-year students (N=30). They were asked to write a technical report about: (1) a Problem in a Safety Workshop, and (2) Trains Development. It has been found that the HITT fourth-year students had a low level in their technical writing skills. The results could be explained as follows (**Appendix 1**):

1. The titles were not clear enough to tell what was going to happen (30%).
2. Most students wrote in a list form not in a paragraph form (40%).
3. Some students wrote in poor technical writing style (30%).

Finally, the researcher adopted Stepanivna' survey (2023: 354) among HITT fourth year students (n=100), asking about their perception of critical thinking, challenges, and potential benefits.

Survey: Assessing HITT students' perceptions of critical thinking, adopted from Stepanivna' survey (2023: 354)

Introduction: The survey aims to identify your perspectives on the relationship between critical thinking skill and English learning within technical disciplines. Your response will provide valuable insights to enhance the integration of critical thinking in your technical English course.

1. **How important do you consider critical thinking skill in your technical field?**
2. **How confident are you in your ability to apply critical thinking skill in technical writing?**
3. **In your opinion, how does English learning contribute to the development of critical thinking skill?**
4. **Have you noticed any challenges when applying critical thinking skill in English context?**
5. **Would you be interested in participating in collaborative tasks that require critical thinking in English context?**

The results indicated the following points:

Question 1: On a scale of 1 to 5, how important do you consider critical thinking in your technical field? 90% of respondents rated it

as "very important" (4 out of 5) or "extremely important" (5 out of 5) for their technical field.

Question 2: How confident are you in your ability to apply critical thinking skill in technical writing? Approximately 70% of participants expressed moderate to high confidence in their ability to apply critical thinking in an EFL context.

Question 3: In your opinion, how does EFL learning contribute to the development of critical thinking skill? Approximately 65% of participants expressed moderate to high opinions on the development of critical thinking.

Question 4: Have you noticed any challenges when applying critical thinking skill in English context? If so, please specify. 60% of students reported challenges such as difficulty in nuanced expression, hesitation due to linguistic uncertainty, and a perceived slowdown in the thought process while writing.

Question 5: Would you be interested in participating in collaborative tasks that require critical thinking in English context? Around 75% of participants indicated an interest in interdisciplinary tasks. 82% highlighted the value of learning to communicate technical ideas effectively.

1.3 Statement of the Problem

The problem can be stated in “the low level of Higher Institute of Transport Technology (HITT) fourth year students' EFL technical writing and critical thinking skills”.

1.4 Questions of the Research

The research is an attempt to answer the following main question: " What's the effect of utilizing a strategy based on EDJA model on developing EFL technical writing and critical thinking skills of Higher Institute of Transport Technology Students". This main question has been divided into the following sub-questions:

1. What are EFL technical writing skills required for HITT fourth year students?
2. What are EFL critical thinking skills required for HITT fourth year students?
3.How far do HITT fourth year students possess these skills?
4.What is the relationship between EFL technical writing and critical thinking?
5.What are the steps of a strategy based on EDJA model to develop EFL technical writing and critical thinking skills of HITT fourth year students?

1.5 Delimitations of the Research

The current research is delimited to:
1. A sample of HITT fourth year students (N=37), Wardan, Giza, Egypt.
2. Technical writing skills in four areas: Technical Content (TC), Writing Style (WS), Grammar, and Mechanics of Writing (MW)
3. The first term study period 2023-2024

1.6 Instruments of the Research

To achieve the aim of the research, the instruments are developed as follows:
1. a needs analysis questionnaire
2. a questionnaire of technical writing and critical thinking skills
3. a pre-posttest of technical writing and a rubric to score it
4. a pre-posttest of critical thinking skills and a rubric to score it
5. A Can-Do Checklist

1.7 Significance of the Research

This research may be useful for: 1. assisting HITT fourth year students to integrate critical thinking skills into EFL technical writing skill, 2. providing curricula and training program designers with a guide to utilize a strategy based on EDJA model to develop EFL technical writing, 3. attracting EFL instructors' attention to promote critical thinking, and 4. directing the researchers' attention

to the relationship between critical thinking in EFL technical writing instruction.

1.8 Definitions of Terms

1. EDJA Model

EDJA is a cooperative learning model based on giving a real problem to solve it in analogic groups. The model is an integration of three theories (constructivism, cognitive, and social) (Al-Awaini, 2021).

EDJA is a model in which students analyze the instructional situations in a collaborative dialogic way and motivate them to synthesize, evaluate alternatives and apply learning in new situations (AL-Helou & Muhammed, 2022: 123)**.**

The operational definition of a strategy based on EDJA model is " a set of instructional procedures in the light of EDJA model that the instructor utilizes to develop EFL technical writing and critical thinking skills of HITT students."

2. EFL Technical Writing

Zaki (2008: 15) has defined it as " conveying technical information to a specific audience with a specific purpose in mind and usually in a standardized format."

El Maghreby (2012) has defined it as " a process of writing a document that describes the process, progress, or the technical results of a certain problem; characterized by its technicality in an easily accessible format."

Farag (2012: 15) has defined it as " a process in which technical writer takes complicated, technical jargon, and translates it into technical style supporting it with illustrations such as designs, charts, and technical symbols."

Haggag (2024: 370) has defined it as "the process that integrates cognitive and skill-oriented steps to describe data related to the technical field."

The operational definition is " HITT fourth year EFL students' ability to produce formal, clear, and readable report that are technically designed for specific readers in their field."

3.Critical Thinking (CT)

Dewey, the father of CT, has defined it as " an active, persistent and thought-provoked belief or knowledge in the light of the reasons for it and its subsequent conclusions."

Bendary (2018: 18) has defined it as " the ability to interpret, analyze, evaluate, infer, and explain data, develop lines of argument and make judgements."

Brahim (2021: 5) has defined it as " a thinking process of making valid judgements, objective decisions, reasonable conclusions and/or solving problems, based on evidence considering different perspectives or explanations."

Mohammed (2020: 22) has defined it as " the ability to ask questions and answer according to the analysis and interpretation of the provided information."

The operational definition is " HITT fourth year EFL students' ability to use their schemata to clarify, evaluate, analyze, justify, infer, self-regulate information for solving problems in the professional context."

2. A Review of Literature & Related Studies

2.1 Characteristics of EFL Technical Writing Skill

In Egypt, technological education has become the train of development. Emphasizing the significance of EFL skills as means

of professional communication, technical writing is considered as the most important form for HITT students. One of the main aims of HITT is achieving a recent integrative track in technical training or technological education to qualify the graduates for the labor market and address the problems they face in the field of transport. According to Technical English Course specification at HITT, the fourth-year students should be able to:

1. study a technical problem, draw conclusions, and write a report outlining it.
2. apply the theoretical and the practical background in project. A report was about a topic related to technical applications or projects.

Hence, technical writing mainly differs from nontechnical in two main aspects: precision and intent. Precision is conveying the idea concisely in the form of technical reports. Intent or an author's purpose is his reason for or intent in writing to inform the reader, or to satirize a condition. It includes specifications, proposals, facilities descriptions, manuals, procedures, and safety reports (Laplante, 2019, 2: 5). The main aspect to write a technical document is that it is different from a " general" one in terms of its purpose, context, medium, and audience (Rus, 2015: 1114). Writing is a process of four stages outlined by Laplante, (2019:49) in figure (1).

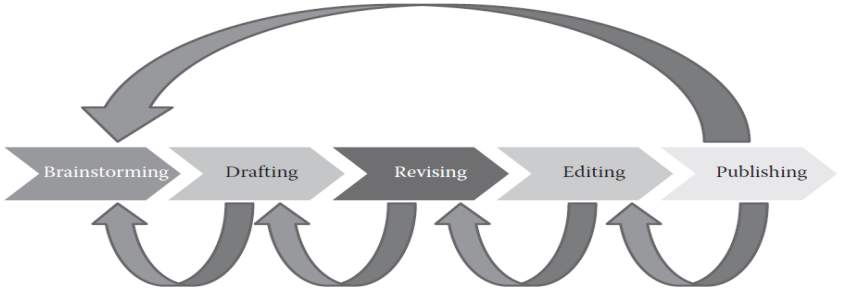


Figure (1) The Writing Process (Laplante, 2019: 49)

Planning is brainstorming the main ideas and connecting them together, removing the unimportant details. Drafting is an initial writing that integrates an introduction, a body, and a conclusion. Revising is a process of organization, checking writing conventions, and reviewing. Editing is to correct the report. Publishing refers to final adaptations. Moreover, Rus (2015, 1111:1112) has indicated the characteristics of technical writing as follows:

1. **Planning:** Before starting to write, the students should first make sure that:
   a. The nature of the audience on which the choice of vocabulary is based.
   b. The purpose (to inform, persuade, instruct, etc.) and the material is known.
   c. The ideas and materials should be organized around them.
2. **Clarity:** The students make sure that transmitting information is not affected using professional jargon (specialized vocabulary and abbreviations).
3. **Brevity:** refers to the efficient use of words.
4. **Simplicity:** Details should be wisely used.
5. **Word Choice:** Students should pay attention to word order.
6. **Active Voice:** The use of the passive voice in technical texts was more appropriate, due to the objectivity and higher formalism.

Other characteristics of technical writing include factual detail, graphics, information sources, realistic audience and situation, headings and lists, length, technical content and special format (Haggag, 2024: 376). The format of technical report is indicated by Al Maghreby (2013, 37: 38) as follows:

1.Title Page: a summary including important features, results and conclusions.

2. Contents: numbers and lists, all headings with page numbers.

3. Introduction: states the objectives of the report.

4.The main body of the report: These sections present the different ideas in a logical order, divided into numbered and headed sections.

5. Conclusions: short logical summing up of themes developed in the main text.

6. Reference: details of published sources of material referred to or quoted in the text (including any lecture notes or URL address of any websites used).

7. Bibliography: other published sources of material" 'including websites, not referred to in the text but useful for background or further reading.

8. Acknowledgement: a list of people who help prepare the report.

9. Appendices: any further material which is (if appropriate) essential for full understanding of your report (e.g. large-scale diagrams, computer code, raw data, specifications) but not required by a casual reader.

2.2 Problematic Areas of EFL Technical Writing

To explore the problematic areas in writing technical report, Al Maghreby (2013) found that there were grammatical errors in style of writing. El-Naggar, Yehya, and Abdel-Aziz (2023: 274) conducted semi-structured interviews for fresh engineering graduates to identify their problems in technical report writing skills. Most of them lacked the knowledge of technical structure and content, familiarity with grammatical rules, and proficiency in the language conventions.

Alaraj (2022, 223: 229), ranked the areas of difficulty in technical writing: 1. Coherence (connecting ideas), spelling, and technical terminology were considered the most difficult areas, 2. Sentence structure, grammar, and cohesion (joining parts of a text using linking words) came in second place, and 3. Mechanisms and punctuation were considered the least difficult. The effective solutions could be divided into three categories: 1. Practicing

writing a lot, 2. Revising, attending writing workshops and comprehending technical writing mechanisms, and 3. Relating writing skills to real life situations or problems.

2.3 EFL Technical Writing Skills

The studies of Zaki (2008), Farag (2012: 14), and Abu El-Magd (2022) divided technical writing skills into: technical content, organization, grammar, literary style, mechanics. These skills included the use of discipline-oriented technical language, layout and structure, content as well as utilizing proper editing and revising techniques.

Assessing students' technical writing was a challenge due to its performative and technical features. In this view, Wright et al. (2022) investigated the nature of technical writing assessment and its instruments to be included in assessing engineering students. Wright expressed the view that "evaluation tools could play an important role, with rubrics serving as the primary assessment tools for technical writing". Accordingly, the writing scoring rubric for students' technical writing performance encompassed the four main criteria of content, organization, terminology, structure, and mechanics of writing. Hence, technical writing skill in this study included content, writing style, grammar, and mechanics of writing.

2.4 Studies Related to EFL Technical Writing Skill

Many studies dealt with technical writing skills. Zaki (2008) investigated the effectiveness of an ESP program in improving technical writing skill for Banha Higher Institute of Technology students. A technical writing program was designed based on a needs analysis of the second-year students. It was concluded that technical writing instruction was essential both for academic requirements and success at the workplace and should go parallel to engineering courses for optimum acquisition. Mitry (2009) determined the effectiveness of suggested scaffolding activities in developing engineering students' technical writing skill and their attitudes towards writing in English. The findings showed that there

was a statistically significant difference between the mean scores of the scaffolding group/SG in their performance in the pre and post administrations of the technical writing test**.** Farag (2012) also proved the effectiveness of suggested scaffolding activities in developing engineering students' technical writing skills and their attitudes towards writing English.

Al Maghreby (2013) promoted technical report writing skills of Engineering students. The tools were a technical writing skills questionnaire, a pre/post technical report writing test and a rubric. Ali (2016) explored the effectiveness of an e-mind mapping based program in developing some technical writing skills of tourism and hotels students. Diab (2021) used an ESP program based on cognitive Academic Language Learning Approach in developing academic reading and technical writing among Microbiology and Biochemistry first year students at the Faculty of Science, Benha University.

Abu El-Magd (2022) enhanced EFL technical writing performance among Computer and Informatics students through text chatbot assisted Edu-blogs. It was found to have a high positive impact on enhancing Computer and Informatics students' EFL technical writing performance. Alaraj (2022) identified the technical writing difficulties that Saudi university students faced, figuring out what caused these difficulties and creating solutions to them. It was found that spelling, technical terminology and coherence were the most difficult areas in technical writing, writing practice deficiency, and lack of terminology were the main causes that stand behind technical writing difficulties. Eisa (2022) examined the effectiveness of a dynamic assessment-based program in developing EFL technical writing for industrial technical secondary school students.

Chekol, Shiferie, and Teshome (2023) investigated the effects of adjunct model of content-based instruction on EFL students' technical report writing performance. It was revealed that the

students who participated in the adjunct EFL program improved their skills of cohesion and coherence, lexical resource, and grammatical range and accuracy significantly. El-Naggar, Yehya, and Abdel-Aziz (2023) examined the impact of a constructivist-based program using Docear Software on developing technical report writing skills of the second-year students of Benha Faculty of Engineering. The findings showed a statistically significant difference in the technical report writing skills.

Utilizing a Mobile Learning Management System (M-LMS) to develop technical report writing skills of freshmen students at Hurghada Faculty of Computers and Artificial Intelligence. Haggag (2024) used the one-group quasi-experimental design. A group of (35) students was selected to study a technical report writing module based on Canvas application. Results showed that there were significant mean differences between the scores of the participants in the sections of layout, technical content writing, and the overall score of the test.

The world is getting both a more technical and complex day by day life environment, that's why to think critically. It is generally accepted as a very vital stage in every field of learning, particularly in the last decades (Ahmed & Ibrahim, 2023: 10).

2.2 Critical Thinking Skill

2.2.1 Definitions of Critical Thinking (CT)

CT was defined by Lai (2011, 40:41) through three approaches: 1. psychological, 2. philosophical, and 3. educational. Definitions based on the psychological approach relate CT to cognitive skills. It was defined by Dwyer, Hogan, and Stewart, (2014: 43) as "a metacognitive process that, through purposeful, reflective judgment, increases the chances of producing a logical conclusion to an argument or a solution to a problem." Definitions based on the philosophical approach focused on the outcome of CT rather than on the process. It was defined as "a reflective and reasonable thinking process focused on deciding what to believe or do". Based

on the educational approach, CT was linked to the concept of higher-order thinking from Bloom's taxonomy and located at the higher-order levels of analysis, synthesis, and evaluation.

The psychological approach to define CT was as "a purposeful, self-regulatory judgment which resulted in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgment was based" (Facione,1990: 3). The definition presented six CT cognitive skills: (1) interpretation, (2) analysis, (3) inference, (4) evaluation, (5) explanation, and (6) self-regulation.

The National Council for Excellence in Critical Thinking (NCECT, 2014), defined it as the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/ or evaluating information gathered from, or generated by observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

CT, as the ability to think rationally, is understanding the logical connection between ideas (Mohammed, 2020: 104). It was acknowledged as being an important goal for many professionals within higher education (Giacomazzi, Fontana & Trujillo, 2022). As a tool for facing different challenges that might arise in the workplace, it included the ability to identify which knowledge might be suitable for a certain problem and how to apply it as part of the solution (Nugraha, et al. 2020). As a practical skill, CT was required to be developed in technical education (Rönnlund, et al. 2019). This was mainly because of a focus on developing competences and skills that directly helped solve the problems that workers would face when they joined the workforce. This, in turn, created a skills gap which should be addressed. Developing CT in

technical education is one way of reducing such gaps. However, there is still a need to design interventions that can develop this skill (Salleh & Sulaiman, 2020: 2). CT is the ability to reason and be an active student rather than passive recipient of information through engaging in reflective thinking (Mohammed, 2020: 105).

2.2.2 Components of Critical Thinking

Al-Ghadouni (2021:3) presented the components of the critical thinking skill:

1. The knowledge base or schemata that serves as students' assumptions.
2. The tendency to critical thinking because of an exciting stimulus
3. Conclusion, so that the outcome of the critical thinking process is reached through the issuance of judgments, decisions.

According to Mohammed, (2020: 119)**,** CT included: 1. Looking at information within proper context, 2. Evaluating the logic and validity of an argument, 3. recognizing assumptions that are not directly stated in the text, and 4. using language clearly and accurately.

CT, as a cognitive process, was a goal directed and purpose driven. Whether that purpose was to solve a problem, support a theory or statement, conduct an experiment, present an interpretation, better understand a topic or decide on a course of action, the skills would assume that CT was not simply reflective thought; it was also applied and generative (Heard et al., 2020: 1).

Specifically, the ACER framework comprised three strands, with each strand containing three aspects (Figure 2). Accordingly, to think critically was to analyze and evaluate information, and reasoning due to appropriate standards, for the purpose of constructing sound and insightful new knowledge, understandings, hypotheses and beliefs. CT encompassed the ability to process and synthesize information in such a way that it enabled it to apply it

judiciously to tasks for informed decision-making and effective problem-solving **(**Heard et al., 2020: 2).

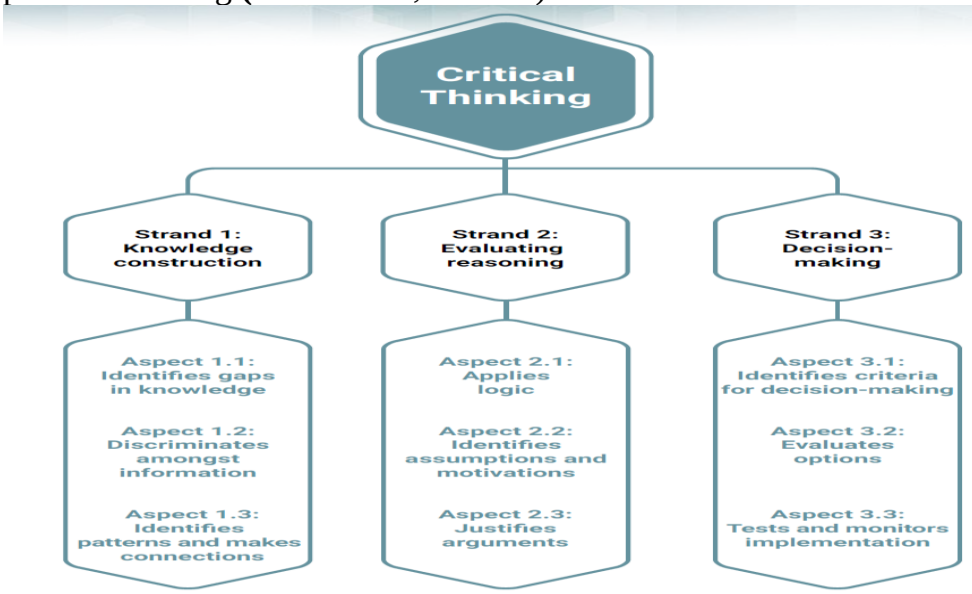


Figure (2) ACER's Critical Thinking Framework (Heard et al., 2020: 2)

CT, as an ongoing process in which students engage, regardless of their language proficiency levels, involved the use of information, experience, and world knowledge in ways which allowed them to seek alternatives, make inferences, pose questions, and solve problems. They came to L2 classrooms with a variety of CT skills developed in their L1, could be ready for and need to do CT in L2 (Mohammed, 2020: 114). CT indicators were identified by Lintangesukmanjaya et al. (2024: 80) in Table 1.

Table (1) Indicator of CTS on Type for Question

N	Indicator	Information
1	Clarification	Formulate the main issues in a problem
2	Evaluation	Build fundamental skills by expressing facts
3	Analysis	Determine logical arguments based on a problem
4	Interpretation	Provide explanations based on bias with different points of view
5	Inference	Determine the conclusion

2.2.3 Critical Thinking Skill

Critical thinking was seen as the process of analyzing and evaluating the thinking process to improve it (Paul &Elder, 2019). Facione (1990) defined critical thinking as a set of sub-skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation. In critical thinking, the students first had a deep understanding of a problem before thinking about the solution. Facione's definition therefore proposed a taxonomy of sub-skills, requiring a person to first understand a problem (interpretation and analysis) before assessing solutions (evaluation), searching for non-explicit causes or consequences (inference) and communicating this process as a whole (explanation) before reflecting on the process and results (self-regulation). Additionally, Mohammed, (2020: 310) described the skills of CT as follows:

1. **Interpretation:**(Categorization, decoding sentences, and clarifying meaning)
2. **Analysis: (**Examining ideas, identifying arguments, and analyzing arguments)
3. **Evaluation (**assessing claims, assessing arguments**)**
4. **Inference (**Querying evidence, conjecturing alternatives, drawing conclusions**)**
5. **Explanation: (**stating results, justifying procedures, presenting arguments)
6. **Self-regulation (**self-examination, self-correction**)**

López, et al. (2023: 4) classified critical thinking into these sub-skills: interpretation (extracting information from a wide range of situations), analysis (identifying implicit and explicit relationships between written and audiovisual resources), evaluation (evaluating judgements and develop rubrics to do so), inference (drawing conclusions), explanation (justifying one's reasoning) and self-regulation (consciously self-monitoring one's cognitive processes).

Critical thinking, as a type of lateral thinking, assisted students to analyze and evaluate information about a situation or phenomenon

or a problem and to make appropriate decisions that benefit in their contexts. As a thinking process through which the students gathered knowledge, deconstructed the gathered knowledge, and created new knowledge. They could raise questions and problems, formulate them clearly, gather and assess relevant information, use abstract ideas, think open-mindedly, and communicate effectively with others (Rana, 2012: 51).

2.2.4 Assessment of Critical Thinking Skill

Many pre- and post-tests were developed to measure critical thinking. The difference in the scores on both tests was used to assess improvements in the students' critical thinking skill. In this sense, each question on the two tests focused on one of the critical thinking sub-skills: interpretation, analysis, inference, evaluation, argumentation, and metacognition. Furthermore, the tests included both multiple-choice and open-ended questions. The responses to these questions were corrected by an expert and given a dichotomous score. The questions related to lower order thinking (i.e., interpretation, analysis, inference, and evaluation) were expressed as multiple-choice and given dichotomous scores.

The assessment of critical thinking skill was a multi-task ability and involved specific knowledge in the different areas in which it was applied. Most assessments involved multiple-choice questions requiring reasoning within a particular situation based upon a constrained set of information provided. In the California Critical Thinking Skills Test (Facione 1990), participants were provided with everyday scenarios and had to answer multiple questions targeting the six higher-order skills. Similarly, the Watson–Glaser Critical Thinking Appraisal presented test takers with passages and scenarios measuring the ability to recognize assumptions, evaluate arguments, and draw conclusions.

Less frequently, case study or experiential methods of assessment were also used. This approach involved asking participants to reflect on past experiences, analyze the situations faced and the way they could behave or make judgments and decisions and then act. Thus, Brookfield (1997:29) made three recommendations for improving the assessment of critical thinking: 1. to assess critical thinking in specific situations, so the students could study the process and the discourse related to it; 2. to involve them in the evaluation of critical thinking, so that the evaluation was not provided only by the instructor; and 3. to allow them in an experiment to document, demonstrate, and justify their engagement, as this learning perspective provided insight into basic dimensions of the critical thinking process.

CT was measured by a variety of tests that followed different formats such as (multiple choice, essays, problem solving tasks, or modified essays). These tests (e.g. The California Critical Thinking Skills Test, The California Critical Thinking Disposition Inventory) were developed. Additionally, there were other tests that focused on assessing critical thinking skills through or in association with reading and writing which, to a certain extent, validated the use of the reading and writing sections such as the International Critical Thinking reading and writing test (Bendary, 2018: 98).

2.2.5 Studies Related to EFL Writing and Critical Thinking Skill

Abd El Massih (1991) proved the effectiveness of utilizing an instructional model to promote critical thinking skills through English language teaching and learning in secondary stage. Al Khoudary (2015) explored the learners and teachers' attitude towards the role of critical thinking in promoting writing skills at AlBuraimi University. It was focused on integrating critical thinking in learners' performance. It was found that students who write critically were more likely to be motivated and their performance was affected positively. This supported the idea of integrating critical thinking in teaching writing skills. Chen (2017) examined

whether a relationship existed between critical thinking and English writing courses among community college students. The study used the California Critical Thinking Skills Test. It was found that writing was inversely related to critical thinking.

To explore the integration of critical thinking in an English for Academic Purposes context, Moore (2017) shed the light on practical strategies for promoting critical thinking skills among students within the technical university context. Using cooperative learning strategy "Think-Pair-Share", to develop argumentative writing and critical thinking skills, Bendary (2018) found that there was a positive relationship between argumentative writing and critical thinking. Stephenson, Miller and Sadler-Mcknight (2019) used two main approaches: peer-led team learning and Science writing workshop template to develop critical thinking and technical writing skills among first year chemistry students. The results indicated the significant effect of the two approaches on developing technical writing and critical thinking skills. Amer (2022) revealed the effectiveness of a deliberations strategy in developing EFL secondary stage students' writing and critical thinking skills. Hindeme, and Iwikotan (2022) emphasized fostering critical thinking skills within ESP courses. Ahmed and Ibrahim (2023: 10) investigated the impact of critical thinking on improving students' learning and how it was important to think critically in the learning process. It was recommended that: 1. Critical thinking should be taught as a main daily activity within the learning process. 2. The students should be exposed to intensive tasks for enhancing critical thinking.

Ibrahim (2023) investigated the effectiveness of a program based on critical literacy approach for developing EFL persuasive writing and critical thinking skills among student teachers. It was revealed that EFL persuasive writing and critical thinking skills were developed because of teaching with critical literacy approach

program. Mohammed (2023: 2) used a suggested EFL program based on extensive reading for developing critical thinking skills and habits of mind. It was found that:

1.Critical thinking skills could help students think about all the possibilities of solving a problem, considering different opinions and identifying people's arguments and discussions as good contributions or conclusions on a specific topic.

2.Critical thinking was an intellectual process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/ or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

3. Critical thinking developing was an effective means for creating new possibilities of finding new different solutions to different problems.

Stepanivna, et al. (2023) assessed students' perceptions of critical thinking. To understand students' perspectives on the relationship between critical thinking skills and foreign language learning within technical disciplines. It effectively contextualized critical thinking within technical disciplines in foreign language classes.

2.2.6 Relationship Between EFL Technical Writing and Critical Thinking

Since critical thinking instruction could improve students' writing performance, it should be of interest to policy makers. In the quasi-experimental study, Normore, et al. (2024) utilized multilevel modelling to examine the effects of direct online critical thinking instruction on writing performance assessing writing structure, grammar, and spelling. It was hypothesized that improving students' ability to identify, analyze, construct, and evaluate arguments assisted them to navigate the cognitive and metacognitive demands of academic writing with greater ease, leading to improved outcomes in standardized test settings and on writing tasks more generally. Results indicated that students who underwent critical

thinking instruction achieved significantly higher relative gains in writing than a comparable control group.

Writing, as a cognitive complex task, involved a series of problem-solving and higher-order thinking skills (Myhill, Newman & Watson, 2020:5). To construct an effective text that was intelligible to the reader, this entailed extensive decision making informed by considerations of the task, purpose, genre, and audience needs (Bazerman et al., 2017: 352). Being able to think critically was a necessary condition for being able to write clearly and persuasively. These considerations suggested that providing students with the opportunity to collaboratively reason and problem-solve during writing experiences would contribute to higher quality writing outcomes (Normore, et al., 2024: 6).

As one of the most important skills in EFL, writing was the mirror that allowed students to think and reflect on their ideas, attitudes, feelings and viewpoints idiomatically. However, most students in Egypt felt afraid and overwhelmed when they were asked to write on a technical topic. They couldn't know how to start a topic, develop their ideas and lack many technical writing skills. This might be due to the traditional method of academic writing instruction that didn't enhance them to interact with their instructors and classmates (Bendary, 2018, 2:3). To write correctly required the students to: 1. think, organize the ideas, and develop their ability to summarize, analyze, and criticize, and 2. strengthen thinking and reflecting (Rao, 2007:100).

Stepanivna, et al. (2023: 357) shed light on the intricate interplay between critical thinking development and foreign language education in technical university settings. It was concluded:
1. reaffirming the importance of critical thinking skills for technical university students in their future careers.

2.applying critical thinking within a foreign language context, demonstrating the potential for effective amalgamation of cognitive and linguistic abilities.
3. highlighting the need for targeted pedagogical strategies that mitigate these hurdles.
4. stimulating students' interest in interdisciplinary tasks and collaborative activities to bridge critical thinking and foreign language education, aligning with the holistic objectives of technical education.

Normore, et al. (2024: 11) concluded that teaching critical thinking appeared from the results presented here to be a useful strategy for helping students develop their writing. There was a positive correlation between instruction in critical thinking and improved writing performance. Moreover, Stepanivna, et al. (2023: 347) explored critical thinking connection with important scientific and practical tasks as follows:
1. In an increasingly globalized job market, technical university graduates were required to engage with international colleagues, clients, and partners. Effective communication and problem-solving in foreign languages were pivotal for successful collaboration.
2. Implementing innovative pedagogical approaches, educators can't only nurture critical thinking skills but also potentially enhance overall learning experiences.
3. Addressing the integration of critical thinking within foreign language education, particularly in technical disciplines.

Stepanivna, et al. (2023:353) illustrated how the study delved into the nuances of contextualization to integrate critical thinking within technical disciplines:
1. Technical problem-solving workshops. For instance, technological students could engage in collaborative sessions where they analyzed real-world technical challenges in English. This contextualized critical thinking within their field of study, allowing them to apply analytical skills to practical scenarios.

2. Case studies required technological students to analyze and propose solutions. This approach could bridge the gap between linguistic skills and technical expertise, prompting students to think critically while using foreign language communication to address intricate technical problems.

Bendary, (2018:99) revealed a positive relationship between critical thinking on the one hand and reading and writing skills and school achievement on the other. To promote critical thinking skills, it required shifting the classroom focus from an instructor-centered to a student-centered approach.

In the era of rapid technological advancement and cross-cultural interaction, technical university graduates were expected not only to possess a solid grasp of their chosen field but also to excel in communication and problem-solving across linguistic and cultural boundaries. This necessitated a comprehensive skill set that included both technical expertise and strong critical thinking abilities

2.3 EDJA Model

2.3.1 EDJA as a Cooperative Learning Model

Cooperative Learning (CL) had many definitions, e.g. Millis (2010: 5) defined it as " a highly structured form of group work focusing on problem solving that could lead to deep learning, and critical thinking". As a strategy to critical thinking, Ormord (2011: 443) indicated that students worked in CL with a small group of peers to achieve a common goal and helped one another learn". Mandal (2009, 97: 98) noted that in CL model, the instructor gave a writing task, and the members of the groups worked together towards certain shared learning goals. They helped each other during the process of drafting the writing task. They could plan, translate, review the work together, monitor and evaluate their writing." Moreover, CL could be characterized in the following Chinese proverb:

Tell me, I'll forget,
Show me, and I'll remember,
Involve me, and I'll learn

CL could assist the students to interact and share their ideas with their group, work together to think critically, and solve the problem (Bendary, 2018: 10). Setting out the problem, activating prior knowledge, demonstrating, and applying had also been shown to promote this skill (Tiruneh, De Cock & Elen, 2017). Exposing students to real-life situations through dialogue, and mentoring had all proven to be effective strategies for developing critical thinking (Giacomazzi, Fontana &Trujillo, 2022). The concept of CL was drawn from the educational philosophies of early social researchers such as Vygostsky, Piaget and Lewin who gave much attention to the role of social interaction in all aspects of learning (Bendary, 2018: 23). Theoretical perspectives on CL provided the bases for a great number of activities and educational strategies as follows:

1. **The Social Interdependence Theory:** assumed that when students worked together, they could reach higher academic levels.
2. **The Cognitive Development Theory**: assumed that students could understand, interpret, and draw conclusions about their environment.
3. **The Social Learning Theory:** assumed that students' learning occurred within dialogues or the social context.
4. **The Constructivist Theory:** assumed that students gave meaning of knowledge based on their personal experience.

Al-Awaini (2021) presented the following stages to integrate the most important principles of the three theories:

1. The "**excitement**" was divided into (putting the student in a problem and stimulating previous experience).
2. The "**dialogue**" was divided into (cooperative brainstorming and groups).
3. The "**clarification**" was for announcing the solution to the problem by the instructor.

4. The "**reinforcement and application**" was divided into three stages (posing a similar problem, analogical dialogue to solve it, and enhancing learning).

To apply EDJA model, the following basic criteria should be met:

- Determining curriculum goals that you wanted to achieve.
- Presenting the problem in a fun, eye-catching way through a story, photo sets, or a video clip that students could solve, relying on their schemata.
- Creating a stimulating environment that could increase students' desire to participate in analogical dialogue.
- Considering the individual differences of students.

In CL, the role of instructors shifted from transmitter of knowledge to mediators of learning. This role involved facilitating, modeling and coaching. While the student's role in CL was: 1. Facilitator coordinated the group's work, 2. Recorder recorded what the group accomplished, and 3. Reporter told others about the group's work (Bendary, 2018: 32).

EDJA, as a cooperative learning model, was based on presenting the educational situation collaboratively by provoking a problem to solve it analogically (Dialogic groups), using their schemata. According to the most important principles of the three theories, learning happened best when students would interact with problems that increased their motivation to learn through their attempts to find a solution collaboratively, and this what was approved by the constructivist theory. This emphasized that the student was an active being and combined this with the most important principles of the Cognitive theory to process information, store, and retrieve it continuously (Mar'i & Al-Haila, 2002: 39).

2.3.2 Goals of EDJA Model

Zayer (2013: 24) identified the goals of EDJA model as follows:

1. Using students' prior knowledge to integrate and build new knowledge in a meaningful way.
2.Activating the role of the student in their interaction with the problems they face, practicing thinking, and solving them.
3. Getting an opportunity to practice mental processes to a better degree than the prevailing methods based on memorization.
4. Applying the information to new learning situations and contexts.

EDJA model assisted the students to acquire these skills (Al-Awaini, 2021):

1. Critical thinking and mental processing of data.
2. Linking previous knowledge with subsequent knowledge.
3. Learn the skill of dialogue through social interaction with peers, defending a certain point of view, convincing others of it, and listening to the other opinion and accepting it.
4. Consolidating the educational goal in the student's mind.

2.3.3 Stages of EDJA Model

Abdel Ani et al. (2017: 235) and Al-Samarrai and Taha (2019: 212) summarized the four main stages of EDJA model as follows:

1. Excitement: an activity or a task could need students' motivation which affected by their preferences (needs, interests, and feedback). This was evident through Gagne's cognitive theory, which stated that the learning process was the result of changes occurring within the cognitive schemata. This theory was based on the ideas of Gagné, Piaget, and Ausubel. One of the most important outcomes of this theory was the interest in how knowledge was acquired, not the transfer of knowledge. The instructor posed the problem and determined all the steps and procedures before application or actual practice. This stage included two steps:

a. Stimulating Students' Prior Experience and Linking it the New Lesson or Topic: when presenting a problem to the class, the students didn't elicit a solution based on prediction, but rather it was linked to previous learning.

b. Transforming the Educational Situation into a Problem was done by defining the objectives of the curriculum to be achieved,

presenting the problem in a fun and attention-grabbing way (through a story, groups of pictures, or video clips...), and then creating a stimulating environment that increased the students' desire to solve the problem, considering their individual levels. Learning could occur best when students are faced with real-life problems.

2.Discussion: After identifying the problem, the instructor asked the students to discuss it. This was an "introductory dialogue," as it gave the instructor information about the student, the problem, and the extent of the student's need for the instructor's help. The dialogue stage consisted of two steps:

a. **Collaborative Brainstorming:** the instructor gave the students the opportunity to ask all their questions and predictions about the topic or problem at hand, then record them in the conceptual map. The instructor rejected any questions from the students about the problem. Whereas the constructivist theory called for the instructor to dialogue with the students, encourage them to participate and express their opinion, and for the instructor to provide an interactive environment for the students.
b. **Analogic or Matching Groups:** The instructor divides the students into corresponding groups. If one group presents certain points of view on a problem, the other group will present the opposite or opposing opinion. Each group provides justifications for choosing those solutions to the other group, and the instructor activates the dialogue among the corresponding groups. The dialogue assists the groups to reach certain results that facilitates the process of reaching a solution to the problem. Social constructivist theory calls for this through its focus on social interaction and the role of language. In developing thinking and dialogue, it also calls for the necessity of creating a learning environment based on dialogue and cooperative learning.

3. Justification: After identifying the problem and conducting many dialogues to collect information, the instructor gives positive feedback on the students' dialogues using the same notes on the board by erasing the false ones and justifying them, then arranging the rest from the correct ones. The instructor explains the action by announcing the solution to the problem, presenting the title and objectives, and begins with an explanation to enhance the validity of the solution. This is done by the instructor recording all the students' dialogues in the form of a conceptual map as a tool of organization, representation, and participation.

4. Application: Based on Bruner's principles of enhancing learning and integrating them with Ganet's steps, students' participation in various educational activities within the classroom lead to increased immersion in educational experiences, and thus they become more attentive. This stage includes:

a. The instructor asked the students to pose problems like the problems presented previously and think critically to find appropriate solutions to them.

b. The analogic groups face each other, one of the groups posed a problem related to the topic, and the other group found appropriate solutions to the problem based on the correct understanding of the lesson.

c. The instructor gave an evaluation in the form of an individual written exercise to ensure that all students understand. When there was any lack, the instructor provided immediate feedback to correct it. The instructor asked the students to submit a final work or project for what they learned.

The Stages of EDJA model could be represented in the following figure:

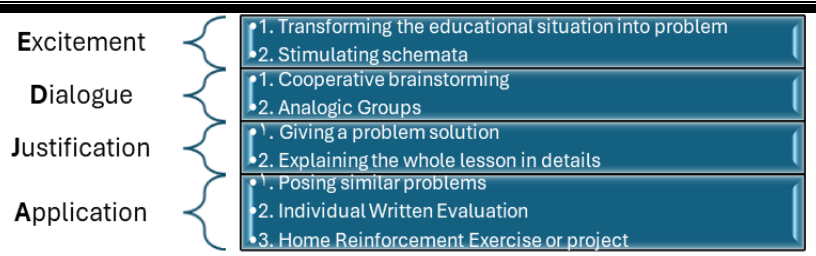


Figure (3) Stages of EDJA model

2.3.4 Studies Related to EDJA Model

Mutanish (2020) identified the effect of EDJA model on mental perception, cognitive achievement, and crushing volleyball for students of physical education and sports sciences at Al-Qadisiyah University. It was recommended to use EDJA model in the educational units because of their great role in mental perception and learning. AL-Helou and Muhammed (2022) explored the effect of EDJA model on the achievement of history among the students of the second intermediate grade. It was concluded that EDJA model could stimulate students' thinking, and critically differentiate between opinions and facts. They felt amused when learning with EDJA model.

Najm (2022) utilized EDJA model to enhance some mathematics skills and enjoyment for the primary school fifth-grade students. It was found that EDJA model highly motivated students' critical thinking in mathematics and learning enjoyment. Abdullah (2023) prepared an instructional program based on EDJA model for improving learning outcomes (cognitive, skillful, and emotional) of some floor exercises skills. It was recommended to pay attention to the application of the EDJA model at all levels of learning.

Rashid (2024) investigated the impact of EDJA model on the achievement of second-year intermediate students in mathematics and their investigative thinking. Results showed that there was a

statistically significant difference among the average scores of the experimental and control group students in the mathematics achievement test in favor of the experimental group. It was recommended to implement EDJA model in mathematics instructors' guides.

2.4 Hypotheses of the Research

1. "There was a statistically significant difference among the mean scores of the study participants of EFL technical writing skill as a whole and its sub-skills in the pre/post-assessment at the level of $\alpha \geq 0.05$, favoring the post-assessment."
2. "There was a statistically significant difference among the mean scores of the study participants of EFL critical thinking skill as a whole and its sub-skills in the pre/post-assessment at the level of $\alpha \geq 0.05$, favoring the post-assessment."
3. "There was a statistically significant difference among the mean scores of the study participants of EFL critical thinking skill in the pre/post-assessment in a Can-Do checklist at the level of $\alpha \geq 0.05$, favoring the post-assessment."
4. There was a statistically significant correlational positive relationship among the scores of the study participants of EFL technical writing test and critical thinking test at the level of $\alpha \geq 0.05$, favoring the post-assessment."

3. Method

3.1 Participants

The participants were (37) EFL fourth-year students at HITT. The fourth-year students were chosen as they were supposed to acquire the skills of technical writing and critical thinking to be utilized in their workplace. They should be able to write a technical report as a main requirement of their job as technologists. It was one group as the content was new. It included technical problems or topics about which they need to think critically then write a technical report on them.

3.2 Setting

The intervention was applied to the fourth-year students at HITT in the first term of academic year 2023/2024.

3.3 Instruments

The instruments were designed and prepared by the researcher as follows:

1. A needs Analysis Questionnaire (NAQ)
2. A Technical Writing and Critical Thinking Skills Questionnaire (TWCTSQ)
3. A Technical Writing Test (TWT) and a Rubric to score it
4. A Critical Thinking Test (CTT) and a Rubric to score it
5. A Can-Do Checklist (adopted from Brahim, 2021:19) to assess critical thinking level at the beginning of the intervention and how much the students will have improved by the end of it.

3.3.1.1 Purpose of a Needs Analysis Questionnaire (NAQ)

The main objective of the NAQ was to analyze and assess the present needs of technical writing skills at HITT as viewed by the fourth-year students (100) of the departments of mechanical units and signals. The NAQ had two versions, one of them was addressed to the fourth-year students and the other was addressed to the instructors at HITT. The questionnaire was an essential step that led to designing a tailor-made intervention that assisted the HITT students to meet their academic requirements regarding technical writing skills.

3.3.1.2 Sources of a NAQ

To develop the NAQ, the researcher followed the following steps:

1. Selecting the items of the NAQ through reviewing the literature and related studies.

2. Conducting interviews with the instructors at HITT and formulating the NAQ items.

3.3.1.3 Description of a NAQ

The NAQ included three parts:

One: EFL Learning Situation or Context Analysis

It contained questions related to 1. number of courses taught in English and importance of English skills as viewed by the students, 2. the percentage of time, devoted to these skills, in the current technical English course 3. the students' language level and their priorities for language improvement and to what extent the current English training was satisfying their needs.

Two: EFL HITT Students' Requirements & Preferred Modes of Learning

It included questions related to techniques of classroom interactions and students' participation. The questions included choosing between learning individually, in pairs or in groups and methods of error correction. It was related to EFL skills that HITT students needed to develop for their profession and the topics they were interested in.

Three: Communication Needs Analysis

It aimed at identifying the technical writing tasks required by students and the frequency of using each task. Students were asked to specify any other writing tasks required.

3.3.1.4 Validity of a NAQ

Judging the validity of the NAQ through submitting it to a jury of eight staff members in EFL Curriculum and Instruction Dept. The jury members approved it after the following modifications:

a. The students' questionnaire should include questions that revealed the modes of learning.
b. The questionnaire should include open questions.
c. Administering the NAQ for the final forms of it (**Appendix 2**)

3.3.2.1 Purpose of TWCTSQ

The objective of the questionnaire was to identify EFL technical writing and critical thinking skills required for the fourth-year students at HITT.

3.3.2.2 Source of TWCTSQ

The questionnaire was prepared in the light of following sources:

1. The regulation of HITT and specifications of the Technical English course
2. The survey of literature and related studies of technical writing (Abu El-Magd, 2022; Alaraj, 2022; Ali, 2016; Al Maghreby, 2013; Diab, 2021; Eisa, 2022; Farag, 2012; Laplante, 2019 & Zaki, 2008).
3. The survey of literature and related studies of critical thinking skills (Abd El Massih, 1991; Ahmed & Ibrahim, 2023; Al Khoudary, 2015; Amer, 2022; Bendary, 2018; Brahim, 2021; Giacomazzi; Fontana & Trujillo, 2022; Heard, et al., 2020; Ibrahim, 2023; Lintangesukmanjaya et al. 2024; López, et al. 2023; & Mohammed, 2023).

3.3.2.3 Description of TWCTSQ

The initial form of the questionnaire included two parts. Part (1) concerned the four technical writing sub-skills: Technical Content, Writing Style, Grammar, and Mechanics which covered (22) items. Part (2) concerned the sixth critical thinking sub-skills: Clarification, Evaluation, Analysis, Justification, Inference, and Self-regulation which covered (16) items. Each sub-skill item was in a three–Points-Likert format for identifying if it was “Required = 3”, “Somewhat Required= 2”, and “Not Required = 1" by ticking (√) in the space provided.

3.3.2.4 Validity of TWCTSQ

The questionnaire was presented to a jury of EFL Curriculum and Instruction (n=8). The final form included (20) items for technical writing and (14) items for critical thinking. Two items were omitted according to modifications given by the jury. Modifications were made as shown in table (2&3).

Table (2) EFL Technical Writing Skill Questionnaire (Final Form)

Main-Skills	EFL Technical Writing Sub-Skills (Final Form=20)
(1) Technical Content	Write a clear and an expressive tittle
	Describe manuals, projects, tools, experiments, and processes
	Illustrate information graphically (i.e. using tables, charts, figures and maps)
	Summarize technical texts
	Write a technical report about a similar problem or topic
(2) Writing Style	Show an objective tone rather than the subjective one in writing
	Present technical reports with specific sections and layout
	Use bullet units and enumerated lists
	Join parts of a text (introduction, body, and conclusion) using linking words
	Construct clear meaning through connecting ideas
	Use technical vocabulary and expressions
(3) Grammar	Use verb tense correctly
	Keep subject and verb agreement
	Use simple, compound, and complex sentences
	Use clear pronoun reference
	Use active rather than passive voice
(4) Mechanics of Writing	Use correct punctuation
	Provide technical standard abbreviations appropriate to the context
	Write with the neat handwriting
	Write with the correct spelling

Table (3) EFL Critical Thinking Skill Questionnaire (Final Form)

Main-Skills	Sub-Skills (Final Form=14)
(1) Clarification	Clarify the main issues in a problem
	Formulate new ideas from the old ones
(2) Evaluation	Distinguish facts from opinions.
	Compare and evaluate different points of view
	evaluate judgements based on the logic and evidence given
(3) Analysis	Identify the problem from different perspectives
	Determine logical arguments based on a problem
	Identify pro and con arguments
(4) Justification	Provide further explanation of events or actions included in the problem
	Justify solutions and arguments based on valid reasons
(5) Inference	Draw logical conclusions from reasons and evidence
	Identify implicit and explicit relationships among the elements of the problem
(6) Self-Regulation	Determine the conflict between different conclusions
	Self-examine and correct one's own thinking to be logic

The jury agreed on the validity of questionnaire, and its suitability for measurement. Thus, the questionnaire was valid (**Appendix 3**).

3.3.3 A Technical Writing Skill Test

3.3.3.1 Purpose of a TWT

The purpose of the test was to determine the students' level of technical writing skills before and after the intervention.

3.3.3.2 Sources of a TWT

The test was adopted from

1. The EFL Technical Writing Skill Questionnaire
2. The regulation of HITT and specifications of the Technical English Course

3. The survey of related studies of technical writing (Al Maghreby, 2013; Farag, 2012; Haggag, 2024; Stepanivna, 2023 & Zaki, 2008).

3.3.3.3 Description of a TWT

The test consisted of five questions testing the twenty targeted EFL technical writing skills as follows:

1. Write a technical report about a technical problem in your workshop
2. Write a technical report about a transport project in Egypt, e.g. Maglev
3. Define the parts of train and railway in the picture
4. Describe how an electric bell works in the picture
5. Summarize the following technical passage in your own words (250 words)

3.3.3.4 Validity of a TWT

3.3.3.4.1 Jury's Validity: To decide the content and face validity, the test and the 4-point scoring rubric were submitted to a jury of EFL Curriculum and Instruction (N=8). They were asked to read the test items and gave their suggestions to the following: (1) Were the test items appropriate for the fourth year HITT students' level? (2) Were the test items assessing the required technical writing skills? and (3) Were the rubric indicators appropriate and sufficient to reflect EFL technical writing skills? Modifications were made in a response to the remarks of the jury and included in the final version of the test and rubric. Thus, the test and rubric were valid for measuring and correcting EFL technical writing test (**Appendix 4**).

3.3.3.4.2 Internal Consistency Validity: SPSS V.18 was used to identify:

a. The internal consistency between the degree of each sub-skill and the total degree of the main skill to which its sub-skills belong using the Pearson Correlation Coefficient.

b. The internal consistency between the degree of each main skill and the total degree of the test, and the internal consistency between each main skill and the other skills using the Pearson Correlation Coefficient.

Table (4) Pearson Correlation Coefficient between the Degree of each Sub-skill and the Total Degree of the Main Skill to which its Sub-skills belong (N = 30)

N.	Main-Skills	Sub-Skills	Correlation
1	**Technical Content**	Write a clear and an expressive tittle	**0.706****
2		Describe manuals, projects, tools, experiments, and processes	**0.771****
3		Illustrate information graphically (i.e. using tables, charts, figures and maps)	**0.859****
4		Summarize technical texts	**0.656****
5		Write a technical report about a similar problem or topic	**0.852****
6	**Writing Style**	Show an objective tone rather than the subjective one	**0.754****
7		Present technical reports with specific sections and layout	**0.813****
8		Use bullet units and enumerated lists	**0.877****
9		Join parts of a text (introduction, body, and conclusion) using linking words	**0.836****
10		Construct clear meaning through connecting ideas	**0.742****
11		Use technical vocabulary and expressions	**0.841****
12	**Grammar**	Use verb tense correctly	**0.828****
13		Keep subject and verb agreement	**0.753****
14		Use simple, compound, and complex sentences	**0.893****
15		Use clear pronoun reference	**0.894****
16		Use active rather than passive voice	**0.718****
17	**Mechanics of Writing**	Use correct punctuation	**0.879****
18		Provide technical standard abbreviations appropriate to the context	**0.873****
19		Write with the neat handwriting	**0.846****
20		Write with the correct spelling	**0.897****

**** Correlation is significant at the 0.01 level**

Table (4) showed that all Correlation Coefficients were statistically significant at the at the level of $\alpha \geq 0.01$. This signified the internal consistency validity of the subskills in the test.

Table (5) Pearson Correlation Coefficient between the Degree of each Main Skill and the Total Degree of the Test, and the Internal Consistency between each Main Skill and the other Skills (N = 30)

Skills	Technical Content	Writing Style	Grammar	Mechanics	ALL Over the Test
Technical Content	1	0.842**	0.839**	0.791**	0.929**
Writing Style		1	0.779**	0.805**	0.927**
Grammar			1	0.911**	0.941**
Mechanics				1	0.935**

**** Correlation is significant at the 0.01 level**

3.3.3.4.3 Discriminant Validity: was measured as 27% of the high marks of the piloting sample (N=30) and 27% of the low marks of the piloting sample were taken. Mann-Whitney Test (Non-Parameter) was used to identify the significance among differences of the means.

Table (6) Differences among the Mean Rank, Sum Ranks, &Z-Value between the Two Groups in EFL Technical Writing Skill test

Group	N	Mean Rank	Sum of Ranks	Z- Value	Sig
High Level	8	12.50	100.00	3.371	0.01
Low Level	8	4.50	36.00		

The table showed that there was a statistically significant difference at the sig. level (0.01) between the two levels. This signified that the test was highly discriminated valid.

3.3.3.4.5 Reliability of the Pre-posttest

1.Cronbach's Alpha Method: was used to measure the reliability of the pre-posttest through using SPSS (V.18), for each skill of the test and all over the test, as indicated in the following table:

Table (7) Reliability of EFL Technical Writing Skills Test (Cronbach's Alpha (N = 30)

Skills	Technical Content	Writing Style	Grammar	Mechanics	ALL Over the Test
Cronbach's Alpha	0.815	0.893	0.865	0.893	0.960

The table showed that Cronbach's Alpha was high (0.893). This signified the validity of EFL technical writing skills test.

2.Test-Retest Method was used to assess the consistency of the test results from one time to another. To measure the reliability of the test, it was administered to a randomly chosen group of (30) fourth year students, other than the participants of the experiment. Then, it was administered again after two weeks to the same group. To measure the reliability of the test, Cronbach's Alpha was calculated for the test through using SPSS program (V.18) for each skill of the test skills and the whole test as indicated in the following table.

Table (8) Reliability of the EFL Technical Writing Skills Test (Test-Retest Method)

Skills	Technical Content	Writing Style	Grammar	Mechanics	ALL Over the Test
Correlation	0.841**	0.809**	0.793**	0.825**	0.967**

**** Correlation is significant at the 0.01 level (2-tailed).**

As shown in table (8), the test was reliable. The Pearson Correlation between the two administrations was (0.967) for EFL technical writing skill at 0.01 level which was highly reliable and statistically accepted.

3.3.3.4.6 Scoring the Pre-posttest

The total score of the test was (100) marks which were distributed into (5) marks for each one of four sub-skills. A 4-point rubric was

developed for scoring the test ranging from “4” to “1” marks according to their performance. They were given "4" marks when their performance was high, “3”: if they had minor mistakes, “2”: if they had some mistakes, and “1”: if they made many mistakes and their performance was low

3.3.3.4.7 Piloting the Pre-posttest

The participants chosen for piloting the test were (30) students, other than those of the experimental group, selected from the HITT fourth year students. To estimate the test time, the time taken by the fastest student (80 minutes) was added to the time taken by the slowest one (100 minutes) then divided by two. It was estimated that (90 minutes) would be enough time to answer the test.

of a Critical Thinking Test 3.3.4.1 Purpose

The purpose of the test was to determine the students' level of critical thinking skills before and after the intervention.

3.3.4.2 Sources of a Critical Thinking Test

The critical thinking test was designed by the researcher to identify the level of HITT fourth year students' critical thinking skills. The test was prepared and adopted by the researcher from reviewing the studies of Ahmed & Ibrahim , 2023; Amer, 2022; Al-Ghadouni, 2021; Brahim, 2021 ; Hindeme & Iwikotan, 2022; Ibrahim, 2023, and Mohammed, 2023. It was designed to measure the level of students' critical thinking skills.

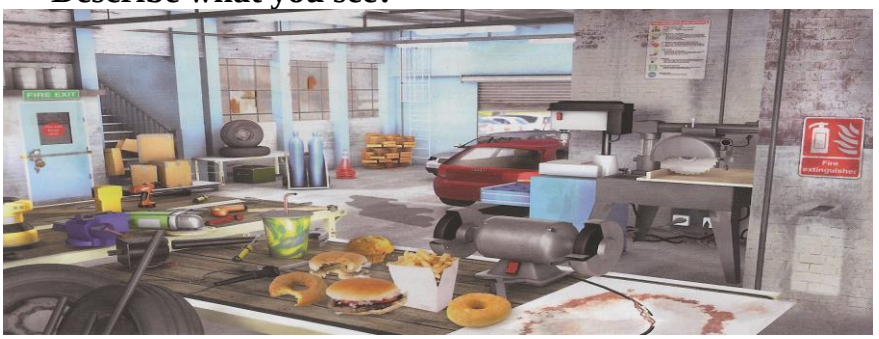
3.3.4.3 Description of a Critical Thinking Test

The test consisted of two questions testing the fourteen targeted EFL critical thinking skills as follows:

1. **Read this technical report about a technical problem from the technician to his supervisor, then answer the questions**
   - What's the problem?
   - Imagine yourself in this trouble or problem, what are the best solutions?
   - Suggest an end or conclusion

- Discriminate among the degress of truth or falsity of inferences
- Determine if conclusions follow from information in given statements
- Evaluate arguments as being strong and relevant or weak and irrelevant
- Imagine that you are the technologist who has faced the problem. How can you Self-examine and correct your own performance?

2. **You are a safety inspector, inspecting the workshop. Describe what you see?**



- How many safety hazards can you see? Make a list.
- What are the main charateristics of safety at the workshop?
- What are other precautions that the technician should follow in the workshop?
- What's your opinion about the precaustions in the workshop?
- Mention all pro and con characteristics of the technologist or safety rules
- What precautions does the technician follow?
- Suggest different tittles

3.3.4.4Validity of the Test

1. Jury's Validity: To decide content and face validity, the test and the 4-point scoring rubric were submitted to the jury of EFL

Curriculum and Instruction (N=8). They were asked to read the test items and gave their suggestions to the following: (1) Were the test items appropriate for the fourth year HITT students' level? (2) Were the test items assessing the required critical thinking skills? and (3) Were the rubric indicators appropriate and sufficient to reflect EFL critical thinking skills? Modifications were made in response to the remarks of the jury. All their comments and suggestions were included in the final version of the test and rubric. Thus, the test and rubric were valid and appropriate for measuring and correcting EFL critical thinking skill (**Appendix 5**).

2. Internal Consistency Validity: SPSS V.18 was used to identify:
a. The internal consistency between the degree of each sub-skill and the total degree of the main skill to which its sub-skills belong using the Pearson Correlation Coefficient.
b. The internal consistency between the degree of each main skill and the total degree of the test, and the internal consistency between each main skill and the other skills using the Pearson Correlation Coefficient.

Table (9) Pearson Correlation Coefficient between the Degree of each Sub-skill and the Total Degree of the Main skill to which its Sub-skills belong in Critical Thinking Test (N = 30)

N.	Main-Skills	Sub-Skills	Correlation
1	Clarification	Clarify the main issues in a problem	0.915**
2		Formulate new ideas from the old ones	0.894**
3	Evaluation	Distinguish facts from opinions	0.667**
4		Compare and evaluate different points of view	0.744**
5		evaluate judgements based on the logic and evidence given	0.770**
6	Analysis	Identify the problem from different perspectives	0.676**
7		Determine logical arguments based on a problem	0.662**
8		Identify pro and con arguments	0.852**
9	Justification	Provide further explanation of events or	0.814**

		actions included in the problem	
10		justify solutions and arguments based on valid reasons	**0.814****
11	**Inference**	draw logical conclusions from reasons and evidence	**0.884****
12		identify implicit and explicit relationships among the elements of the problem	**0.918****
13	**Self-Regulation**	determine the conflict between different conclusions	**0.852****
14		Self-examine and correct one's own thinking to be logic	**0.899****

** Correlation is significant at the 0.01 level

Table (9) showed that all Correlation Coefficients were statistically significant at the level of $\alpha \geq 0.01$. This signified the internal consistency validity of the subskills in the test.

Table (10) Pearson Correlation Coefficient between the degree of each main skill and the total degree of the test, and the internal consistency between each main skill and the other skills (N = 30)

Skills	Clarification	Evaluation	Analysis	Justification	Inference	Self-Regulation	ALL Over the Test
Clarification	**1**	**0.701****	**0.423***	**0.534****	**0.431***	**0.678****	**0.771****
Evaluation		**1**	**0.410***	**0.465****	**0.367***	**0.685****	**0.767****
Analysis			**1**	**0.589****	**0.529****	**0.572****	**0.689****
Justification				**1**	**0.513****	**0.440***	**0.751****
Inference					**1**	**0.534****	**0.731****
Self-Regulation						**1**	**0.863****

**** Correlation is significant at the 0.01 level.**

Table (10) indicated that all Correlation Coefficients were statistically significant at the at the level of $\alpha \geq 0.01$. This signified the internal consistency validity of the main skills in the test.

3. Discriminant Validity: was measured as 27% of the high marks of the piloting sample (N=30) and 27% of the low marks of the

piloting sample were taken. Mann-Whitney Test (Non-Parameter) was used to identify the significance among differences of the means.

Table (11) Differences among the Mean Rank, Sum Ranks & Z-Value between the Two Groups in EFL Critical Thinking Skill Test

Group	N	Mean Rank	Sum of Ranks	Z- Value	Sig
High Level	8	12.50	100.00	3.373	0.01
Low Level	8	4.50	36.00		

As shown in table (11), there was a statistically significant difference at the sig. level (0.01) between the two levels. This signified that the test had high discriminant validity.

3.3.4.5Reliability of the Pre-posttest

3.3.4.5.1 Cronbach's Alpha Method: was used to measure the reliability of the pre-posttest through using SPSS (V.18), for each skill of the test and all over the test, as indicated in the following table:

Table (12) Reliability of EFL Critical Thinking Skills Test (Cronbach's Alpha)(N = 30)

Skills	Clarification	Evaluation	Analysis	Justification	Inference	Self-Regulation	All over The Test
Cronbach's Alpha	**0.776**	**0.753**	**0.769**	**0.791**	**0.763**	**0.711**	**0.873**

Table (12) indicated that Cronbach's Alpha was high (0.873). This signified the validity of EFL critical thinking skills test.

3.3.4.5.2 Test-Retest Method was used to assess the consistency of the test results from one time to another. To measure the reliability of the test, it was administered to a randomly chosen group of (30) fourth year students, other than the participants of the experiment.

Then, it was administered again after two weeks to the same group. To measure the reliability of the test, Cronbach's Alpha was calculated for the test using SPSS program (V.18) for each skill of the test skills and the whole test as indicated in the following table.

Table (13) Reliability of the Critical Thinking Skills Test (Test-Retest Method)

Skills	Clarification	Evaluation	Analysis	Justification	Inference	Self-Regulation	ALL Over the Test
Correlation	0.796**	0.829**	0.814**	0.752**	0.913**	0.850**	0.947**

**** Correlation is significant at the 0.01 level (2-tailed).**

As shown in table (13), the test was reliable. The Pearson Correlation between the two administrations was (0.947) for EFL critical thinking skill at 0.01 level which was highly reliable and statistically accepted.

3.3.4.6Scoring the Pre-posttest

The total score of the test was (70) marks which were distributed into (5) marks for each one of the fourteen sub-skills. A 4-point rubric was developed for scoring the test. The rubric consisted of four parts scored on a four points Likert scale ranging from “4” to “1” marks. They were given "4" marks when their answer was completely correct, “3”: if they had minor mistakes, “2”: if they had some mistakes, and “1”: if they made many mistakes and their performance was low.

3.3.4.7 Piloting the Pre-posttest

The participants chosen for piloting the test were (30) students, other than those of the experimental group, selected from the HITT

fourth year students. To estimate the test time, the time taken by the fastest student (60 minutes) was added to the time taken by the slowest one (80 minutes) then divided by two. It was estimated that (70 minutes) would be enough time to answer the test.

3.3.5 A Can-Do Checklist (adopted from Brahim, 2021:19) to assess critical thinking level at the beginning of the intervention and how much the students had improved by the end of it. In addition to pre- and post-tests which were developed to measure critical thinking, these tests were based on the theorical definition of critical thinking and its operationalization. A checklist could also be used as an inventory of skills at the beginning and end of a course. This type of checklist might form part of a portfolio. Checklists were good indicators of "can do–can't do" and "done–not done," but were less informative than scaled rubrics.

Dear Student,

This instrument will serve to assess your initial critical thinking level at the beginning of the course and how much you will have improved by the end of it. In the first column, for every skill check (√) if you think you already can do it and (×) if you think you can't. At the end of the course, you will fill in the second column to see how much you have improved.

Table (14) A Can-Do Checklist (Brahim, 2021:19)

N.	Skill	Week 1		Week 7	
		Yes	No	Yes	No
1	I can distinguish facts from opinions.				
2	I never take things for granted.				
3	I can consider issues from different perspectives				
4	I can give more than one interpretation of events, conversations, and actions.				
5	I can compare and evaluate different points of view				
6	I can evaluate different opinions and draw reasonable conclusions				
7	I can distinguish weak and strong arguments				

8	I can analyse arguments and respond to them				
9	I can make deep inferences				
10	I can identify a writer's or a speaker's purpose				
11	I can formulate positions and support them with valid reasons				
12	I can argue my opinions convincingly				
13	I respect other people's opinions even if they are different from mine				
14	I can search for relevant and reliable sources for my written assignments and presentations.				
15	I can assess sources' relevance and credibility (printed and online)				
16	I can synthesize relevant information from various sources and use them effectively with the correct referencing				

3.4 The Procedures and Experimental Design

3.4.1 The procedures

The procedures of the research were carried out as follows:

1. Identifying HITT fourth year Ss' EFL technical writing and critical thinking skills through:
   a. Reviewing the literature and related studies to these skills and EDJA model
   b. Preparing the instruments
   c. Submitting the tools to a jury of EFL curriculum and instruction then modifying them accordingly
2. Validating the reliability of the instruments then piloting the tests
3. Selecting the sample/ one experimental group (N=37)
4. Administering the instruments to the sample before the experiment
5. Implementing the steps of a strategy based on EDJA model to the sample
6. Administering the instruments to the sample after the experiment
7. Analyzing and interpreting results

8. Giving conclusions and recommendations for further studies

3.4.2 Experimental Design

3.4.2.1 Purpose of the Intervention

The research aimed at developing the fourth-year students' EFL technical writing and critical thinking skills through using a strategy based on EDJA model.

3.4.2.2 Description of the Intervention

The researcher adopted the quasi-pre-post experimental design which investigated the effect of an intervention (independent) variable on other (dependent) variables. One experimental group of (37) students was selected randomly as the study sample. It was adopted one experimental group because the content was different from the content they were studied.

The researcher conducted a needs analysis of the fourth-year students of HITT. The topics of interest or problems were identified according to their needs. This step assisted the researcher to tailor an interesting content that motivated the students to think critically and write technically. The content included technical problems or topics they need to think critically and presented them through writing a technical report.

3.4.2.3 Duration of the Intervention

The intervention included (14) sessions, lasted for seven weeks (90-minutes for one session and two sessions per week). There was a pre-posttest which was on Saturday, 25th of November 2023. There was an introductory session which was on Tuesday, 28th of November. The experiment began on Saturday, the 2nd of December 2023 to the 16th of January 2024. The posttest was applied on Saturday, the 20 th of January 2024. The intervention began with an introductory session which included:

1. Icebreaker: A short activity to introduce the main topic of the class in no more than 5 minutes. Icebreakers are an effective way of boosting students' engagement as they improve enthusiasm and help get the attention of the class.

2. Sharing the lesson objective: A short activity of no more than 5 minutes to explain the expected learning outcomes for the lesson.

3.4.2.4 Implementation of A Strategy Based on EDJA Model

A strategy based on EDJA model was a set of instructional procedures that the instructor followed through reviewing literature and related studies on EDJA model, technical writing and critical thinking. To implement it, there were three stages of teaching that instructor followed: pre-teaching, during teaching and post-teaching. The Instructor's Manual was designed (**Appendix 6**).

1. Pre-teaching: Excitement Stage (20 minutes)

-The instructor tailored the students' interests and needs into real technical problems to be posed.

-The instructor presented the technical problem or topic in a motivational way through a case study, picture to describe, a video, a story…etc

-Ss were asked to identify or clarify the main issues in the problem. They stimulated their cognitive schemata through linking prior experience to the new lesson or topic. They could use a concept map to represent their ideas and main issues in the problem.

2. During-teaching: Discussion & Justification Stage (40 minutes)

-The instructor conducted an "introductory problem dialogue" among the analogic groups to collect information or facts about the problem.

-Ss gave their ideas, opinions, compare, and evaluate their different points of views about the main issues or points.

-Ss could evaluate their judgements based on logic and evidence

This stage included three steps:

a) **Collaborative Brainstorming**:

-Ss asked their questions and make predictions about the topic or problem at hand.

-Ss participated and expressed their ideas to be recorded in the conceptual map.

b) Analogic or Matching Groups:

-The instructor divided the Ss into four analogic or corresponding groups (8-9 members). These groups could be named and had a leader. Each group presented certain points of view on a problem, the other group presented the opposite or opposing opinions. Each group justified solutions and arguments based on valid reasons to the other group.

-Ss drew logical conclusions from reasons and evidence

-Ss identified implicit and explicit relationships among the elements of the problem and corrected each other's thinking to be logic

c)Practice:

-The instructor guided the Ss to know how to write technical reports with specific sections and layouts

-Ss began in groups to imitate the model and write a report based on the format and style of technical writing to convey their idea.

-Ss joined the parts of the text (introduction, body and conclusion) using linking words

-Ss organize and link their ideas in a meaningful way

- Ss revised the content, edited grammar and checked their writing mechanics to modify it.

3) Post-teaching: Application Stage (30 minutes)

- Ss posed problems like the problem presented previously. The analogic groups could think critically to find solutions to them

-They faced each other, and the other group found appropriate solutions to the problem based on the correct understanding.

-The instructor gave an evaluation in the form of an individual written exercise to ensure that the information reached all students.

-Ss submitted a final work or project as an application for what they learned.

The Roles of the instructor and students were as follows:

-Material provider: or Stimulator: drawing students' interest to bring real problems they faced to their learning.

-Evaluator: reviewing the students' progress through their portfolios

-Supporter: giving positive feedback to the weak students

-The roles of the students were researcher and collaborator, problem solver and critical thinkers.

Observations during the Intervention:

During the intervention, HITT students were more interested and engaged in using EDJA model. They were aware of identifying the problem, discussing main issues, sharing ideas, analyzing and synthesizing information, representing it visually through concept maps. They were able to pose problems like the problems faced previously and felt excitement during technical writing process.

4 Results

4.1 Validating the Hypotheses of the Research

4.1.1 Validating the First Hypothesis

To verify the validity of the first hypothesis "There was a statistically significant difference among the mean scores of the study participants of EFL technical writing skill as a whole and its sub-skills in the pre/post-assessment at the level of $\alpha \geq 0.05$, favoring the post-assessment." The "t" value was measured for the two independent samples (Independent-Samples T-Test) to indicate the differences among the average scores of the study participants in the pre/post-applications of EFL technical writing skill test as a whole and in its sub-skills. To measure the Effect size of the intervention on EFL technical writing skills, the Effect size ($\eta 2$) was calculated. The following table showed this.

Table (15) Results of the T-test between the pre/post-applications of EFL technical writing skill test as a whole skill and in its sub-skills

Skills	Test	N.	Mean	Std. Deviation	t-value	Sig α	DF	η2
Technical Content	Pre	37	10.19	3.48	19.510	0.01	36	0.914
	Post	37	22.27	2.19				
Writing Style	Pre	37	12.22	3.50	21.726	0.01	36	0.929
	Post	37	25.68	2.57				

Grammar	Pre	37	12.64	2.91	18.119	0.01	36	0.901
	Post	37	22.05	1.72				
Mechanics of Writing	Pre	37	8.59	2.98	16.831	0.01	36	0.887
	Post	37	16.89	1.58				
ALL Over the Test	Pre	37	43.65	10.41	27.395	0.01	36	0.954
	Post	37	86.89	5.28				

As shown in table (15), there was a statistically significant difference among the mean scores of the study participants of EFL technical writing skills as a whole and its sub-skills in the pre/post-assessment at the level of $\alpha \leq 0.01$, favoring the post-assessment, where t-value was (27.395) which was significant at the level of significance (0.01). Thus, this hypothesis was accepted. The Effect size ($\eta 2$) of the intervention on EFL technical writing skills as a whole and its sub-skills was ranged from (0.887-0.954). This was greater value than (0.14). This signified a great effect of the intervention on developing these skills. The following figure showed the differences among the mean scores of the study participants in the post-assessment of EFL technical writing skills test as a whole and in its sub-skills:

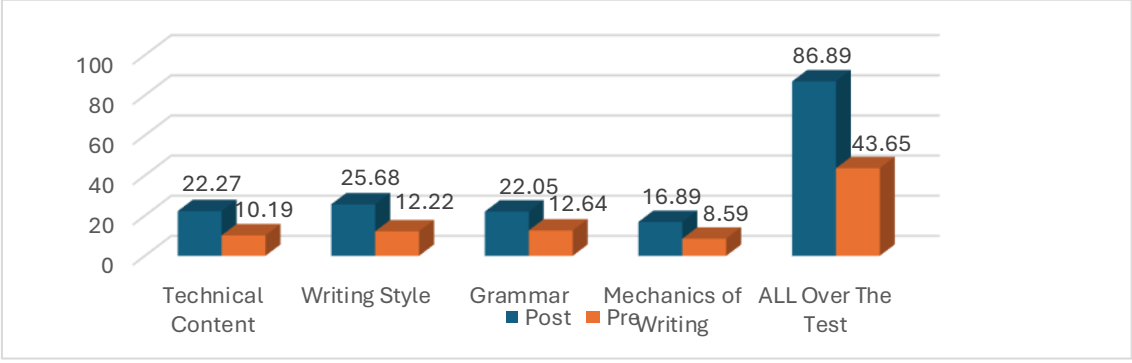


Figure (6) the differences among the mean scores of the study participants in the pre/post-assessment of EFL technical writing skills test as a whole and in its sub-skills

4.1.2 Validating the Second Hypothesis

To verify the validity of the second hypothesis "There was a statistically significant difference among the mean scores of the study participants of EFL critical thinking skill as a whole and its sub-skills in the pre/post-assessment at the level of $\alpha \geq 0.05$, favoring the post-assessment". The "t" value was measured for the two independent samples (Independent-Samples T-Test) to indicate the differences among the average scores of the study participants in the pre/post-applications of EFL critical thinking skills test as a whole skill and in its sub-skills. To measure the Effect size of the intervention on EFL critical thinking skills, the Effect size ($\eta 2$) was calculated. The following table indicated this.

Table (16) Results of the t-test between the pre/post-applications of EFL critical thinking skill test as a whole skill and in its sub-skills

Skills	Test	N.	Mean	Std. Deviation	t-value	Sig α	DF	η2
Clarification	Pre	37	3.57	1.69	15.448	0.01	36	0.869
	Post	37	8.46	0.87				
Evaluation	Pre	37	6.38	2.40	11.830	0.01	36	0.795
	Post	37	12.92	1.44				
Analysis	Pre	37	6.16	1.52	19.460	0.01	36	0.913
	Post	37	12.89	1.26				
Justification	Pre	37	3.05	1.51	19.986	0.01	36	0.917
	Post	37	9.00	0.75				
Inference	Pre	37	3.89	1.52	16.511	0.01	36	0.883
	Post	37	8.62	0.98				
Self-Regulation	Pre	37	3.00	1.41	17.844	0.01	36	0.898
	Post	37	8.95	0.94				
ALL Over the Test	Pre	37	26.05	4.89	31.754	0.01	36	0.966
	Post	37	60.84	3.15				

Table (16) showed that there was a statistically significant difference among the mean scores of the study participants of EFL critical thinking skills as a whole and its sub-skills in the pre/post-assessment at the level of $\alpha \leq 0.01$, favoring the post-assessment,

where t-value was (31.754) which was significant at the level of significance (0.01). Thus, this hypothesis was accepted. The Effect size (η2) of the intervention on EFL critical thinking skills as a whole and its sub-skills was ranged from (0.887-0.954) . This was greater value than (0.14). This signified a great effect of the intervention on developing these skills. The following figure showed the differences among the mean scores of the study participants in the post-assessment of EFL critical thinking skills test as a whole and in its sub-skills:

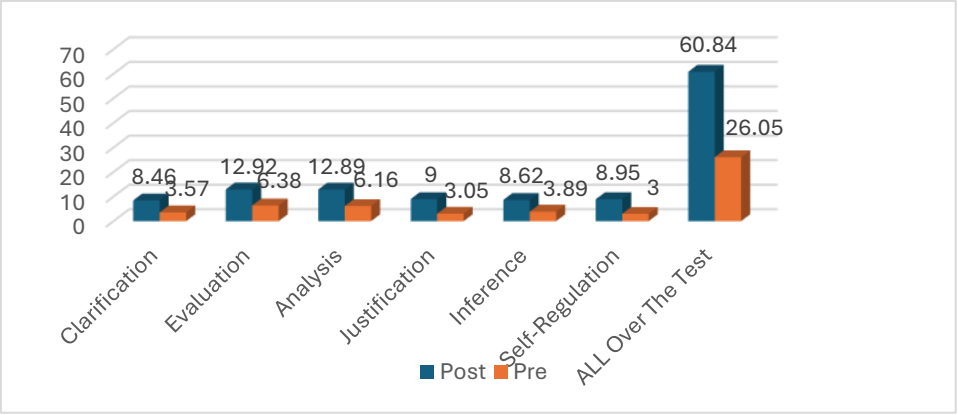


Figure (7) the differences among mean scores of the study participants in the pre/post-assessment of EFL critical thinking skills test as a whole and in its sub-skills

4.1.3 Validating the Third Hypothesis

To verify the validity of the third hypothesis "There was a statistically significant difference among the mean scores of the study participants of EFL critical thinking skill in the pre/post-assessment on the Can-Do checklist at the level of $\alpha \geq 0.05$, favoring the post-assessment". The "t" value was measured for the two independent samples (Independent-Samples T-Test) to indicate the difference among the average scores of the study participants in the pre/post-applications of EFL critical thinking skills checklist. To measure the Effect size of the intervention on EFL critical thinking

skills checklist, the Effect size (η2) was calculated. The following table indicated this.

Table (17) Results of the t-test between the pre/post-applications of EFL critical thinking skills on Can-Do checklist

Test	N.	Mean	Std. Deviation	t-value	Sig α	DF	η2
Pre	37	5.92	2.15	20.437	0.01	36	0.921
Post	37	14.27	1.37				

As indicated in table (17), there was a statistically significant difference among the mean scores of the study participants of EFL critical thinking skills in the checklist in the pre/post-assessment at the level of $\alpha \leq 0.01$, favoring the post-assessment scores, where t-value was (20.437) which was significant at the level of significance (0.01). Thus, this hypothesis was accepted. The Effect size (η2) of the intervention on EFL critical thinking skills, it was reached (0.921). This was greater value than (0.14). This signified a great effect of the intervention on developing these skills. The following figure showed the differences among the mean scores of the study participants in the pre/post-assessment of EFL critical thinking skills checklist

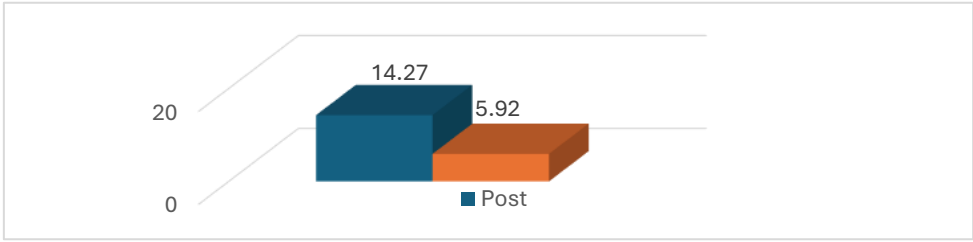


Figure (8) the differences among mean scores of the study participants in the pre/post-assessment of EFL critical thinking skills on A Can-Do checklist

4.1.4 Validating the Fourth Hypothesis

To verify the validity of the fourth hypothesis "There was a statistically significant correlational positive relationship among the scores of the study participants of EFL technical writing test and critical thinking test at the level of $\alpha \geq 0.05$, favoring the post-assessment." The Pearson correlation coefficient was calculated among the scores of the study group students in the technical writing skills test and their scores in the critical thinking test. The following table showed this.

Table (18) The Pearson correlation coefficient among the scores of the study group students in the technical writing skills test and their scores in the critical thinking test

Skills	Technical Content	Writing Style	Grammar	Mechanics	ALL Over the test
Clarification	0.888**	0.832**	0.894**	0.577**	0.904**
Evaluation	0.839**	0.785**	0.750**	0.607**	0.941**
Analysis	0.873**	0.840**	0.680**	0.598**	0.909**
Justification	0.902**	0.770**	0.696**	0.615**	0.808**
Inference	0.830**	0.549**	0.719**	0.607**	0.837**
Self-Regulation	0.865**	0.791**	0.806**	0.641**	0.941**
ALL Over the Test	0.929**	0.875**	0.891**	0.637**	0.963**

****. Correlation is significant at the 0.01 level**

Table (18) indicated that there was a statistically significant correlational positive relationship among the scores of the study participants of EFL technical writing test and critical thinking test at the level of $\alpha \geq 0.01$, favoring the post-assessment. This confirmed the validity of the fourth hypothesis.

4.2 Discussion of the Results

Validating the four hypotheses of the research had indicated that there were statistically significant differences among the mean scores of the study participants in the pre-post assessment favoring the post assessment of technical writing and critical thinking skills test due to utilizing the strategy based on EDJA model. This development was clear in their performance during and after the

training sessions. They had the passion to identify other problems and solve them by writing a technical report. This might be attributed to the following aspects:

The researcher identified the learning gaps in Technical English course among the HITT fourth year students through conducting a needs analysis questionnaire, interviewing with the HITT instructors, reviewing both the regulation and the specifications of the Technical English course, and the literature and related studies. This helped the researcher select the content that motivated the students to think critically and write technically. The content included technical topics and problems related to the field of transport technology focusing on practical and useful ESP knowledge and EDJA model activities that helped integrate their critical thinking skills into technical field and brought excitement together.

Their excitement was increased through presenting a technical problem in a collaborative learning process, analogic groups, discussion, brainstorming...etc. The students brainstormed their ideas collaboratively on the concept maps, posing questions, giving their opinions and the opposite ones, justifying their solutions and drawing conclusions. Each group also reflected on each other's performance, revised and corrected their writing. The more the students participated in EDJA model, the more they became technical writers and critical thinkers. This evoked the need to integrate critical thinking skills into technical discipline.

Validating the first hypothesis confirmed developing technical writing skills due to collaborative brainstorming and analogic groups. The instructor gave the students the opportunity to ask all their questions and make predictions about the topic or problem at hand, then recorded them in the conceptual map. As the instructor

didn't reject any questions from the students about the problem, they reached the higher order thinking level. They related their schemata to the new knowledge. Moreover, the EDJA model was based on the constructivist theory which called for the instructor to dialogue with the students and encourage them to participate and express their opinion and discuss the opposite opinions. The method of dialogue and discussion assisted the groups to reach certain results that facilitated the process of reaching a solution to the problem. Social constructivist theory called for this through its focus on social interaction.

Accordingly, HITT students could discuss their learning problems, write documents related to their field, have sufficient knowledge of the topic they approached in writing, related their technical skills to real life situations, and were enriched with many resources to model their writing. Technical writing skills should be related to their field study. Analytical skills should be interwoven with technical content. Critical thinking not only described the ability to think in accordance with the rules of logic and probability, but also the ability to apply these skills to real-life problems, which were not content-independent. This could be achieved through utilizing a strategy based on EDJA model.

A strategy based on EDJA model was a workshop style model for developing technical writing skills through group work activities. This result was consistent with the results of many studies such as the studies of Abdullah (2023), AL-Helou and Muhammed (2022), Mutanish (2020), and Najm (2022) which recommended utilizing EDJA model to stimulate the students' thinking in writing process considering the student as an active participant in the process of learning.

Validating the second and third hypothesis indicated developing critical thinking skills due to utilizing a strategy based on EDJA model. The activities were participatory which encouraged analogic groups to share ideas, give opinions, and justify them. This result

was consistent with the results of many studies such as the studies of Ahmed and Ibrahim (2023), Al Khoudary (2015), Brahim, (2021), and López et al. (2023) which recommended integrating critical thinking in EFL learning in general and technical writing in particular. There were many studies that dealt with relating or integrating critical thinking into argumentative writing or creative writing but to the best knowledge of the researcher, there were none of the studies on the Egyptian context that dealt with the relationship between critical thinking and technical writing.

Validating the fourth hypothesis revealed a correlational positive relationship among the scores of the study participants of EFL technical writing test and critical thinking test at the level of $\alpha \geq 0.01$. This result was consistent with the results of the studies of Amer (2022), Bendary (2018), Chen (2017), Ibrahim (2023), Normore (2024), and Stepanivna (2023) which recommended integrating critical thinking and technical writing skills. Since a report could be no clearer than the thoughts upon which it was based, those who learned to write clearly would of necessity train themselves to think more critically too. The research results affirmed the significance of critical thinking skills in technical disciplines and underscored the potential of EFL learning to nurture these skills

4.3 Conclusions

The following conclusions were extracted in the light of the previous findings:

1. The development of HITT students' technical writing and critical thinking skills was due to the activities of collaborative brainstorming, analogic groups, discussion, etc.

2. The intervention accommodated to diverse students' needs, and characteristics giving them numerous opportunities to interact in real technical problems.
3. Critical thinking should be integrated into technical discipline.

4.4 Recommendations

In the light of previous results, the following recommendations could be presented to:

1. update technical English courses considering the students' needs and the learning outcomes
2. teach technical writing skills, and activities in an integrated course and in accordance with the critical thinking skills.
3. pay attention to relate technology student's learning experience with real word problems.

4.5 Suggestions for Further Research

1. Utilizing the EDJA model for developing technical reading and attitudes towards it.
2. Investigating the effectiveness of EDJA model on developing vocabulary usage and academic engagement.

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