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Title

AN EXPLORATORY STUDY ON PROJECT-BASED LEARNING'S PEDAGOGY IN AN ESP INTERDISCIPLINARY SYLLABUS: the case of Mathematics Students at NHSM- Algiers

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Dedication

This work is dedicated to my beloved mother.

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Abstract

This study examined teaching English to ESP students using interdisciplinary approach to enhance the integration of English, mathematics and computing through Project Based Learning. It was hoped that the results would bring a change in the way knowledge is imparted to 21st century students and prepare them for the real-world. The study attempted to showcase, through extensive literature, that students needed more than the basic, academic skills to thrive in their life after graduation. This study aimed to reveal the feasibility of interdisciplinary approach in an ESP class, using project based learning and discuss the benefits and challenges of its implementation into the educational system. While several studies have been conducted in interdisciplinary syllabus, the need for a practical way on how to use it in class was important in the view of the researcher was critical. Besides, it was hoped to provide students with a better understanding of the connection between various disciplines, they could be more successful in the subjects taught and able to apply acquired knowledge in class out of the box. The study was guided by four research questions. The researcher attempted to explore to what extent teachers were familiar with interdisciplinarity, the way project as a tool to meet the 21st century students, and find out whether it was in alignment with modern education, and what the challenges and limitations might have hindered its application in the Algerian Educational system. Its purpose was, then, to explore the effectiveness of project based learning to teaching English to mathematics students. Empirical data were gathered through interviews of teachers, questionnaires and classroom observation and extensive literature related to the importance of interdisciplinary teaching in the 21st century. In the semi-structured interviews, nine teachers participated in the study while thirty-nine students took part in the survey. As for the third, classroom observation, it was conducted by the researcher as a non-participant. The data were analysed using descriptive statistics, frequency distribution, tabulation and percentages. The study took place at the National High School of Mathematics (NHSM), Algiers. The findings revealed that most of the students (84,6%) demonstrated positive attitudes towards the project initiated and conducted in class at NHSM and with a high sense of engagement and motivation. They were able to realise that all subjects were connected in a way or another. As for teachers' interviews, the findings revealed that most of them were not familiar with interdisciplinarity and conducted projects in a traditional way. They also admitted that this approach requires time management, interdisciplinary collaboration and teacher training. As a result of the study, few recommendations were made. First, it was recommended that teachers should be given opportunities to take part in continuous professional development programs on effective application of interdisciplinarity and experiment with project-based learning. Then, designing an action plan to facilitate teachers' cooperation and promoting reflective practice was highly recommended. Finally, it was recommended that syllabuses be in alignment with 21st students' needs, aspirations, interests and learning styles.

Keywords: Algerian Educational System; Interdisciplinarity; Project-based learning; Student-centred pedagogy; 21st century learning; Student engagement

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List of Abbreviations

ESP: English for Specific Purposes

GE: General English

ID: Interdisciplinary (teaching)

IDY: Interdisciplinarity

NA: Needs analysis

PBL: Project-based learning

PD: Professional development

PSA: Present Situation Analysis

PW: Project work

TSA: Target Situation Analysis

List of Acronyms

ENMATCOM: English Maths Computing

OECD: The Organization for Economic Cooperation and Development

NHSM: National High School of Mathematics

Introduction

"The object of teaching a child is to enable him to get along without a teacher."
—Elbert Hubbard

1. Introduction

Although mathematical knowledge is and can be used along with many other subjects in schools, colleges and universities, it is mostly taught in isolation making it impossible for students to apply any acquired mathematical knowledge in their daily life to solve real problems or deal with real life experiences. As a matter of fact, up to this day the syllabus is still based on the concept that instruction should be imparted in isolation which turns out to be unfit in modern education where students are required to develop abilities required in the workforce and face the 21st century challenges.

Twenty first students' education is no longer limited to the teaching of the four skills (listening, speaking, reading and writing), but more inclined to teaching skills like communication, creativity, collaboration, critical thinking and problem solving in the syllabus (Rotherham & Willingham, 2009). Traditional teaching is made inappropriate and compelling to educators and researchers to bring reforms to the educational institutions and integrate more skills to keep up with the changes of the world mostly influenced by globalisation and technology. If the world has changed, then teachers have to embrace the changes as stated by Drake (1998) who stated that: "If we live in an interconnected and interdependent world, it makes sense that knowledge be presented as interconnected and interdependent."

As more and more educators realized that students needed to be fully engaged in the teaching-learning process, several attempts to redesign the syllabus and provide the students with the 21st century skills through innovative teaching and learning have been intended to prepare them for the future. Evidently, they have been made to shift from the actual mode of knowledge transmission to a new mode that helps them learn how to learn, how to think critically, find and synthesise information, and use technology (Barron & Hammond, 2008).

To do so, researchers stressed the need for interdisciplinary (ID) education as an approach to meet the 21st century requirements rather than a discrete, subject matter (Connolly & Vilardi, 1989). In studies conducted by Drake & Reid (2010), it has been demonstrated that with an ID syllabus, students performed equally to or better than students in a one discipline–based syllabus as it gives more opportunities that go beyond the typical constraints of a single content area. They are placed in a context whereby they make connections between knowledge acquired in class and real life experiences to solve a problem (Blumenfeld et al, 1991) with teachers acting as facilitators. Moreover, an ID syllabus fosters students' critical thinking,

creativity, collaboration and communication skills, and support the use and application of what has been taught and learnt in new and different ways (Dole et al; 2016).

One way to make students see the connections between, at least two disciplines, is the use of problem-based learning (PBL), which consists of providing students with opportunities to solve problems that are found in other subjects within contexts and beyond the institution (Labudde, 2014). PBL, an effective means to promote students' achievements and transfer skills so much needed and required by employers (Murray & Savin-Baden, 2000), enables students not only to understand the content of the subject matter (maths) but develop their autonomy making English classes (with maths students) motivating, interesting and student centered (Choike, 2000).

If PBL has emerged as an effective approach to make students active and engaged in investigating in authentic problems (Blumenfeld et al, 1991; McGrath, 2004), shifting from the transmission mode to the PBL mode is not without challenges. Teachers are required to develop new pedagogical strategies, new ways of assessing by taking part in teacher professional development (PD) sessions, attending conferences and collaborating with peers (Hancock et al, 1992; Marx et al, 1997).

Having said this, it is imperative that teaching in higher education (HE) should move towards an ID mode to provide students with the opportunity to acquire knowledge by pulling from more than one discipline like solving a problem, explaining a phenomenon, creating a product, or raising a question (Boix-Mansilla, 2005: 16). This enables them to face the 21st century challenges and see the connections between subjects (Lattuca et al; 2017).

However. although recognizing the advantages and importance of ID teaching, teachers may have difficulties in integrating other subjects in the teaching process (Krause et al., 2020) due to time limitation, lack of materials/ideas and lack of knowledge of other subjects (Nguyen & Nguyen, 2019) all of which are addressed in the study.

This study aims to show that teaching through ID syllabus is a suitable approach to achieve the purpose of meeting the students' needs in modern education and cope with the challenges associated with developing the 21st century skills.

In this study, the researcher proposes the process of designing ID project work (PW) for a mathematics classroom which begins with a problem that embodies mathematical concepts

covered in their field and ends up with a students' product using both the target language and technology.

1.1. Background of the Study

Interdisciplinarity is an integrative approach using more than one discipline and is built on the principle that students learn best when a material presented to them is connected to other disciplines. Research indicates that using an ID approach provides students with relevant, less fragmented, and stimulating experiences (Jacobs, 1989).

More interestingly, research has come to the realization that today' education, based on teaching through fragmentation, poses real problems to students when confronted to a problem in their daily life as they are not able to pick the subject that would help them solve that particular problem. Since fragmented syllabus did not help students face real life problems, educators had to consider the shift from fragmented syllabus to ID syllabus in order to bridge the gap between school and real life as 21st century students need more than one discipline to solve problems (You, 2017).

Shifting from teacher-centered instructional approach whereby knowledge transmission is based on rote learning and factual information to student centered approach has become a must to acquire the 21st century skills that would offer them the opportunity to meet the demands of the job market as asserted by Barron and Darling-Hammond (2008).

In search of finding a way that provides students with teaching quality, PBL emerged as an effective one. PBL, which according to Hasni et al. (2016) engages students in resolving a real-life problem through investigations and collaboration with peers, teachers, and members of their society, is a process that starts with a problem and ends up with a product as a solution.

In a PBL lesson, students are engaged in authentic tasks to solve real-world problems by developing a multitude of skills: finding a driving question, debating, negotiating, making deductions, arguing, working with peers, communicating, collecting and analyzing data… (Blumenfeld et al, 1991; Thomas, 2000; & Mergendoller et al, 2006).

As such, in a PBL lesson, not only do students learn to deal with real life problems but learn to transfer their acquired learning in class to novel situations out of the box (Blumenfeld et al, 1991). However, implementing PBL is not without challenges; therefore, teachers are required to upgrade their knowledge, use new strategies in alignment with the demands of modern education (Edelson et al, 1999; Hancock et al, 1992; Marx et al, 1997).

This thesis proposes an ID teaching with PBL as an innovative tool for maths students studying English. It is hoped that with PBL students could see the relationship of maths with other subjects and acquire the 21st century skills which are as important as the content knowledge acquisition. As students understand the links between different subjects, learning becomes enjoyable and meaningful.

1.2. Significance of the Study

The focal point of this study is ID teaching using PBL in a mathematics class. The PBL model proposed in the study is novel, developed for teachers teaching different disciplines. It is primarily intended to support English teaching to ESP students with an authentic project implemented at NHSM with assessment tools within a framework that can be used by teachers in their own classes and for future researchers to explore the claims made about its potential.

It is true that there are many studies on ID practices at all educational levels; however, very few studies were conducted on the applicability of ID teaching with mathematics students in the Algerian universities to the researcher's best knowledge. In this regard, the goal of this thesis is to research on the feasibility of ID studies with mathematics students in an English course at the university level along with its advantages, disadvantages and challenges.

Traditionally, university teachers are appointed to their positions on the basis of their specialization and given the syllabus at the beginning of the academic year. Lesson preparation is founded only on a single discipline or assigned course which makes it traditional and isolated from other disciplines (Lattuca, 2001). He stressed the importance of creating an ID teaching and learning environment and the value of rethinking the way teachers can merge some disciplines. Perhaps, it was that concern of re-examining how instruction is provided to 21st century that made the researcher delve into a new alternative to traditional "fragmented" syllabus that compels students to study from 8.30 a.m to 4. pm., go from one class to another to, acquire knowledge in isolation with no opportunity to transfer it, work in groups, communicate, or debate unlike an ID syllabus that enables students to work in groups to resolve a problem which fosters the spirit of teamwork and promotes interpersonal communication, skills of great value in 21st workplace.

The study, which did not suffer resources as the researcher had access to overseas libraries, provided quantitative and qualitative findings that may assist teachers not currently using PBL, consider its potential. Therefore, it is hoped that it:

- will trigger a debate as regards to its effectiveness in improving students' achievement; and in preparing them to meet the demands in this changing world;
- could lead to positive change as far as syllabus design is concerned;

- serve as a model for teachers to embark on this new approach and/or open areas for further research.
- would provide teachers evidence of the importance of bringing modifications in their teaching practices and find more motivating and engaging strategies.

As far as the contribution of this study to the whole Educational System of Algeria at the higher level is taken into consideration, several facts are to be considered. First, the researcher sorted the topic of this thesis as a result of the experience of applying the approach of interdisciplinary and PBL while teaching ESP to students of Maths, Engendering, Computation, Material Sciences and Physics for eight (8) years at the Universities of Mostaganem and Mascara, having the same results. Besides, the same approaches are widely applied by the researcher as an Assistant teacher of English at the Department of English at the University of Ghardaia, mainly Literature, Civilization and Grammar, in addition to workshops with students following the same approach. Secondly, the project of this study was conducted at the National Higher School of Mathematics that follows the same educational system that is followed by the Algerian universities. Effectively, this study is evidently reliable to be applied.

1.3. Statement of the Problem

With the changes that occurred in the fied of education, student engagement in the teaching learning process has become a priority and emphasized, and this is why ID instruction is known to be of great value to achieve the goal. Unfortunately, according to studies, its implementation has not been given weight and consideration (Erdamar, 2019; Yayla & Yayla, 2018) as teachers are not able to move away from single disciplinary teaching (Yalçın, 2020).

In fragmented teaching, students acquire knowledge through rote learning, memorisation, and factual information in complete disconnection with other subjects with teachers as absolute knowledge transmitter. Unfortunately, this mode of teaching robs students' ability to deal with problems in a world described as complex as stated by Tekbıyık Yalçın and Emrahoğlu (2017).

One way to support students' learning in modern society, teachers are required to find ways to make different disciplines interact as teaching different disciplines in a fragmented way is in full contradiction of what students face in their daily life. Teaching through disciplines on the basis of an ID syllabus enables students develop 21st skills like communication, creativity, critical thinking, collaboration, independence, problem solving, and knowledge transfer to new contexts (Yates, 2017, p. 92). To Parappilly et al. (2021), an ID syllabus is the right response to 21st century students as it requires students to use acquired knowledge in class to solve a problem, create a solution, explain phenomena or generate further questions (Boix Mansilla & Gardner, 2003; Repko, 2009).

As such, the primary aim of the study was to investigate to what extent ID could bridge the gap between knowledge acquired in class and using it out of the box. Furtherly, to achieve this, a tool was needed to implement an ID lesson and methods were to be found to assess learning in this context.

The researcher found a wide body of studies on ID, but few discussed how to apply it in class and assess learning. Therefore, after identifying the gap between ID instruction and assessment tools, the aim of the study was extended to finding an assessment tool to address the gap in ID teaching and learning.

In search of a tool that would serve the role of merging two or more disciplines and assessing learning and after extensive reading literature related to ID instruction, the researcher came across PBL as an approach that could fulfill the role cited above. Being authentic and relevant, PBL motivates students to be fully engaged using the expertise of each member in the group and knowledge acquired from other disciplines to work on a question or problem, find a solution and share it with an audience..

1.4. Purpose of the Study

The purpose of this thesis was to:

- explore the effect PBL has on students' learning, and how it can be used to prepare them to be successful in their career.
- reveal the feasibility of ID for mathematics students studying English by sharing a model project implemented in October 2024 in a School where students used to prepare and present projects in a traditional way.
- to share ideas on how ID instruction with PBL as an approach could make students connect some concepts to other disciplines.

1.5. Aims of the Study

In modern teaching, there is a felt need to ensure that students are provided with instruction that suits their needs and meets their interests so that they can apply their acquired knowledge outside the educational institution and face real life problems.

The traditional way of teaching administered in a way with each subject taught in isolation has become irrelevant and obsolete to students living in a world whereby everything is interconnected. As a result of this, researchers and educators are stressing the importance of moving away from mono-disciplinarity to IDY, a methodology that provides students with opportunities to integrate knowledge drawn from two or more disciplines to solve a problem, create a product, or raise a question that would lead to resolve a problem (Mansilla, 2005, p. 16).

The goal of this study is to give educators a theoretical underpinning for ID as well as a useful tool for putting the ID approach into practice in the classroom. While the practical section details a project carried out by students enrolled in the mathematics department at NHSM, Abdelhafid Ihaddaden Science and Technology Hub., the foundational theory seeks to explain how to organize an ID lecture and evaluate students' PW. It aims to demonstrate how PBL instruction in a math classroom can increase students' interest in the teaching and learning process.

PBL and interdisciplinary instruction are very compatible and frequently work in unison. Since PBL frequently involves complicated, real-world problems that call for knowledge and abilities from numerous disciplines to address, interdisciplinary teaching, which integrates multiple subjects, naturally fits with PBL. To sum up, PBL gives interdisciplinary learning a real-world setting where students can apply their knowledge and abilities to solve these issues in a meaningful way.

1.6. Research Questions

The overall objective of the thesis is to understand how interdisciplinary syllabus can help teachers teach 21st century skills through disciplines and show the interconnections between them. Through qualitative and quantitative research methods, this study will address the following questions:

RQ1: To what extent are teachers familiar with ID instruction?
RQ2: To what extent are teachers familiar with PBL in higher education?
RQ3: To what extent is ID using PBL as a tool is in alignment with the 21st skills acquisition?
RQ4: What are the challenges and limitations of using PBL?

Hypotheses

The following hypotheses emerged from the literature in relation to the research questions.

H1: Most likely teachers are not familiar with interdisciplinary teaching approaches.

H2: Most likely teachers are conducting PW in a conventional way.

H3: It is hypothesized that PBL implementation is in full accord with the teaching of 21st century skills difficult to acquire in a conventional class.
H4: PBL is time consumer. It requires teachers a specialized training.

1.7. Limitations of the Study

The findings of this study have to be examined in light of some limitations. The first limitation of this study originates from the fact that it was confined to one department – department of mathematics, at NHSM, Abdelhafid Ihaddaden Science and Technology Hub, Algiers. Moreover, the information obtained from the paticipants can be said to be limited since one project was conducted for the purpose of this study. Therefore, since this study was designed as a case study in one department, the results cannot be generalized to other deparments. The setting and structure of the School where the study took place can affect the results of the study. The generalization of the findings can be possible only if the study was conducted in different departments and in different areas of the country with poor facilities and lack of pedagogical materials.

Still, the results can provide an insight about the instructional model of teaching ESP through PBL to ESP teachers. The second limitation of the study was that all data were based only on students' views. Therefore, the results of the study are limited only to students' perceptions regarding project work.

In an attempt to bring a small contribution in the field of education, then an ID syllabus

for maths students has been constructed (appendix S) and chaperoned with links and references for further reading. In addition, to save the reader's time, all the figures, tables and graphs have been compiled and appended along with the list of appendices.

1.8. Definitions of Terms

For the purpose of this study, the following definitions were used:

1. **Academic purposes:** Refers to the language and associated practices that people need in order to undertake study or work in English medium (Richards & Rodgers, 2001, p.205).
2. **Active learning:** Students are encouraged to think, discuss, research, and create as part of active learning approaches. Students practice skills, solve issues, grapple with difficult questions, come to decisions, offer answers, and use writing and discussion to put concepts into their own words in the classroom.
3. **Assessment:** The action or an instance of making a judgment about something (Joughin (2010).
4. **Authentic materials:** Authentic materials are materials created for real world purposes (Prasad & Akhtar, 2017).
5. **Coaching:** It is a conversation that focuses on the improvement of learning by promoting "self-awareness" ((van Nieuwerburgh, 2012).
6. **Collegiality:** The sharing of ideas, support, respect, and community among a group of colleagues (Gori, 2014).
7. **Critical thinking:** Critical thinking is a methodical and disciplined intellectual process that involves the active and proficient conceptualization, application, analysis, synthesis, and evaluation of information obtained through observation, experience, reflection, reasoning, or communication, serving as a foundation for beliefs and actions (Cohen, 1971).
8. **Curriculum:** The curriculum is as a structured framework of planned experiences that enables students to develop and demonstrate proficiency in both content knowledge and practical learning skills. It acts as a fundamental reference for educators, outlining the essential elements necessary for effective teaching and learning, ensuring that all students are provided with challenging academic opportunities (Hlebowitsh, 2004).
9. **Discipline:** A specialized field of study, a branch of knowledge distinguished by the uniqueness of its content and methods (Yadav & Lakshmi, 1995).
10. **Engagement:** Refers to the student's level of investment in learning. It includes being thoughtful and purposeful in the approach to school tasks and being willing to exert the effort necessary to comprehend complex ideas or master difficult skills (Fredricks et al, 2011).
11. **Entrepreneurialism:** Entrepreneurialism refers to the process by which an individual takes initiative

on a concept, typically aiming to challenge the existing market through the introduction of a novel product or service. While entrepreneurship often begins as a small-scale venture, the overarching goal is significantly more ambitious: to achieve substantial profits and secure a prominent position in the market through innovative ideas (Hayek. 2005).

12. **Evaluation:** Evaluation is the methodical process of examining your actions and the manner in which they are executed, ultimately leading to a determination regarding the 'worth, merit, or value' of a particular subject (Ogunniyi, 1984).

13. **Formative assessment:** A formative assessment is characterized as a low-stakes evaluation that typically does not impact a student's final grade. Such assessments may involve summarizing key concepts from a lecture or administering a weekly quiz to evaluate understanding of the material covered *(Alahmadi* et al; 2019).

14. **Interdisciplinary approach:** Interdisciplinary approach means to teach/ integrate more than one discipline through single subjects or topic (Shulman, 2002)

15. **Interdisciplinary teaching:** A method of investigating a theme, issue, question, or topic by combining elements from other academic disciplines (Newell & Green, 1982).

16. **Learning style:** Learning styles can be characterized as comprehensive patterns comprising various factors, behaviors, and attitudes that enhance an individual's learning experience in specific contexts, thereby guiding both learning and teaching processes (Ormrod, 2008).

17. **Mixed-ability:** Mixed-ability classes refer to educational settings in which students exhibit significant variations in their abilities, motivation to learn English, individual needs, interests, educational backgrounds, learning styles, levels of anxiety, and prior experiences, among other factors (Ainslie, 1994).

18. **Problem Based Learning:** A student-centered approach to learning that allows students to collaborate; learn critical thinking strategies and knowledge through the experience of solving an open-ended question (Ali, 2019).

19. **Professional development:** It refers to any type of learning or training undertaken to increase knowledge of a given area (Mitchell, 2013).

20. **Project-Based Learning:** With the help of project-based learning, students can learn new things by spending a lot of time researching and solving a challenging topic, question, or challenge. This could be one project or a "series of projects that require students to use diverse skills—such as researching, writing, interviewing, collaborating, or public speaking—to produce various work products, such as scientific studies, research papers, public-policy proposals, multimedia presentations, video documentaries, art installations, or musical and theatrical performances, for example." (Al-Balushi & Al-Aamri, 2014).

21. **Projects:** Supplementary, long-term educational assignment necessitating personal initiative, undertaken by an individual student or a group of students (Katz & Chard, 2000).

22. **Reflective practice:** Reflective practice is the ability to reflect on one's actions so as to engage in a process of continuous learning (Brookfield, 1999).

23. **Summative assessment:** Summative assessment is an evaluation of students' current understanding and achievement. It allows teachers to track students' progress over a period of time. It is done at the end of teaching unit or several teaching units and can be benchmarked or standardised against other students' work (Moss, 2013).

24. **Tachers' collaboration:** Collaboration is the process of working together to achieve a common goal. In teaching, the common goal is always improved learner outcomes. Teacher collaboration involves: debating, planning, and problem-solving together. inquiring together, using evidence and research to guide decision-making (Bryk et al., 2015).

25. **Target needs:** The term target needs refers to what learners need to do in the target situation. It consists of three components- necessities, lacks, and wants. Learning needs are what learners need to do in order to learn (Hutchinson & Waters, 1987).

26. **Target situation:** Target situation is situation in which the language learners will be using the language they are learning (Hutchinson & Waters, 1987).

1.9 Organization of the Study

This thesis has been structured as follows:

General Introduction

Chapter one introduces the dissertation with the following components after an introduction: background of the study, background of the researcher, significance of the study, statement of the problem, purpose and aims of the study, followed by the research questions, limitations of the study and a set of of terms used throughout the study.

Chapter one

Chapter two provides a review of literature related to the importance of ID in English for Specific Purposes (ESP) instruction. It comprises two sections. Section one highlights the following components: The origins, characteristics, principles and challenges of ESP. Section two provides literature on designing an ESP syllabus.

Chapter two

Chapter three entitled "The Merits of Interdisciplinary Syllabus in Modern Education" comprises four sections. Section one discusses the importance of teaching and learning through

IDY in HE while section two highlights its potential in promoting 21st century learning skills.

Section three shows how to apply IDY in a maths class through PBL: the case of mathematics students at NHSM, Abdelhafid Ihaddaden Science and Technology Hub, Algiers. Section three would have been incomplete without highlighting the reader about PBL. Therefore, a fourth section was added to fulfill that role and was titled as: "Project Based Learning as a Vector to Achieving Interdisciplinarity" and backed up with a model project implemented in the School mentioned afore.

Chapter three

Chapter four contains two sections. Section one describes research methods employed in this dissertation with details on research design, participants, data collection, … whereas section two presents the findings and the discussions of the study. Data analysis is presented on the basis of the research questions revealing data about the potential of IDY teaching and students' feedback about PW.

General Conclusion

It begins with the discussion based on the findings, conclusion derived from the study, then heads towards the implications, and limitations to close the chapter with recommendations as regards to IDY teaching in ESP classes.

1.9. Summary

This thesis is structured in a way to give not only an overview on IDY for mathematics students studying English, but it goes so far as to discuss the importance of providing 21st century students with effective instruction and engaging them in the teaching learning process. Furtherly, it describes a project-based lesson whereby maths students conducted several projects each of which tackled a world/societal issue.

It is hoped that the reader will be provided with both theoretical and practical framework to embark on an ID teaching to promote students' autonomy. Besides, they are equiped with knowledge and skills essential to survive in a world that is more and more demanding as the 21st century education requires that students reach and possess high standards and communication skills to address different societal issues. Indeed, it is these requirements that imposed an entire change in the field of education, a shift from rote teaching mode based on facts and memorization to critical thinking and problem solving mode.

As shown throughtout the thesis, ID syllabus, is more likely to enable students grasp the materials they have learnt and engage in classroom activities (Russo, 2011) through projects

conducted and presented to an audience. In so doing, students work for a purpose and realize that many disciplines are connected to mathematics.

All in all, it is hoped that through this study, the reader may benefit from the ideas fuelled on how IDY can be implemented.

Chapter one: Related Literature Review

"Tell me and I forget. Teach me and I remember. Involve me and I learn."

—Benjamin Franklin

CHAPTER ONE: RELATED LITERATURE REVIEW

2. Section one: ESP Origins, Characteristics, Principles and Challenges

2.1. Introduction

ESP emerged in the 1960s as a result of the second world war in 1945, the rapid expansion of science, medicine, technology, business, media, and the increase of overseas students studying in English Speaking countries (Hutchinson & Waters, 1987). Its key characteristics is the context in which the language is used, and the emphasis on how the language is utilized in real-life communication or target situation that a certain group of students needs. As such, teachers are expected to provide students with knowledge and tasks they need for their future career and equip them with a certain language proficiency for a situation where specific language is going to be used (Basturkmen, 2022; Belcher, 2013; Papadima-Sophocleous et al., 2019).

As in a General English (GE) course, the ESP course should be designed so as to meet assigned objectives, use authentic materials, and develop methods to meet the needs of students who do not want to learn English for pleasure but for academic and occupational purposes.

However, many new ESP teachers are challenged as far as designing an ESP course and finding appropriate materials. In addition to teaching, they are required to play several roles. They are expected to teach, conduct needs analysis (NA), design a course syllabus, find materials, do research, evaluate… Morever, they are expected to bridge the gap between theory and practice so that their students are fully equipped with knowledge to meet their needs in their future workplace through effective instruction in accordance with 21st century requirements.

Many researchers in the field of ESP emphasized the importance of teaching ESP with a ‘‘student centered approach’’ and in consultation with their needs as far as content and methods are concerned (Hutchinson & Waters, 1987, p. 19). As a matter of fact, success in ESP teaching depends on teachers’ ability to reach their students through innovative strategies and engaging tasks as opposed to traditional teaching.

Modern education strives to provide students with “socially engaging learning experiences” to use Dewey’s terms (1938), and allow them to participate in real-life activities within social contexts. As a result, they learn to work together, communicate, think critically and solve problems, with the combination of different disciplines, as the world today with its all complexities needs more than one discipline to solve a problem. Thus, ESP syllabus in HE

needs to espconsider ID approach so that students gain knowledge from different disciplines and develop skills transfer as it will be demonstrated in this study through PBL with mathematics students.

2.1.1. The Origins of ESP

According to Hutchinson and Waters (1987, p. 5), the emergence of ESP can be attributed to three main reasons: the New World's requirements, the linguistics' revolution, and the shift from teacher centered type of teaching to student's type of teaching.

Firstly, after World War II, the world witnessed an enormous expansion in the field of science, technology (in the hands of the United States) and economy, resulting in a dire need of an international language. As a lingua franca in both technology and trade, English, then, gained popularity (Hutchinson & Waters, 1987, p. 6).

Secondly, in the educational context, and due to these developments, students became more aware of their needs, interests, and career objectives. Students' awareness on what they need put pressure on teachers to gear their instruction accordingly and resulted in a shift from the study of language to how language is used (Hutchinson & Waters, 1987; Widdowson, 1978). This revolution in linguistics made linguists focus more on the ways language could be used in real life situations, and how the spoken form could vary from the written form, and how the use of the language could vary from one context to another. Widdowson (1978) affirmed that since language differs from one situation to another, then, it becomes imperative to provide students with instruction that meets their needs. Such an awareness during the late 1970s witnessed the emergence of scientific English under the name English for Science and Technology (EST) for which Hutchinson and Waters (1987), Swales (1990), Selinker and Tarone (1981) are regarded as the pioneers.

Thirdly, the emergence of ESP owes it to the psychology of learning (Hutchinson & Waters, 1987, p. 18). The focus was on how language is acquired while taking into account students' differences in terms of learning strategies and skills employed by the students themselves. As a result, it was thought that developing courses for specific groups of students relevant to their needs and interests was quite essential. This is being said, it became evident that ESP cannot be seen as a product but rather but an "approximation" to meet students' needs and impart the competence they need as stated by Widdowson (1978, p. 10).

2.1.2. Definitions of ESP

Since its emergence, there have been many attempts to define ESP. Hutchinson and Waters (1987, p.19) define ESP as an approach to language teaching in which all decisions as to content and method are based on the students' reason for learning.

Robinson (1980) has defined it as the teaching of English to students with specific goals and purposes in mind which can be professional, academic, vocational, scientific...

Mackay and Mountford (1978, p. 2) have referred to ESP as the teaching of English for "clearly utilitarian purposes" and as a movement that seeks to serve the language needs of students who wish to carry out specific roles (doctors, nurses, architects, biologists..).

2.1.3. Characteristics of ESP

In attempting to define ESP, Strevens (1998) stressed the need to distinguish between absolute and variable characteristics.

2.1.3.1. Absolute Characteristics of ESP

2.1.3.1.1. It is defined to meet specific needs of the students.

2.1.3.1.2. It uses methodology and activities that serve the discipline.

2.1.3.1.3. It is centred on the language appropriate to these activities as far as grammar, lexis, register, study skills, discourse, and genre are concerned.

2.1.3.1.4. It should be differentiated from GE.

2.1.3.2. Variable Characteristics

2.1.3.2.1. It may be designed for specific disciplines.

2.1.3.2.2. It may use a different methodology from that of GE.

2.1.3.2.3. It is most likely designed for adult learners though it can be designed for high school students.

2.1.3.2.4. It is generally designed for intermediate or advanced students (Dudley-Evans, 1998).

2.1.4. Principles of ESP

The fundamental principle of ESP is that it targets students enrolled in a specialised field or area. Based on Hutchinson's and Waters' (1987, p.19) view that ESP is an approach rather than a product, it becomes obvious that in an ESP course, both the content and method are dependent on the students' purposes for taking up a course. Therefore, prior to designing any ESP course, it is imperative to identify and analyse the students' needs (Munby, 1978). Unlike GE, ESP teachers need to be constantly aware of these needs as they may vary from one group

to another, and from one student to another according to the reasons for and the situations in which they learn English (Robinson, 1980). Being goal oriented, ESP teachers are compelled to teach differently because they are dealing with students who come to class with a specific reason for which they want to learn English.

To know more about the principles of teaching ESP, one has to go back to its origin. Actually, ESP started with some teachers, between the 1960s and 1970s, who were assigned English courses to students involved in science and technology. As these teachers had little knowledge of what to teach and how to teach the language of science and technology, they embarked on collecting data, materials and analysing them. Then, the concept of syllabus design was created by Munby (1978) after proceeding to NA, the cornerstone for any ESP course. In other words, ESP teaching begins with the students' needs, and any syllabus and materials should support these needs. Only after needs' identification, teachers can embark on teaching with a focus on the language elements and skills needed by their students for their field of study, workplace, or professional career.

2.1.5. Difference between ESP and GE

GE refers to the mastery of English with no specific reason for learning. The ultimate aim of GE is reaching proficiency to communicate a message. As such, decisions on what to teach are taken by policy-makers and implemented by teachers, not by the students. In contrast to GE, ESP's aim is for particular reasons and needs voiced by the students. Once the reasons are expressed, teachers endeavour to help them reach their goals (Nunan, 1988, p. 18).

The distinction between ESP and GE in language learning and teaching is clearly expressed by Widdowson (1978), who avows that:

> *"ESP is a training program aimed at enhancing students' competence to complete specific activities, with future objectives mentioned. GE, on the other hand, aims to provide students with general capacity for uncertain future situations. Both require resources to support intervening objectives, which are abstract projections of purposes (p.6)."*

Said differently, ESP refers to the specific use for which language will be used for a restricted competence, whereas GE refers to the objectives' achievement to develop a general capacity of language use. Therefore, an ESP course design starts off first with students' needs as mentioned earlier and their full involvement in materials production (Nunan, 1988, p. 18). The approach adopted in an ESP course can be said to be bottom up taking its impetus from

particular issues and situations while GE teaching is seen as top down in terms of course design, methodology, and evaluation.

A further difference between ESP and GE lies in teachers' collaboration. Unlike GE teachers, ESP teachers are always seeking information related to a particular field and willing to ask for assistance from colleagues (Morena, 2014). Another difference is that, contrary to GE, ESP is intended for adult students and/or graduates, with a certain background going from intermediate to advanced; students who want to enhance their proficiency in a particular field according to Dudley-Evans and St. John (1998, p. 4). As for the roles assumed, ESP teachers are seen as practitioners performing a variety of roles: collaborator, researcher, course designer and material developer, tailoring their instruction to a specific area rather than general purposes.

All in all, the difference between ESP and GE lies mainly in the way the learning purposes are defined and implemented. If ESP is objective-oriented dealing with the development of a restricted competence to cope with defined tasks, GE deals rather with the development of general capacity to cope with undefined 'eventualities in future' (Widdowson, 1978).

2.1.6. The Prominent Roles of an ESP Teacher

2.1.6.1. Role as a Teacher

An ESP instructor has to assume several roles when covering an ESP course. In addition to the qualities needed to teach a technical course, an ESP instructor should not only have a good command of GE language, but take the role not of knowledge transmitter but that of a consultant (Robinson, 1980) and assume several roles.

2.1.6.2. Role as a Course Designer

The ESP teacher is expected to devise courses and provide students with materials in harmony with their needs. However, finding suitable textbooks that address the majority of students' linguistic and communicative demands for a specific course can be daunting and complex (Dudley-Evans & St. John, 1998). Failure to find suitable materials, the ESP teacher is expected to find, adapt and prepare his own teaching materials from different sources or self written - when it is not possible to find suitable ones (Kennedy & Bolitho, 1984). In addition to finding teaching materials, teachers are required to check whether the selected materials are efficient during and after the course as opposed to a GE teacher, whose task is only but to follow the prescribed syllabus, use the textbooks and adhere to the teaching methodology recommended by the ministry.

2.1.6.3. As a Collaborator

Since an ESP teacher will be working in different academic and professional settings, prior to course planning, he needs to be informed about his students' field and the needed teaching materials. Given the fact that the teacher is not supposed to master all the disciplines, collaboration with subject specialists is highly recommended (Dudley-Evans & St. John, 1998) as it constitutes a starting point for the instructor to be more aware of the data subject, syllabus and the students' needs. Such a practice (collaboration between the language teacher and subject teacher) not only sets a sound foundation to course design but promotes collegiality and team-teaching which can impact positively on the students' achievement and teacher's instruction.

2.1.6.4. As a Researcher

In order to conduct NA, design a course and select adequate teaching materials, the teacher has to be not only an avid researcher (Swales, 1990), but has to possess an aptitude and skill for the research which goes beyond identifying students' needs. In this era of globalisation and technology, the teacher is to identify his students' skills, learning styles and match them with his inputs and teaching styles. The benefit of being teacher researcher enables the teacher to be well informed and updated about the latest findings pertaining to ESP which will increase students' motivation to learn and enhance their language and professional competencies.

2.1.6.5. As an Evaluator

To ensure there is compatibility between a given course, materials taught and the students' learning priorities, the ESP teacher is required to evaluate, not only his students' linguistic knowledge and skills, but also the courses and materials he himself devised (Dudley-Evans & St. John, 1998). He even subjects his own teaching to evaluation through coaching, lesson observation, in service training session, reflective practice…

2.1.7. Challenges in Teaching ESP

Studies by Hoa and Mai (2016) revealed a wide range of challenges in teaching ESP courses in universities are faced by teachers. Among these challenges, the following can be cited:

2.1.7.1. Technical Vocabulary

Teachers of ESP have to possess an academic knowledge of the terminology related to the field they are teaching (Coxhead & Dang, 2019).

2.1.7.2. Teaching Materials

Inadequate teaching material and resources can be another challenge facing ESP teachers. Teaching materials are crucial in language teaching as they provide taechers with the necessary input (Merine, 2020). They can be found in different forms: textbooks, workbooks, texts, activities,.. However, when selecting adequate materials some important elements ought to be taken into account: students' needs, lacks, wants, level, interests, course objectives, materials availability, knowledge background, and time constraint (Richards & Rodgers, 2001)

Unfortunately, based on many studies, several ESP materials do not reflect the realities of ESP classrooms, impacting in this way on students' interest and motivation (Gatehouse, 2001). Gatehouse (2001) suggests that: "in order to get appropriate and effective materials in ESP, developers should ensure there is no discrepancy between the syllabus design and the teaching materials". To do this, developers might be tempted to remove some important terms, or concepts of the subject matter when adapting the teaching materials to be matched with the students' level, or because instructors are not specialists in that subject (Gupta, 2013). As a result, the teaching materials might lose their very essence in terms of authenticity, or essential concepts.

2.1.7.3. Mixed-Ability Students

An ESP class with mixed ability students can pose real problems as far as students' language proficiency is concerned (Dudley-Evans & St John, 1998, p.5) compelling teachers to consider differentiated instruction, content, methods and assessment to meet students' diversity.

2.1.7.4. Language

Teaching ESP involves a totally different language which may turn difficult to teach because teaching English for medicine, architecture, biology, or IT requires special knowledge.

2.1.7.5. Course Design

Designing a course is another challenge as ESP students have clear objectives related to their field that renders the task of designing appropriate course complicated. For Hussain (2018) and Azar (2020), any ESP course should consider the following elements: materials authenticity, clarity of purpose real life based tasks.

2.1.7.6. Teachers' Collaboration

Flowerdew (2019) found that collaboration between ESP teachers and subject specialists in the same workplace is not likely to occur or to be feasible because of background differences. Still, teachers' collaboration issue will be discussed profoundly in this study.

2.1.8. ESP Teachers' Qualifications

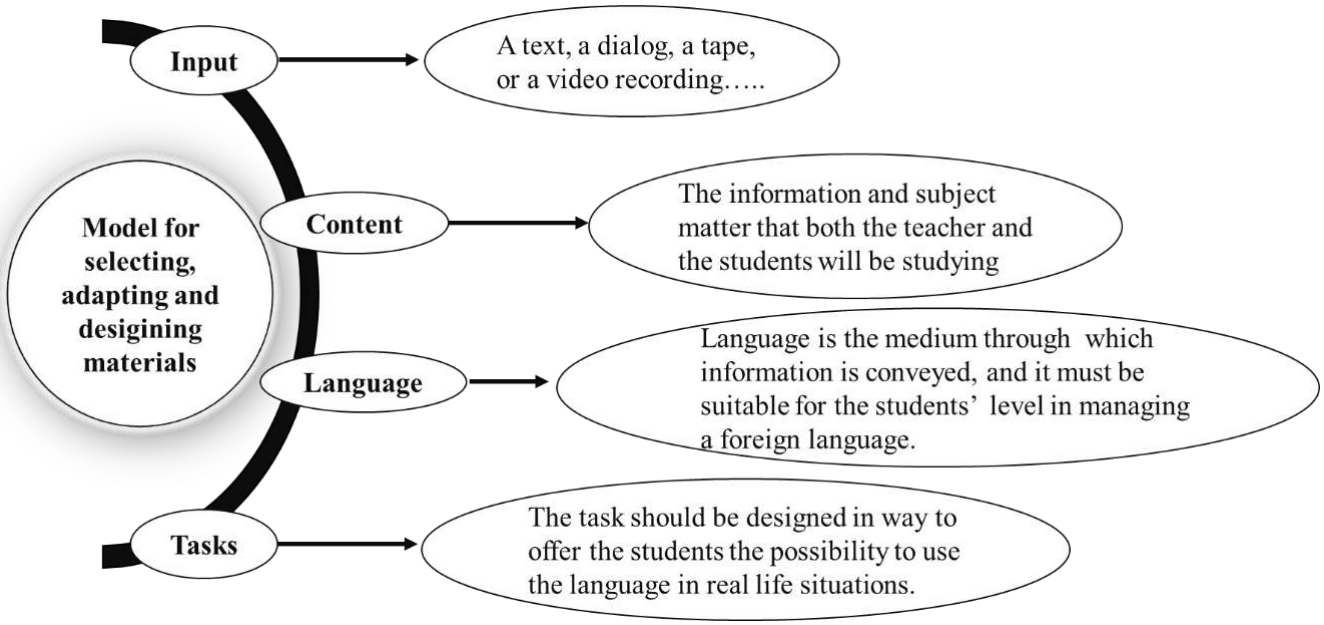
Traditionally, English language teaching focuses on developing students' listening, speaking, reading and writing skills where the teacher acts as an authority to disseminate knowledge in the classroom. However, in the ESP context, teaching requires that the teacher be knowledgeable about the subject he has been assigned with a lesser authority regarding the content and should be qualified enough to impart effective instruction.

Unfortunately, most of ESP teachers lack inadequate training on achieving their objectives and meeting their students' various needs with different learning styles. In fact, they are not trained well enough and/or lack knowledge to adjust their teaching styles with students who come to the course with different learning styles, needs, interests and background (Basturkmen, 2006). It lies, then, on ESP experts to train ESP teachers acquire language skills related to specific domains, such as law, medicine, biology, tourism industry and banking, and promote the culture of collaboration, which is crucial in promoting teaching as it has the merit to bring the subject expert and a language teacher in one setting ending up as team teaching. Alternatively, ESP teachers should be encouraged to attend pre-service prior to joining the institution, or take part in "in-service training" sessions organised by their own institution or others in their area. Attending such sessions can greatly benefit teachers to acquire the three kinds of competences: Language Competence, Pedagogic Competence and Language Awareness as stated by Thomas (1993).

For Chien et al., (2008, p. 120), a qualified ESP teacher must be familiar with the students' subject field. In other words, he must possess relevant background about the specialty to be taught such as medicine, science, technology if he wishes to function effectively as an ESP teacher, provide students with inputs that facilitate language learning (Merine, 2020) and adapt them on the basis of their needs, interests, level, and course objectives. It is true that ESP students come to class with clear objectives related to their job or needs. However, this is not always true as asserted by Gatehouse (2001) who stated that, in addition to objectives clarity of the course, an ESP course has to cover authentic materials, be purpose related, encompass real communicative tasks to make students active participants in the teaching learning process.

It should be borne in mind that when adapting or creating one's materials, four elements should be taken into account: the input, content focus, language focus and the task (Hutchinson & Waters (1987, p. 5). Figure 1.1. showcases how these elements can influence one another and contribute to the creation of a framework when selecting and adapting materials.

Figure 1.1.: *Materials' Selection Framework (Designed by the researcher)*



2.1.9. Summary

Chapter one has highlighted the emergence of ESP in HE and the importance of teaching it in alignment with the demands of 21st century to prepare students for the new challenges imposed by employers. As a matter of fact, due to globalization, today's workforce is entirely different from that of the last century. In a world where industries have become more competitive and where all forms of technologies are booming, 21st century employers are more demanding. They demand that university graduates be active, communicate well, master technology, solve problems, show readiness to work within a team, and think critically.

With these new requirements, policy makers, educators and researchers were compelled to consider new content, new methods and new approaches to meet them and ensure that teachers are providing their students with teaching quality and assuming new roles like: conducting a NA, preparing a syllabus, providing materials, collaborating with other teachers from different disciplines, assessing students, and evaluating the course.

To this end, ESP teachers are required to level up their competencies and follow the most updated studies in the course they are in charge of by attending PD programmes that can

take the form of pre-service, in-service, workshops/ training sessions, reading articles, lesson observation, collaboration with colleague, etc., if they wish to overcome the challenges imposed by digitally-oriented students. In addition to leveling up their knowledge competence in their field of specialty, ESP teachers need to develop their digital literacy skills as well to benefit from information and communications technology in PD programmes offered to them.

2.2. Section two: Syllabus Design in ESP

2.2. Introduction

A syllabus is usually designed after the needs/situation analysis. It uses the data collected from the NA leading to a plan for the content and sequence. An ESP course cannot meet the students' needs unless it is founded on a NA (Dudley-Evans, 1998, p. 5). Said differently, for an ESP course to yield fruitful results, the students' lacks, necessities, wants and authentic material should be detected and well-studied prior to the course (discussed later in the study). Therefore, it has become evident that any decision being made in designing an ESP syllabus should focus on the students' needs for learning English and should be justified in terms of relevance and motivation.

2.2.1. Syllabus Definition

Numerous definitions of the syllabus emerged in the last few decades. Hutchinson and Waters (1987, p. 80) define syllabus as follows: " A syllabus can be described as a statement of what is to be learnt, and reflects of language and linguistic performance". A syllabus, then, focuses on a set of outcomes (product) rather than a process.

Yalden (1987) defines syllabus as a "summary of the content to which learners will be exposed" (p. 87). Yalden (1987) views it as an approximation of what will be taught and that it cannot accurately predict what will be learnt.

Noss and Rodgers define syllabus as "a set of justifiable, educational objectives specified in terms of linguistic content" (1976) while Johnson (1982) defines syllabus as "an inventory of items with which learners are to be familiarised". However, Corder (1973) believes that it is more than being an inventory of items since in addition to determining the content of learning, a syllabus provides a rationale of how that content should be selected and ordered. A further definition provided by Hyland (2006, p. 54) says that " a syllabus is a coherent plan for a course of study, providing a map for both teachers and students specifying the work to be accomplished by students on the basis of explicit objectives."

2.2.2. The Difference between Curriculum and Syllabus

Curriculum and syllabus are often used interchangeably causing sometimes confusion. The term "curriculum" refers not only to the course of study in a particular subject but to the entire teaching learning process with the inclusion of teaching materials, equipment, examinations, and teacher training programs (Stern, 1983, p. 434). On the other hand, a syllabus is a statement of what should be taught containing points about the method of teaching and the time to be taken. Dubin & Olshtain, 1994, p. 28) define a syllabus: "as a more detailed form of teaching and learning elements which translates the philosophy of the curriculum into a series of planned steps leading towards more narrowly defined objectives at each level. To dispel the nuance, it is possible to see syllabus as part of the curriculum as a whole.

2.2.3. Syllabus Design Criteria

According to Webb (1976), to design a good syllabus, syllabus designers ought to take into account the following criteria:

- progress from known to unknown matter
- appropriate size of teaching units
- a proper variety of activities
- teachability
- creating a sense of purpose for the student.

In another vein, Nunan (1988) suggests that to design a syllabus design, some questions ought to be asked:

> *The key question in relation to a linguistic perspective is: "What linguistic elements should be taught?" From a learner perspective, the key question is: "What does the learner want to do with the language?" Finally, from the learning perspective, the key question is: "What activities will stimulate or promote language acquisition?" (pp. 25-6)*

Halim (1976) goes so far as to say since designing a language syllabus is a complex process, the language course designer has to consider all the relevant variables, grouped into two categories:

a. linguistic variables, which include the linguistic relations, between the language to be taught and the language or languages which the student uses in his daily activities;

b. non-linguistic variables which range from policy to social, cultural, technological and administrative variables.

2.2.4. The Importance of Needs Analysis

Viewed as a systematic collection and analysis of all relevant information necessary to satisfy the language learning requirements of the students within the context of the particular institutions involved in the learning situation (Takaaki (2006, pp. 1-9), NA leads to the awareness of what students need. Such an awareness can have an influence only on the course content known as target needs, but also on students' subjective needs: their interests, wishes, expectations and preferences. In other words, the needs detected prior to a given course can be subject to changes during the course. Students' needs can be classified as: necessities, lacks, wants

- Necessities: Importance of language mastery to deal with a given situation.
- Lacks: Importance of being aware of any existing gap between target proficiency and actual performance.
- Wants: Importance of knowing want students need in addition to the institution's requirements.

The information gathered using different tools (surveys, questionnaires, interviews, tests, job analyses, observation, etc.) can be used as a stone foundation to designing a language course and as evaluation to improve and implement language programmes and also to bridge the gap between teachers' perceptions and students' performance.

2.2.5. Goals of Needs Analysis

NA in language teaching may be used for numerous and different purposes (Richards, 2001, p. 52):

- It provides a means of obtaining wider input into the content, design and implementation of a language program.
- It can be used to set objectives and contents.
- It helps the syllabus designer to find out the discrimination among various types of learners and design courses based on their common needs.
- It helps to find out what language skills a learner needs in order to perform a particular role.

- It helps determine if an existing course adequately addresses the needs of potential learners.
- It identifies if there is a gap between what learners are able to do and what they need to be able to do.
- It can help in setting goals, objectives and content for a language program by determining general and specific language needs.

2.2.6. Instruments for Conducting Needs Analysis

There are various ways to conduct NA. According to Richards (2001), to collect data, the following instruments can be used: questionnaires, interviews, meetings, observations.

2.2.6.1. Questionnaires

Questionnaires are quite interesting for three basic reasons:

- They are easy to prepare.
- They can be used for different subjects.
- They provide information, easy to organise and analyse if the participant gives accurate information; otherwise, more questions will be needed to understand what the participant wants to say.

To get adequate data when using questionnaires, the language used should be at the learners' level and devoid of terminology unfamiliar to respondents (Yalden, 1987). The questions can be either open, or closed. The set of open questions comprises questions that can be answered in a way the respondent chooses, whereas the second set limits the respondents' answers. It is true that open questions provide the analysts with a wider range of information, but they are regarded as time consuming both for respondents and for interpretation. Yalden (1987) contends that questionnaires in addition to having the advantage of collecting big amounts for a big number of respondents, they are regarded as being less biased, than interviews.

2.2.6.2. Interviews

Interviews allow the analyst to go deep in the exploration of the issue though they cannot be conducted with very large groups. They have also the advantage of having the respondents' answers recorded. To get a deep understanding of the students' needs, analysts' questions should not be limited to pre-determined ones (Richards, 2001).

2.2.6.3. Meetings

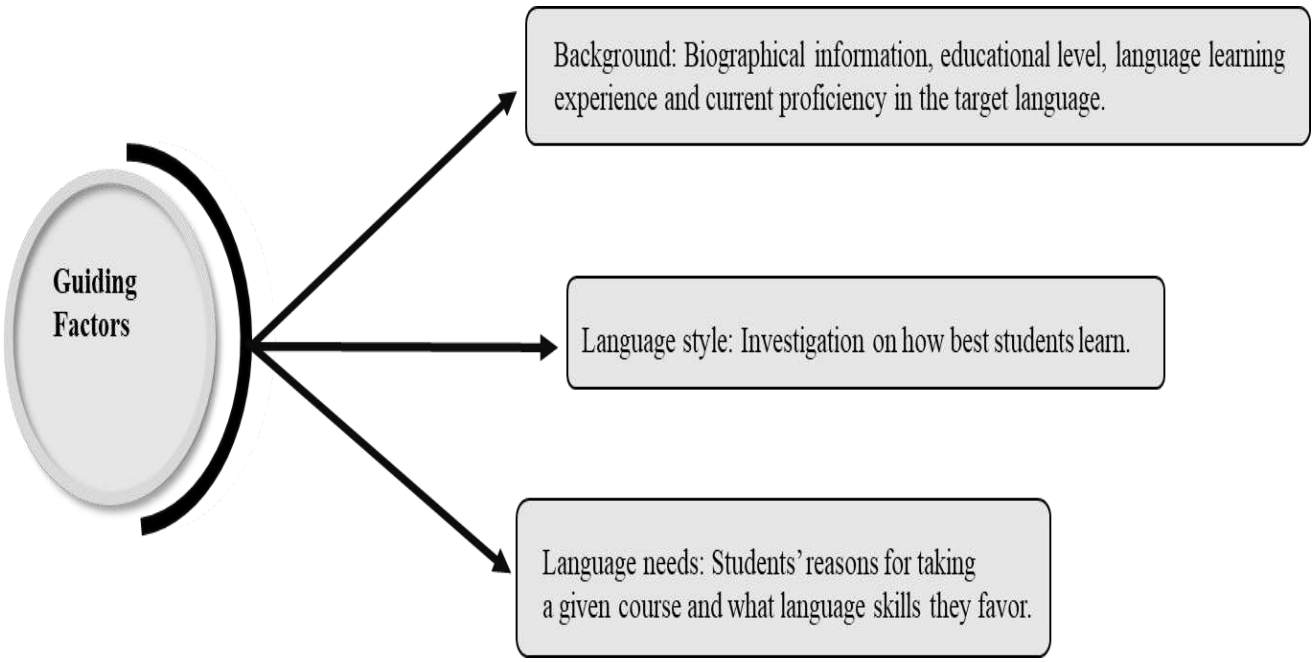
Meetings enable the researcher to obtain a lot of information within a short lapse of time though the obtained data information may not be quite accurate, or objective.

2.2.6.4. Observations

Observations can be an efficient tool to assess students' needs and behavior in a target situation. However, because many people are uncomfortable being observed while performing a task, the observer must possess the skills of "how to" and "what to" observe to get a large amount of accurate data.

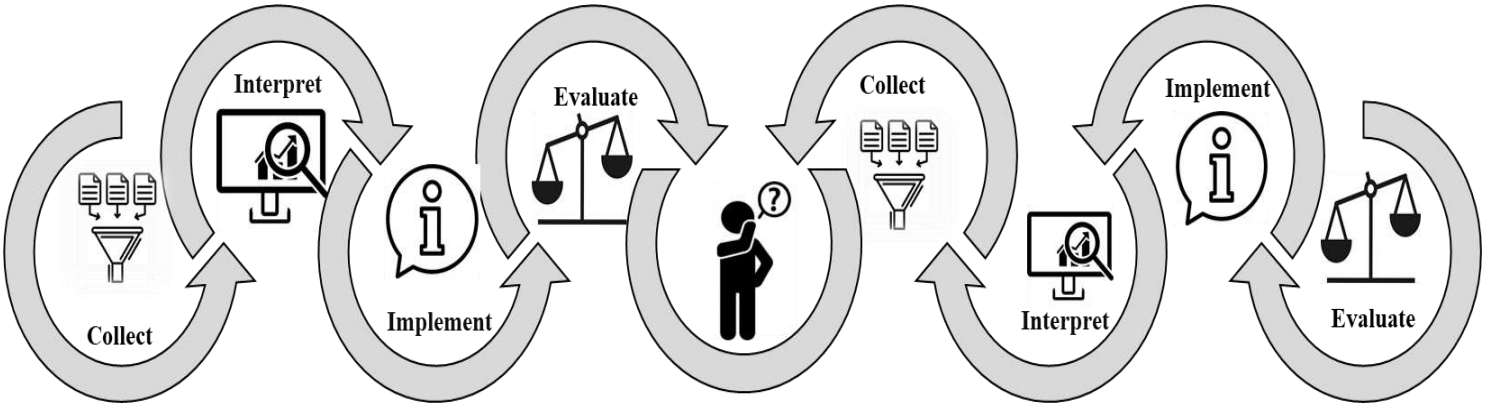
To obtain accurate data from these instruments, Fitzgerald proposes three factors that can guide the analyst during the NA process: Background, language style, and language needs (clarified in Figure 1.2).

Figure 1.2: *Instruments Guiding Factors (Designed by the researcher)*



After data collection and interpretation, the analyst should proceed to implementation. In other words, the findings are a leading vector to practical actions before evaluating (Graves, 2000, p. 100). The evaluation step advocated by Graves (2000) makes the analyst go back, decide if new information is needed making the NA process cyclical as shown in Figure 1.3.

Figure 1.3.: *Needs Analysis Process (Designed by the researcher)*



It is worthy to note that before choosing a suitable method, the purposes of the NA should be established, as these might vary depending on the learners. (Richards 2001, p. 52). Having introduced possible techniques for conducting NA, it can be concluded that the best result will probably be generated if a combination of methods is used.

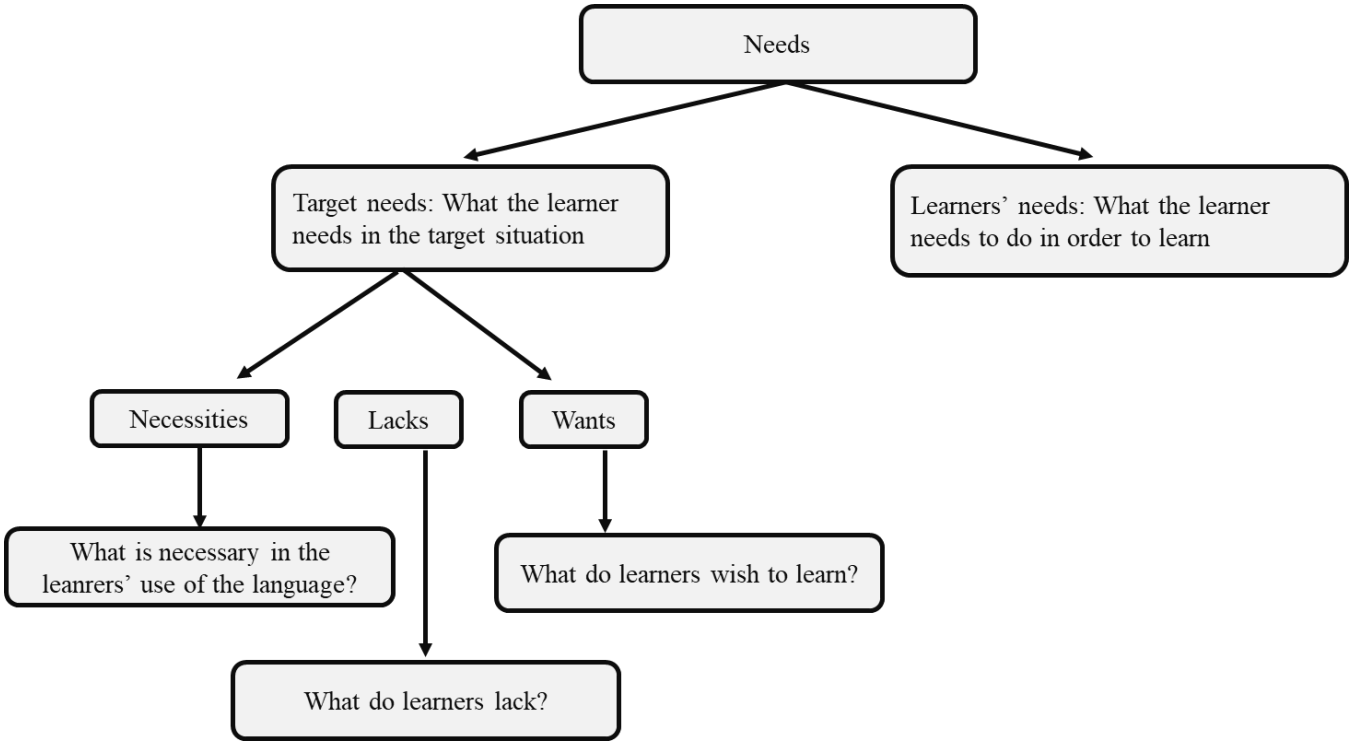
2.2.7. Models of Needs Analysis

Various models of NA have been proposed by academics. However, the most used ones are: Target Situation Analysis (TSA), Present Situation Analysis (PSA), Hutchinson and Waters' Model, and Dudley-Evans and St John's Model. These models have gained much recognition because of their identification of language needs from different perspectives.

2.2.7.1. Target Situation Analysis

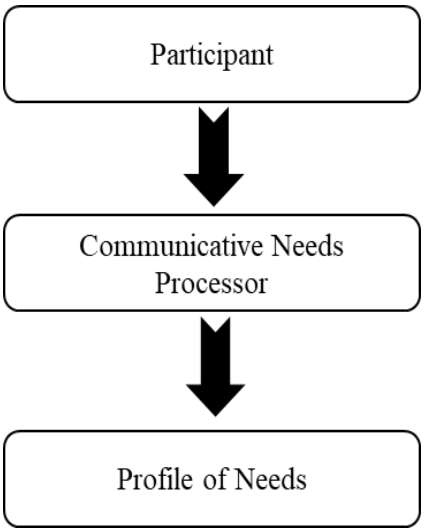
Target Situation Analysis is the situation in which the language learners will be using the language they are learning (Hutchinson & Waters, 1987). It is a NA which focuses on learners' needs at the end of a language course. Hutchinson and Waters (1987) stress the usefulness of looking "at the target situation in terms of necessities, lacks and wants" (p. 55) as illustrated in Figure 1.4.

Figure 1.4.: *Hutchinson and Waters' necessities, Lacks and Wants (Designed by the researcher)*



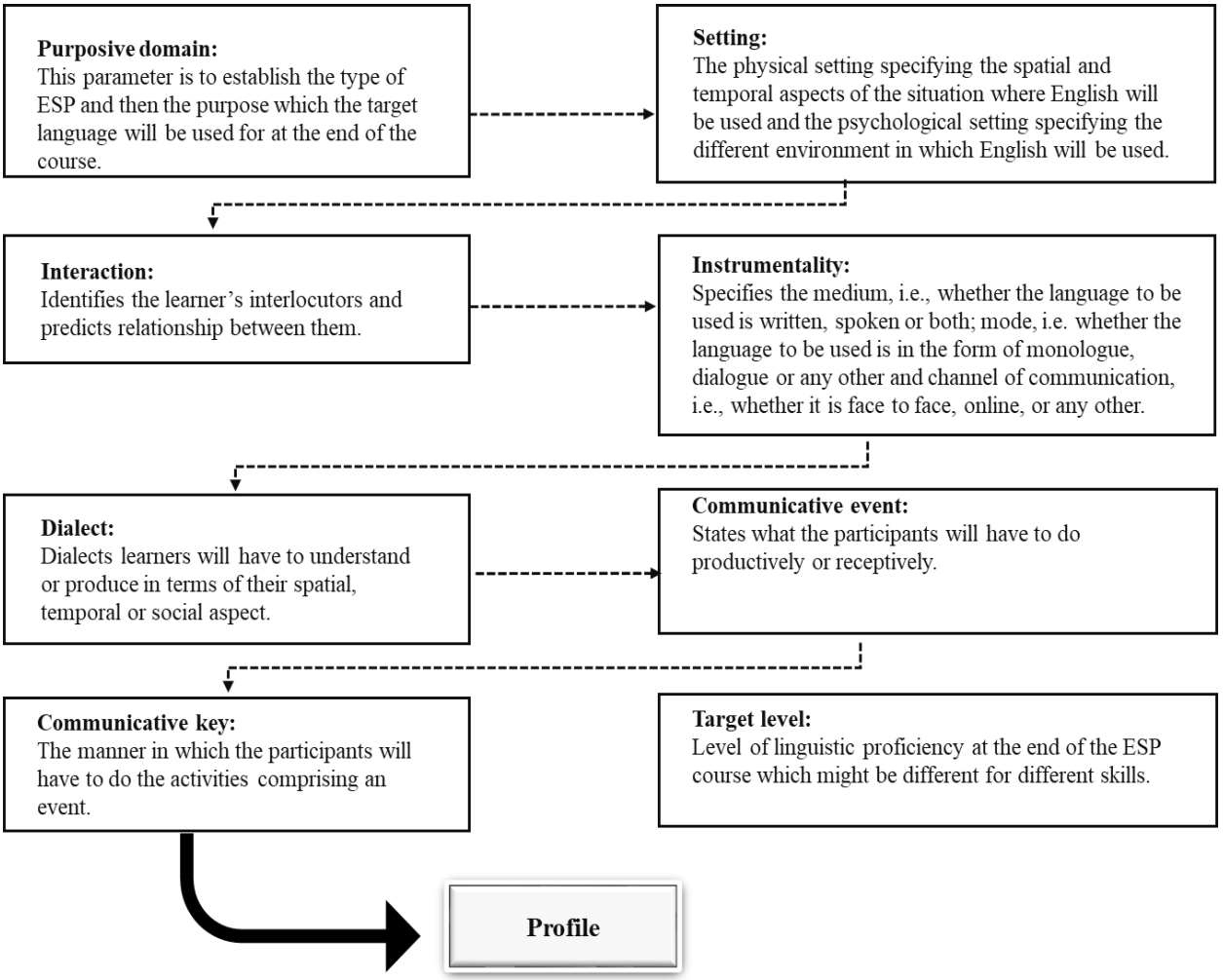
The TSA model, proposed by Munby (1978), is based on the learners' communicative needs in the target situation. To spot the target language needs of a group of learners, Munby (1978) proposed a set of questions related to communication variables (topic, participants, medium….) and called the set "Communication Needs Processor" (CNP). Munby's model (Figure 1.5.) aims at finding out to what extent learners' needs had been met by the end of a language course and measure their target level performance. It is conducted through two stages.

Figure 1.5.: *Munby's Communication Needs Processor (Designed by the researcher)*



The first stage of CNP starts with a set of questions about key communication variables, mentioned afore, to identify the target language of learners' needs. The second stage uses the data obtained in to establish the learners' profile as regards to their needs using eight parameters illustrated in Figure 1.6.

Figure 1.6.: *Learners' Profile (Designed by the researcher)*



2.2.7.2. Present Situation Analysis

The Present Situation Analysis, proposed by Richterich & Chancerel (1987), can be viewed as a complementary source for TSA. TSA attempts to reveal the target needs and target level performance at the end of a language course (Songhori, 2008). However, PSA tries to analyze learners' present situatio and the gap between what the learners are able to do at the beginning of the course and what they need to be able to do by the end of the course in terms of language proficiency, strengths, and weaknesses (Robinson, 1980). Questions comprising: previous learning experience, reasons for attending the course and their expectations, and

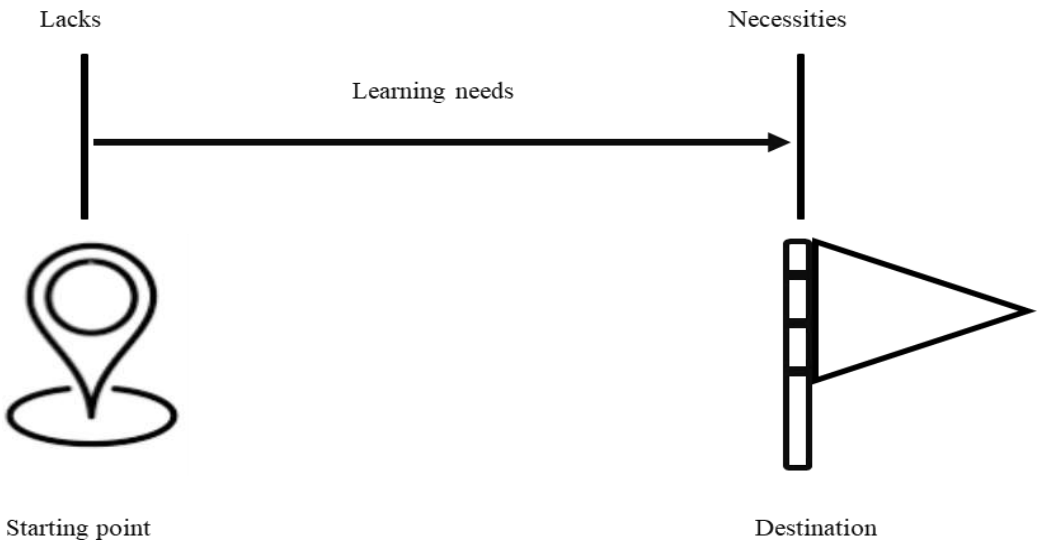
attitudes towards English in PSA will determine how learners' way of learning can be affected by their personal background (Paltridge & Starfield, 2013).

The ultimate aim of PSA is to gather data to enhance the way a course is designed, to evaluate the teaching materials and the effectiveness of the teaching methodology at the present time in relation with the learners' actual needs. According to Jordan (1997), data collection for PSA can be obtained from three basic sources: the learners themselves, the academic institution and the prospective employer.

2.2.7.3. Hutchinson and Waters' Model

In the model of Hutchinson and Waters (1987), NA consists of two parts: target situation needs and learning needs. The former includes "necessities", "lacks" and "wants". "Necessities" are determined by the demand of the target situation. They are the necessary needs that enable the learner to use effectively in the target situation. "Lacks" are the gap between "necessities" and what the learner already knows, which is the existing proficiency of the learners. "Wants" are learners' subjective needs, which have no direct relationship between the objective needs perceived by the teachers and course designers. The latter, on the other hand, are how learners learn the language. They are about the learners' motivation of learning the language, the way they prefer to learn, the available resources, the time and place the course will take place and the learners' personal information. Comparing learning needs to a journey, Hutchinson & Waters (1987) characterise the "lacks" as the starting point for the journey, and "necessities" as the destination (Figure 1.7).

Figure 1.7: *Hutchinson and Waters' Model (Designed by the researcher)*

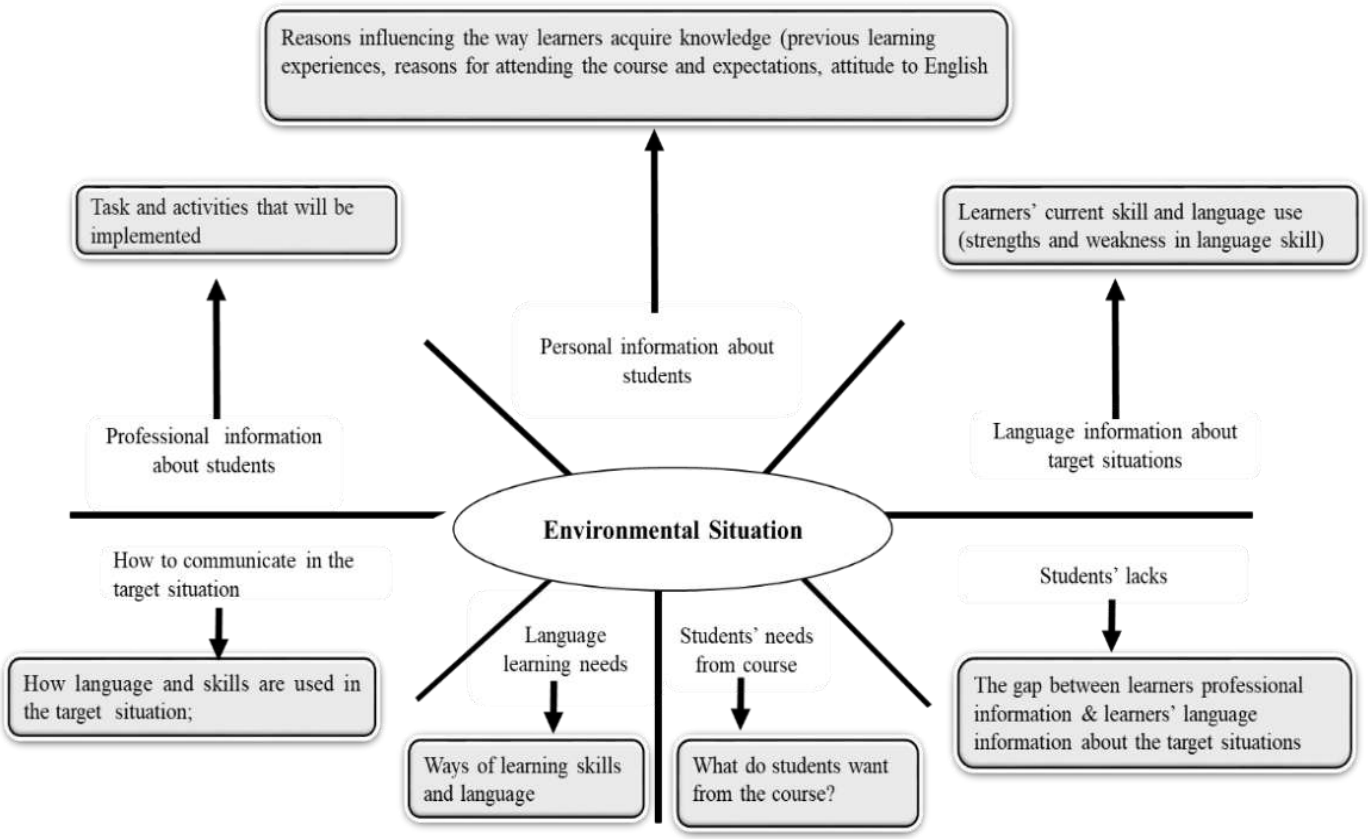


However, as the course is progressing, the attitudes and approach of learners may change, hence, the necessity of conducting NA during the whole process of the course (Richterich & Chancerel, 1987). In other words, NA can be carried out at different stages during the curriculum design process and the identification and analysis of needs should be a continuous process (Richterich and Chancerel, 1987). Being aware and engaged in this cyclical movement could be helpful to both the course designers and teachers to make necessary changes.

2.2.7.4. Dudley-Evans and St John's Model of Needs Analysis

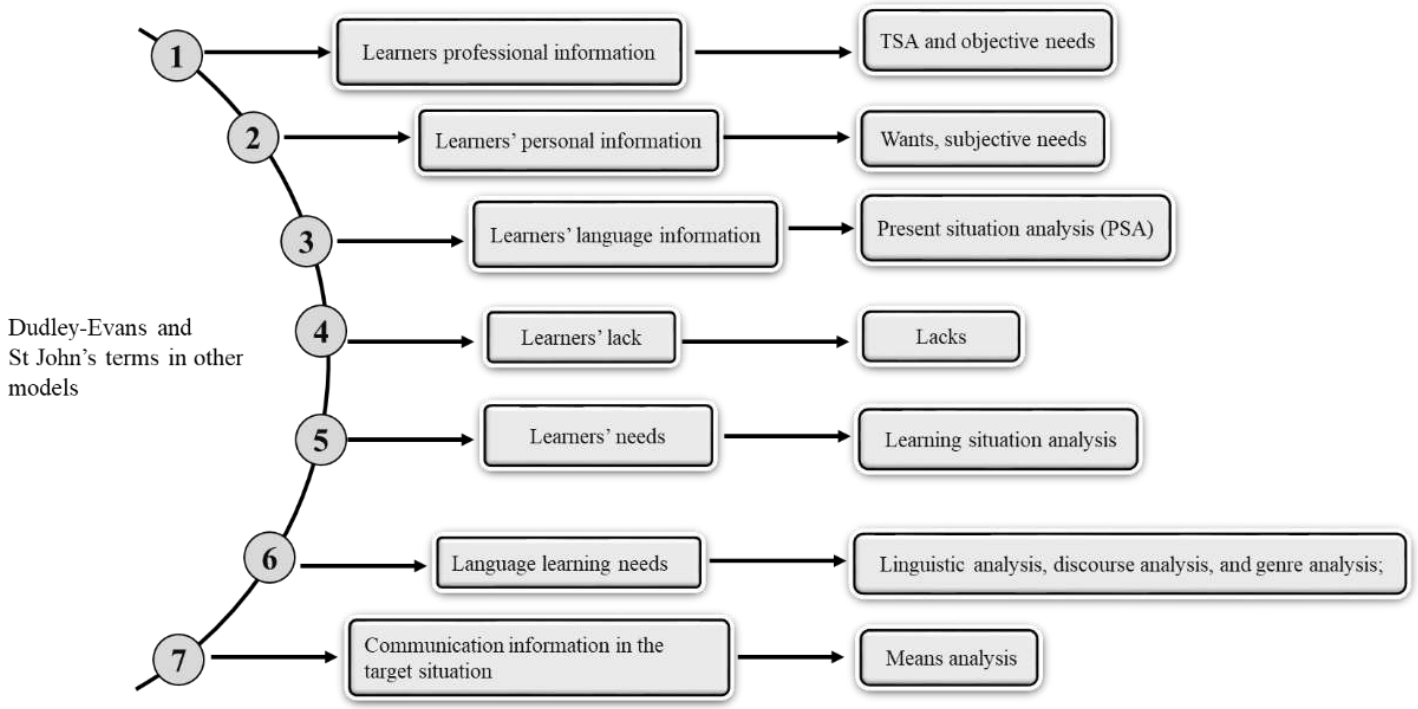
When Dudley-Evans & St. John (1998) introduced their model, they argued that NA is a process of establishing the "what" and the "how" of a course and emphasized the importance of conducting it in a formative way. Comprising eight aspects, the Dudley-Evans & St John's model (1998, p. 125) illustrated in Figure 1.8 could be viewed as the most comprehensive model for an ESP course.

Figure 1.8: *Dudley-Evans and St John's Model of Needs Analysis (Designed by the researcher)*



Of all the models, Dudley-Evans & St. John's (1998) is viewed as the most comprehensive concept of NA since it encompasses and embraces all the above-mentioned approaches. Dudley-Evans & St. John's terms (1998) are found in all the approaches discussed earlier and illustrated in Figure 1.9.

Figure 1.9: *Dudley-Evans & St. John's Terms (Designed by the researcher)*



Whatever form is used by analysts, the basic purpose of NA is to find out the wants and needs of learners. In so doing, the teaching approaches and teaching contents are aligned with the learners' needs which will result in enhancing learners' motivation.

2.2.8. Types of Syllabuses

2.2.8.1. The Notional-Functional Syllabus

Nunan (1988) explains the term "function" as using the language for communicative purposes while the term "notion" refers to concepts used in the language. In simpler words, the notional-functional syllabus gives primacy to the development of communicative competence and the ability to use language effectively in real-life communication situations through rote learning. Its primary concern is teaching the use of patterns, deriving its content from an analysis of learners' needs to express certain meanings. However, the notional-functional

syllabus was criticized as dividing language into discrete units because it does not represent the nature of language as communication (Widdowson, 1978).

2.2.8.2. The Structural Syllabus

The structural syllabus was very popular during 1960s and 1970s. Designing a structural syllabus consisted of selecting a sequence of grammatical items along with lists of vocabulary items (Celce Murcia, 2001, p. 55). The target language was presented in a controlled sequence with the internalization of rules (Ur, 1996, p. 178), building on the idea that language is made up of a limited number of rules that can be combined in many ways to produce meaning. Before going on to the next rule, the language learner must first master each one in the order listed in the syllabus. The items in the syllabus are meant to regulate the learner's input in such a way that only one thing is offered at a time (Celce Murcia, 2001, pp. 55-56). In addition to this assumption, it was believed that once students have internalized the rules, they would be able to use them when communicating. Celce Murcia (2001, pp. 55-56) listed several shortcomings the structural syllabus:

- Grammar syllabuses' linear sequencing did not adequately capture the complexity of language.
- Research in the field of second language acquisition has demonstrated that language is not always picked up by students in the sequence given by the grammar curriculum.
- The structural syllabus is designed to concentrate on one single facet of language. However, there are actually multiple facets to language.

On another similar note, Richards and Rodgers (2001) criticized the structural syllabus as the language items are introduced separately, and not as a whole with the introduction of an item after the mastery of the previous item.

2.2.8.3. The Situational Syllabus

The situational syllabus focuses on situational needs rather than on grammatical units, functions, notion, etc. It is characterized by a content based on a list of real-life situations reflecting a language used in everyday life, outside the classroom such as first school experience, being at the airport, booking a table at a restaurant/ a room in a hotel, asking for information… With this syllabus, language is taught in contexts and not in isolation. Richards and Rodgers (2001, *p. 42*) report "*In Situational Language Teaching, structures are always taught within sentences, and vocabulary is chosen according to how well it enables sentence patterns to be taught."*

Richards and Rodgers (2001) expressed their criticisms as follows:

- Little is known about the language used in different situations, so selection of teaching items is typically based on intuition.
- Language used in specific situations may not be transferred to other situations.
- Grammar is dealt with incidentally, so a situational syllabus may result in gaps in a student's grammatical knowledge.

Unlike, the structural syllabus, the situational syllabus recognizes that language cannot be taught in isolation from the social context. Indeed, students need the language that can be used in situations (at the bank, booking a ticket, sending a parcel at the post office…) they are most likely to encounter outside of the classroom. As opposed to structural syllabus, the situational syllabus is more motivating than the grammatical syllabus because the whole teaching learning process is centered around real life situations (Harmer, 2001, p. 298).

A critic of the situational syllabus, Wilkins (1976, p. 20–24), notes that situations are not always predictable. Not all individuals go to the post office to deliver a parcel. One may go to the post office to complain about a non delivered letter, for example. Another issue depicted in the situational syllabus is that most of the materials are based on dialogues with a certain grammatical pattern which is not authentic in real life. In real life, we use a variety of grammatical patterns.

2.2.8.4. Task-Based Syllabus

Skehan (1996) defines "task" as activities (giving directions, describing a recipe, telephoning to obtain information, etc.) carried out, to be used in real-like life situation using the target language. He reports:

> *Tasks are activities which have meaning as their primary focus. Success in tasks is evaluated in terms of achievement of an outcome, and tasks generally bear some resemblance to real-life language use. (p. 20)*

Richard & Schmidt (2002, pp. 540-541) define tasks syllabus as "a syllabus which is organized around tasks, rather than in terms of grammar, vocabulary or functions. Task-based

syllabuses are an excellent way of learning a language since it offers the students a purpose for learning of a language rather than internalising rules that would be of no use in real life situations. Nunan (1988) offers the following criteria for tasks-based syllabuses:

- promotes meaning and negotiation;
- allows for flexible approaches to task and for different solutions depending on the skills and strategies drawn on by the students;
- involves students' contributions ;
- defines a problem to be worked through by the students but under the teacher's guidance;
- involves language use to do the task;
- provides opportunities for students to communicate and to practice the language;
- promotes problem solving and critical thinking and sharing of information and expertise.

However, task –based syllabus is subject to criticism as it is quite difficult to order the items in a syllabus. With the task-based syllabus, the syllabus designer is faced with determining the degree of difficulty of a task due to some elements like the student himself, characteristics of the student, the cognitive difficulty of the task, the complexity of the language that the learner is required to process and produce, the psychological stress involved in carrying out the task, and the amount and type of background knowledge required (Nunan, 1988, p. 48).

The task -based syllabus may promote communication in the target language, but as long as there is no certainty on which tasks should be there, it may not get the support of instructors (Harmer, 2001, p. 299).

2.2.8.5. Content-Based Syllabus

The main focus of content-based syllabus is content, the only element when organizing the syllabus. According to Al-Shamiry (2005, p. 114), " It is usually organized around themes and topics which contain information that will be acquired during the teaching-learning process" making learning the target language more meaningful since it provides topics relevant to the students' needs and reflects real life situations. According to Krahnke (1987, p. 10), with a content-based syllabus, the purpose of instruction is teaching some content using the language that the students are also learning.

In the same vein, Nunan (1988, pp. 48- 50) reports that, with a content-based syllabus, the students are driven not only to acquire language through a series of relevant topics but are totally exposed to the language. Moreover, they are taught in the language they need through exposure and through a set of rules (Crandall & Richard, 1990). However, though this syllabus has many supporters, some critics believe that it gives no indication on how to select and grade grammar, functions, and so forth.

2.2.9. Steps of Syllabus Design

Syllabus designers have to go through several stages to design a syllabus. Most researchers like Sysoyev (2000) and Chen (2007) agree on the same stages in designing any syllabus. The stages are:

2.2.9.1. Setting the Goals and Objectives

After conducting NA, the cornerstone of syllabus design, the next stage of syllabus design is setting the goals and objectives. It is important to highlight, here, the nuance between between goals and objectives. Graves (2000, p. 17) defines a goal as something to be achieved as far as language learning is concerned, whereas an objective is the specific way through which the goal will be achieved. By having in mind well articulated goals and objectives for the future syllabus, the syllabus designer will have a picture of the syllabus framework.

2.2.9.2. Conceptualizing the Content

The second stage, content conceptualization, is really a challenging issue that the syllabus designer can face. To address the students' needs and conceptualize the content of the syllabus, the syllabus designer needs not only to take into account data about the students' goals and objectives but also determine which aspects of learning to include, emphasize, integrate, and implement. Of some learning aspects the syllabus designer can focus on or consider, Sysoyev (2000, p. 3) cites: basic skills, communicative competence, vocabulary awareness...

2.2.9.3. Selecting and Developing Materials and Activities

The third stage, selecting and developing, implies developing new materials or adapting already existing ones when they do not suit the syllabus. Several elements need to be taken

into account when developing, or adapting materials. Graves (2000, p. 27) suggests that in order to select materials and activities the following elements should be taken into consideration:

- effectiveness in achieving the syllabus purpose;
- appropriateness and relevance of the materials in terms of interests, needs, and level so that the students will feel comfortable;
- feasibility, so that the material will be in accord with the students' capabilities.

In addition to these items, Potocar (2006, p.2) suggests the following:

- variety in working methods;
- use of information technology, multimedia…;
- promoting students' autonomy through PW, presentations…;

2.2.9.4. Evaluating

The last step is evaluation. In order to improve and/or promote the effectiveness of a syllabus, teachers need to evaluate it. Syllabus evaluation can be conducted during the term or semester through the students' grades, their interest, participation, and motivation in class. These elements can serve as cues for teachers on whether learning is taking place. Otherwise, it can take place at the end of the semester by using questionnaires, surveys, talks,… in which students express their feedback as far the content, instructional methods, activities, and teachers' performance are concerned. In listening to the students' voice, teachers could determine the shortcomings of the syllabus (Sysoyev, 2000, p. 3).

2.2.10. Syllabus Design Challenges

In this section issues related to designing a syllabus are addressed.

2.2.10.1. Teaching Materials

After the NA, syllabus designers are confronted with the textbooks materials. Ready made commercial textbooks can be used as materials in a course (Hutchinson & Waters, 1987, p.106); however, not only all the textbooks meet the students' learning needs. The textbooks available in the market could be: too easy, too difficult, or dull in terms of content and sometimes far from the students' field of study. Therefore, ESP teachers can be challenged not

only to find suitable materials but adapt them on the basis of the instructor level of knowledge about the subject and the students' capabilities (Gupta, 2013).

2.2.10.2. Mixed-Ability Students

Another challenge facing syllabus designers is mixed ability classes. Mixed ability classes are a fact that cannot be ignored. Consequently, both teachers and syllabus designers should be more sensitive to their roles in designing teaching materials that take into account the students' learning styles in their teaching practices by considering differentiated instruction to reach and tap the potential of every student in class.

2.2.10.3. Motivation

The outdated way of transmitting knowledge to students via lectures and textbooks, remains the dominant approach to education in many parts of the world as of today (OECD, 2009) though it tends to be obsolete in modern education. It is true that students learn/ acquire information through transmission, but it remains based on fact and memorisation. With such a mode of teaching, students are typically incapable of applying the knowledge acquired in their life. Therefore, this transmission model is not the most effective way to teach 21st-century students.

According to a study of learning scientists, who stressed the importance of engaging students in the teaching learning process and meet their needs, it has been found that there is a significant correlation between students' engagement and effective instruction (Marks 2000). Strategies that promote students' engagement are important and syllabus designers are to include them should they wish to provide students with teaching quality (Marks, 2000).

2.2.11. Syllabus Formats and Organization

2.2.11.1. Syllabus Formats

When selecting the shape of the syllabus, the basic dilemma which course planners have to sort out is the ideal format. Dubin and Olshtain (1994, p. 51) present five possible types:

2.2.11.1.1. The Linear Format

The linear format is adopted for discrete element content, particularly grammar or structures. Issues of sequencing and grading are of paramount importance. Once the sequence has been determined, internal grading will be presented and teachers cannot change the order of units or skip some.

2.2.11.1.2. The Modular Format

The modular format is well suited for courses which integrate thematic or situational contents. Academically oriented units are integrated.

2.2.11.1.3. The Cyclical Format

The cyclical format is an organizational principle which enables teachers and learners to work with the same topic more than once, but each time a particular one reappears at a more complex or difficult level.

2.2.11.1.4. The Matrix Format

The matrix format gives users maximum flexibility to select topics from a table of contents in a random order, the matrix is well suited for situational content.

2.2.11.2. Syllabus Organization

Having decided about the "what to teach", the next step is finding an appropriate strategy to present it in a well organised manner that will not only provide a description of the language but promote learning too. Therefore, it should be presented in a way that facilitates both teaching and learning.

The syllabus can be structured on the basis of gradation: from easy to difficult, from general to particular, from deduction to induction, from induction to deduction, or from items/situations familiar to learners to unfamiliar ones. It is stressed by Corder (1973) that: "the ideal syllabus would be one in which the sequencing of items taught logically derives from and presupposes the learning of some previous items."

2.2.12. Summary

Being the corner stone of any language progam, the syllabus needs to be designed with care with the students' needs, the teaching-learning environment and resources available in mind in order to ensure successful learning.

This section has highlighted the importance of NA prior to designing a syllabus. It also discussed the challenges to design an ESP syllabus, find, select and adapt teaching materials. The different syllabuses highlighted in the section offer valuable insights to create a syllabus. If they seem different, they are all featured by some objectives to be achieved. However, an effective syllabus is the one that is based on activities and tasks which promote real, meaningful

communication, and knowledge that can be used in real life (Richards & Rodgers, 2001, p. 69) and/or in the workplace.

Chapter Two: The Merits of Interdisciplinary Syllabus in Modern Education

The task of the modern educator is not to cut down jungles, but to irrigate deserts.

—***C. S. Lewis***

CHAPTER TWO: THE MERITS OF INTERDISCIPLINARY SYLLABUS IN MODERN EDUCATION

3.1. Section one: Teaching and Learning through Interdisciplinarity in Higher Education

3.1.0. Introduction

It is true that many lectures are still based on lectures and knowledge transmission via handouts, but both teaching and learning are significantly changing in the 21st century. Modern classes need to be less teacher-centered and more learner-centered (Weimer, 2002). The shift from teacher centered to students centered approach is mainly due to technology, globalization, and the new requirements of jobs which focus more on communication skills.

These new requirements in the workplace urged educators and teachers to develop the skills and knowledge that students need to succeed and cope with both the changes and 21st century requirements. According to Wagner (2008), who interviewed hundreds of employers and education leaders, students need other seven skills if they wish to survive in modern society: Critical thinking and problem solving; collaboration and leadership; agility and adaptability; initiative and entrepreneurialism; effective oral and written communication; accessing and analyzing information; and curiosity and imagination.

The change in view revealed that it is imperative to bring reforms to the educaional system and renew the way instruction is provided by improving the syllabus with an emphasis on linking one discipline with other fields (Yetkin and Daşcan, 2006). This mode of teaching called, ID teaching, will enable students to link what they are learning with other disciplines and use the knowledge acquired in any situation or event they may encounter outside the classroom. The effectiveness of ID approach lies in the fact that one subject dealt with and through different disciplines makes the students understand the subject from different perspectives.

3.1.1. Definitions Interdisciplinary Teaching

An ID approach offers students the possibility to explore and integrate multiple disciplines to produce a deep understanding of a problem, or a viable solution of an issue from different perspectives. Boix Mansilla and Duraising (2007) define ID teaching as:

> *…. the capacity to integrate knowledge and modes of thinking in two or more disciplines or established areas of expertise to produce a cognitive advancement – such as explaining a phenomenon, solving a problem, or creating a product – in ways that would have been impossible or unlikely through single disciplinary means. (2007, p.219)*

Humphreys, Post and Ellis (1981) see it as "An integrated study is one in which students broadly explore knowledge in various subjects related to certain aspects of their environment" (p. 11). They state that such an approach links the humanities, communication arts, natural sciences, mathematics, social studies, music, and art.

Shoemaker defines an integrated syllabus as:

> *...education that is organized in such a way that it cuts across subject-matter lines, bringing together various aspects of the curriculum into meaningful association to focus upon broad areas of study. It views learning and teaching in a holistic way and reflects the real world, which is interactive. (1989, p. 5)*

As for Dressel's definition, it not only supports Shoemaker's but goes beyond the simple linking of subject areas:

> *In an interdisciplinary approach based class, the learning experiences provide the learners with a unified view of commonly held knowledge but also motivate and develop learners' power to perceive new relationships and thus to create new models, systems, and structures. (1958, pp. 3-25)*

As can be seen, all the definitions provided in this section support the view that integrated syllabus prepares students for lifelong learning.

3.1.2. History of Interdisciplinarity

Interdisciplinarity in education dates back in the time of J. Dewey who, in 1938, referred to subjects taught in educational institutions as 'water-tight compartments' (p. 48) and disconnected from each other. In the 1960s, Bruner (1966) and Stenhouse (1968) started to believe that knowledge should not be separated. Still, the foundations of IDY lie on Dewey's theory about learning. Dewey believed that schools should be a natural social setting whereby teaching should be student centered focusing mainly on creativity. His views give importance to individual needs, and combines real life situations and education. Although Dewey's theory is quite old, it has recently surfaced in the 21st century education as it promotes students'

engagement through an ID syllabus (Campbell & Henning, 2010). However, Drake & Burns (2004) claim that it was Johann Friedrich, a German philosopher, who stressed the importance of unifying the programs.

3.1.3. The Advantages, Disadvantages, and Challenges of Interdisciplinary Syllabus

3.1.3.1. The Advantages

There are many advantages when integrating more than one disciplines in teaching. Students are able to see and make connections between concepts and explore the interrelationships between fields of knowledge (Deborah, 1998). As opposed to traditional teaching environments, integrative teaching has the advantage of connecting students to the real world as well (Yıldırım, 1996). According to Jacobs (1989), the use of integrative teaching can contribute greatly to students' academic success as it provides students with effective and meaningful life learning experiences. Such a type of teaching makes students bring their knowledge backgound of different disciplines, work together, rendering teaching and learning more active and motivating (Aybek, 2001). Many researchers like Repko (2009); Hungyo & Kijai (2009) asert that intergrative instruction fosters the students' cognitive ability and critical thinking.

3.1.3.2. The Disadvantages

Despite the above advantages, the integrative approach has a number of disadvantages (McDonough & Shaw 2003) such as the time required to prepare the lesson and the confusion that might emanate during the integration (Jones, 2010). Besides, some instructors, who are used to teaching in a discrete way, may display resistance as claimed by (Richards & Rodgers, 2001) as the process of integative syllabus requires teachers' collaboration and expertise or training. In order, to gain expertise, teachers are required to document themselves, prepare their own materials…. which can be daunting and challenging (Hinkel, 2001). Moreover, integrative instruction can be challenging for students, too, as they come to class with different language proficiency, knowledge background, needs and interests (Hinkel, 2001). As a result, teaching through integrative approach can turn out to be hectic and can lose its very essence (For more advantages and drawbacks of integrative syllabus, see appendix B).

3.1.3.3. The Challenges

Of some of the challenges, ID approach:

- entails preparing lessons with teachers from other fields which can be quite challenging in terms of time, effort and planning.
- necessitates moving single subject to multi teaching subjects.
- might result in noo covering the sylllabus (Hyland, 2006).
- entails sometimes overcoming disciplinary barriers that may arise but respecting other colleagues' expertise coming from different disciplinary backgrounds (Zhang, 2017).

3.1.4. Types of Interdisciplinary Approaches

Four types of ID approaches are identified by OECD (2009) in education. These are:

3.1.4.1. Inter-disciplinary Instruction

Actually, IDY has existed since the early 1960s but lost poularity very quickly though students benefited greatly from this type of syllabus (Campbell & Henning, 2010). However, in the beginning of 21st century, the term started to experience a resurgence due to the new demands of modern education and the development of skills needed to face the 21st century challenges like creativity, critical thinking, problem solving...

Repko (2009) refers to ID instruction as the integration and synthesis of the knowledge and approaches from different disciplines to address a problem or issue involving the collaboration and cooperation of teachers from two or more disciplines working on common questions to achieve shared results.

When implementing ID instruction, not only connections between the disciplines are made, but the whole teaching/learning process centers around the student (Klein, 1990). Of other benefits, ID instruction promotes problem solving and creativity by making students synthesising and integrating rather simply memorising information and makes teachers and students collaborate with the purpose of enhancing the learning experience (Rover, 2002).

Most of the themes used in ID instruction tap problems that cannot be solved by only one field of study. Examples of topics that could be integrated in cognitive science as ID are: neurology, psychology, anthropology, linguistics, memory and language acquisition.

3.1.4.2. Intra-disciplinary Instruction

According to the Dictionnaire Actuelle de L'education, (Guerin 1993), intra-disciplinary instruction is the operation which combines two or more interrelated contents in the same field of study, in order to solve a problem, study a theme or develop the skills

Intra-disciplinary approach, the simplest form of IDY, consists of planning a lesson on the basis of a theme for a period of time connecting topics from different subjects. In using this approach, the students are enabled to see the connection between topics in the teacher's own subject in addition to another subject (Bolstad, 2020). The aim of this approach is to integrate subjects' knowledge and skills into a coherent whole in a vertical form, gradually from one level to another. An example of integration often used is: chemistry and physics. By explaining the physics of light, we demonstrate how this relates to the inner workings of our eyes, which are very sensitive to visible light due in large part to the chemical makeup of our atmosphere).

3.1.4.3. Multi-disciplinary Instruction

Multi-disciplinary approach is referred to as the connection of two or more disciplines such as maths and science (Fogarty, 1991), but without making any conscious connections between the subjects. In this appoach, every individual contributes according to his own expertise without drawing any analysis or conclusion. Working in a close collaboration with teachers, students work with the same theme in different subjects. For example, DePiper et al. (2017), described a multidisciplinary approach where physical oceanographers, biologists, economists, and anthropologists worked together on an integrated ecosystem assessment program. In this approach, each of the scientists presented his research and data that could be used to support the development of an integrated ecosystem assessment (DePiper et al. 2017). Another example of this can be if the students are learning about the industrial revolution in social studies and how it improved the quality of life for many, and then learn about simple machines in their science class.

3.1.4.4. Trans-disciplinary Instruction

Transdisciplinarity is regarded as the highest form of IDY. In this approach, the lessons are planned on the basis of "real-world problems" that need to draw input from multiple subjects leading to a natural connection (Meeth, 1978). Transdisciplinarity sees no separation between the subjects (Drake, 1991). It occurs when people from different background bring their

expertise to the table to develop innovative ideas about an issue (Choi & Pak, 2006). Therefore, a transdisciplinary approach can be said to be primarliy problem-focused requiring scholars from at least two disciplines to collaboratively develop innovative models to provide solutions to specific, common, real-world problems (Stokols et al., 2008).

When using transdisciplinarity, students are not expected to acquire the same knowledge by the end of the class or course, but are encouraged to take an active part in the content of the lessons, ask questions, be creative, and solve problems (Bolstad 2020). As an example, to promote tourism in a coastal town, people from different different fields are needed (government agencies, economists, environmentalists, private sectors,…..)

3.1.5. Summary

Teaching through ID approach has been praised by many experts due to its numerous benefits. It appears that it gives students a purpose for learning when they see that many subjects are interconnected, enabling them see their own subject from different perspectives, and promoting in this way new learning experiences.

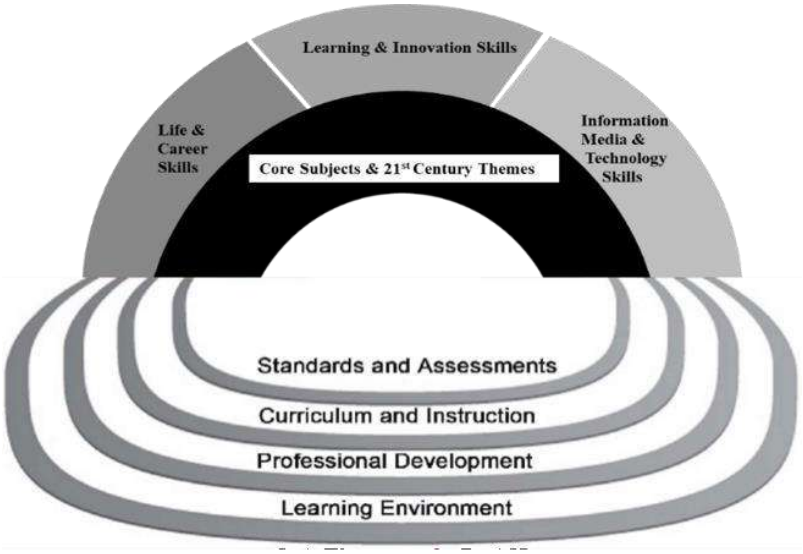
Promoting learning of a given topic from different perspectives improves interpersonal communication, gives high flexibility in problem solving, and develops critical thinking. Unlike single discipline approach, in ID approach, students acquire the skill of knowledge transfer when they join the workforce.

3.2. Section two: the Efficacy of Interdiscilinarity in Promoting 21st Learning Skills

3.2.0. Introduction

Twenty first century skills are a collection of competencies that students need to develop in order to succeed in work, and life in a world driven economy where knowledge and innovation are the bases of societies. To face the 21st century chanllenges, there is a felt need to rethink the way students are taught. Modern education must be in full alignment with the new demands of challenging in this way teachers to consider new ways of teaching in order to equip their students with 21st century skills. To this effect, in 2009, a 21st century education's vision was developed by Partnership for 21st Century Skills (Figure 2.1.) to reconceptualise and reinvigorate education to enable students face the new challenges, promote critical thinking, analysis, and problem solving .

Figure 2.1.: *Partnership for 21st Century Skills (Designed by the researcher)*



Note. Partnership for 21st Century Skills is an organization that promotes the inclusion of critical thinking, problem-solving, and communication skills in the instruction of world languages, English, reading or language arts, science, math, economics, and the arts.

3.2.1. Defining 21st Century Skills

Wagner (2008) defines 21st century skills as the skills students need to survive in their life and workplace:

- Critical thinking and problem solving
- Collaboration and leadership
- Agility and adaptability
- Initiative and entrepreneurialism
- Effective oral and written communication
- Accessing and analyzing information
- Curiosity and imagination.

3.2.2. The Importance of 21st Century Skills

There are several reasons for equipping students with 21st century skills. Among these reasons, we can mention: economic and civic ones. For the former, computers and machines can turn to be costly to do a job that can be done by people possessing a minimum knowledge, which means that the workplace of today needs a limited number with basic and higher-order thinking skills (Pellegrino & Hilton, 2012, p. 55). Said differently, today's market needs people who can innovate through complex thinking and communication skills to solve new problems.

As for the latter (civic education), it is important to teach basic civic knowledge to promote civic engagement so that they become engaged citizens. Citizens who would:

- think critically when analyzing a piece of news;
- debate an issue without any biases;
- solve problems and address social challenges;
- be willing to work with others and communicate effectively in order to communicate and share their opinions (Putnam, 2000).

3.2.3. Challenges in Teaching 21st Century Skills

Up to this day, the most dominant approach in today's education is still through transmission model or rote learning (Peterson et al., 1989). Although policy makers, educators, and teachers are aware of the importance to shift to a new model, teachers are reluctant on moving away from a mode of teaching they have been using for years. However, Schleicher (2012) asserts that teachers' apprehension is motivated by the transmission model that requires less disciplinary and pedagogical expertise than does the contrasting "constructivist" model through which students actively gain skills and knowledge but demands more efforts.

There is no doubt that through the transmission model, students can acquire a lot of information, but they are unable to apply the acquired knowledge to new contexts, or in real life situations (Boix-Mansilla & Jackson, 2011). Another challenge facing the development of 21st century skills is that they can be acquired through other disciplines and not in isolation (single discipline). The third challenge hampering the teaching of the 21st skills is assessment. Teachers find it more difficult to assess 21st century skills than factual retention or rote learning.

3.2.4. Key Considerations to Promote 21st Century Skills

3.2.4.1. Ensure Instruction Relevance

Since the 21st century skills have become important in modern society in a world driven by technology, it is important for students to learn skills that are relevant to their needs and enable them face the 21st century challenges and use them (skills) in their daily life (Wagner, 2008).

3.2.4.2. Avoid Single-Based Discipline

Teaching through memorization and rote learning is not only irrelevant in today's society but undermines any chance of developing students' 21st century skills (Schiefele & Csikszentmihalyi, 1995). One way to make the syllabus relevant is to deal with topics that can

be found in other disciplines (climate change, wars, justice…). As an example, the topic on climate change can be approached through the implications of the issue on the economy of the area, using statistics, news items, newspapers, social media…

3.2.4.3. Use High Order of Questioning

Most of the traditional syllabuses are featured by lower-order exercises neglecting higher-order thinking ones. In order to develop students' thinking skills, teachers should ensure that lower- and higher-order thinking skills be taught simultaneously. To promote thinking skills, the teacher could ask probing questions frequently. Using questions like: why?.., why not?... can contribute greatly to understanding a problem through negotiation (Schwartz & Fischer, 2006). It is true that high-level thinking skills are not easy to develop but they are of great value in promoting critical thinking.

3.2.4.4. Teach Knowledge Transfer

Learning transfer is crucial in students' life and career. In the context of education, transfer of learning is the ability of students to apply knowledge and skills gained in class in their workplace or life. Learning transfer is positive when acquisition or performance is facilitated; however, it is negative when performance is impeded (Salomon & Perkins, 1989). For effective learning transfer in teaching, the following elements could be considered in every program:

- Set clear and measurable learning objectives.
- Use multiple methods and formats.
- Provide opportunities for practice and feedback.
- Encourage group work.
- Link learning with real-world examples/situations

3.2.4.5. Foster Students' Autonomy

Twenty first century teaching demands that students be taught to develop some autonomy as far as learning is concerned and be aware of what they are learning and how they are learning. Not only such a type of learning (metacognition) is a critical skill, but it helps students to learn other skills, acquire knowledge, develop strategies, and have attitudes more effectively as well by questioning (Pauli, Reusser, & Grob, 2007). Dweck (2009) asserts that with metacognition students develop positive mental models about how they learn, and accept that mistakes and failures are opportunities for self-inquiry and growth. One way to promote metacognition

according to Dweck (2009) is to praise students for their efforts and align instruction according to their learning style.

3.2.4.6. Promote Teamwork through Collaboration

Promoting collaboration amongst students to act as a group is highly recommended in modern education (Felder & Brent, 2007). This is because developing the skills learnt through teamwork promotes peer interaction, dialogue, problem solving and cooperation (Tarricone & Luca, 2002), fosters social bonds amongst students, and allows a flow of diverse ideas and skills resulting in every individual bringing his/her own expertise (Davies, 2009). However, as students are not born to work together, teachers are required to guide their students all along the assigned activities and teach them how to interact between members regularly to reach a goal (Oakley, Hanna, Kuzmyn, & Felder, 2007).

3.2.4.7. Exploit Technology

Technology offers the potential to develop students' 21st century skills by providing them with new ways to develop their problem solving, critical thinking, and communication skills. It can help students practice transfer those skills to different contexts, reflect on their thinking and that of their peers, practice addressing their misunderstandings, and collaborate with peers. As a tool, the Internet can provide a forum for developing students' 21st century skills and knowledge, but they must be taught also how to filter out information and synthesize it properly (Dede, 2005).

3.2.4.8. Cultivate Creativity

In an era characterized by technology and a myriad of information sources, teachers are compelled to teach their students not only how to analyze and assess problems from different perspectives but overcome complex situations (Pink, 2006) and be creative as emphasised by Robinson (1980). A class that fosters creativity results in a positive atmosphere whereby students find lessons relevant to their lives and become intrinsically motivated to learn and use their new found knowledge and understanding creatively and helps them recognize their own creative capacities.

Therefore, if the wish of policy makers is to make students become citizens capable of facing complex business, political, environmental and cultural issues, teachers have to be

backed up with appropriate syllabuses that ensure students are being equipped with the skills to solve problems and taught how to be creative (Guilford, 1992).

3.2.5. Teachers' and Students Roles in Interdiscplinary Instruction

In ID instruction, both teachers and students have a key role to play to make instruction succesful.

3.2.5.1. Teachers' Role

In a traditional classroom, teachers' role was more important than the students' since they were the main source of knowledge transmission. They dominated the class during the whole session and acted as a model of language to follow (Richards and Rodgers, 2001), and they were the main source of information.

However, 21st century students can get any information in a click, which entails that teachers need to teach them differently, assume the role of facilitator and guide them to apply knowledge acquired in class in real life instead of using rote learning (Yıldırım, 1996).

In modern education, and specifically, in ID instruction whereby one or two disciplines are merged and with a student-centered approach, students are encouraged to try, explore, question and generate new knowledge through relevant and authentic problem solving tasks.

3.2.5.2. Students' Role

In ID instruction, students have also a role to assume by engaging themselves in the learning process, by taking risks in communicating and by negotiating meaning in the target language. In so doing, they learn that making mistakes is part of the learning process and gain confidence to use the language.

3.2.6. Challenges in Implementing Interdisciplinay Instruction

Actually, there are several factors that can affect the implementation of ID instruction. Among these factors mentioned by Lehmann (2006): motivation, attitudes, anxiety, learning achievements, aptitudes, intelligence, age, and personality. On another vein, Oxford (2001) identified three types factors that can hinder the implementation of ID instruction: institution factor, student factor and teacher factor.

3.2.6.1. Teachers' Factor

Teachers' effectiveness during a lesson depends on how well they can adapt effective teaching skills according to circumstances that might spring up; therefore, teachers should be knowledgeable about:

- content(subject matter)
- teaching principles, strategies to promote critical thinking
- designing a differentiated lesson plan
- students' interests, motivation, learning syles, attitude…

3.2.6.2. Students' Factor

Students' attitude towards learning can impact either positively or negatively on the teaching learning process (Gardner, 1989); therefore, it can in no way be demeaned. Teachers should see to it that their students be nurtured with engaging activities to turn negative attitudes to positive attitudes as far as learning is concerned (Brown, 2001). Brown (2001) asserts that taking into account students' attitude establishes a positive classroom climate whereby motivation towards learning is fostered.

3.2.6.3. Institution's Factor

Elements like materials and resources (textbooks, teacher guides, language lab classes, etc. can hinder the implementation of ID (Richards and Rogers, 2001), let alone the problem of large classes with heterogeneous abilities and interests. A large class with mixed ability can hinder greatly the teaching learning process according to Johnson et al. (1998).

3.2.7. Importance of Teachers' Collaboration for Effective Interdisciplinary Implementation

Because the traditional way of teaching is administered in a fragmented way, students will find it hard to merge all the disciplines to solve a problem when they join the workforce (Jacobs, 1989). Here comes the usefulness of ID syllabus that helps students understand, view a complex problem from different perspectives and proceed to knowledge transfer (Yıldırım, 1996).

Effective teaching with an ID approach requires teachers from different disciplines collaborate and communicate which entails negotiating, resolving differences, developing a shared understanding, and working together in an efficient and goal -oriented way with other

professionals assuming different roles, at different levels, in order to achieve a concrete product, or outcome (Manathunga et al., 2006).

3.2.7.1. Teachers' Collaboration' Principles and Practices

Taylor, Smiley, and Richards (2015) identified several principles and practices that impact collaborative processes. Collaboration implies:

- the participation of two or more parties working together;
- the participation of individuals as equal partners;
- the choice of those involved is voluntary;
- sharing responsibility among those involved for outcomes, positive or negative;
- identifying and working toward a common goal;
- sharing resources, knowledge, and skills;
- developing a community.

3.2.7.2. Benefits

Teachers' collaboration in ID instruction can benefit teachers in the following ways:

- continued learning in content knowledge, modern technology and recent methodology
- sustained enthusiasm for teaching and PD (Shibley, 2006);
- effective syllabus development (Parks & Goldblatt, 2000);
- multiple inputs from experts of other subjects.

3.2.7.3. Challenges

Unfortunately, there are several barriers that may jeopardise teachers' collaboration. Some of these are:

- differences in philosophy, pedagogies, personalities (Lynch, 2006);
- lack of willingness to collaborate;
- lack of open attitude from both sides;
- lack of willingness to engage in accepting other members' input and feedback;
- sharing responsibilities and setting goals.

3.2.7.4. Teacher Collaboration Framework

Several frameworks have been suggested as regards to teacher collaboration, but McCarthy, Brennan, and Vecchiarello's (2011) seems to be the most feasible due to its simplicity and feasibility.

McCarthy, Brennan, and Vecchiarello (2011) suggested four steps for implementing a collaborative relationship:

- Identifying the roles and rules

All the members are required to establish a shared vision with each member's role and responsibility according to the area of expertise quite well defined.

- Establishing a shared vision

A shared vision is referred to as the identification of goals and outcomes for the student. All team members are required to consider the students' strengths, weaknesses and interests when developing the shared vision.

- Developing a collaborative plan

Once the vision is established, goals and objectives are to be ientified to help the students reach the vision. The goals need to be observable, measurable, and specific.

3.2.8. Assessment in Interdisciplinary Teaching

ID has been defined as 'the capacity to integrate knowledge and modes of thinking drawn from two or more disciplines to produce a cognitive advancement – such as explaining a phenomenon, solving a problem, or creating a product – in ways that would have been unlikely through single disciplinary means' (Boix-Mansilla, 2007, p. 16). This capacity is often described as crucial in solving emerging complex problems and achieving sustainable development goals (Bertel et al. 2022). Unfortunately, such a mode of teaching makes assessment quite complex and challenging. As a result, and in the absence of clear, practical guidance for ID assessment, teachers often revert to disciplinary assessment approaches they are familiar with.

Assessment is an important issue in ID teaching. However, there are issues on what to assess and how to assess and measure learning. While the answer to "what to assess" can be found in the syllabus provided by the institution, "how to assess" is teachers' sole responsibility to use engaging tasks in alignment with 21st century learning: PW, presentations, charts or any task that showcases how much students have learnt. Such types of assessment would not only provide teachers with information about their students' development intellectual capability but promote deep learning (Field et al., 1994).

Unlike traditional classes (single discipline classes) where students are assessed to find out how much they have learnt in relation with classroom activities, assessment in ID classes goes beyond testing and grading. It strives to bridge the gap between what has been taught in class and how to use knowledge out of the box to meet the standards an expectations of the 21st century (Biggs, 2003).

3.2.8.1. Charateristics of 21st Century Standards and Assessments

It is fudamental that assessments be designed to support students' learning, provide valuable data for policy and decision making. As such, 21st century assessment bears some characteristics and standards:

- provides insight on what and how students are learning in time (J. Ross, 2006);
- allows teachers to modify or personalize instruction (J. Ross, 2006);
- allows teachers to assess a wide range of skills and abilities (Dikli, 2003);
- involves students not only in the teaching learning process, but encourages them also in the creation of assessment criteria, and diagnoses their strengths and weaknesses and the monitoring of their own learning (Dikli, 2003). As an example of self assessment, one can cite rubrics, which are very successful when asking students to create evaluation criteria.

3.2.8.2. Principles of Interdisciplinary Assessment

The work of OECD (2009) on "assessment" suggests a number of principles worth to be considered. It should:

- be aligned with the 21st century goals: Assessments must clearly reveal the expected learning and skills that students are to understand and apply.
- include adaptability, flexibility and unpredictability: One of the requirements of 21st century is to teach students to make decisions and act when confronted to new situations.
- be based on critical thinking: Any form of assessment is to make the students apply their acquired knowledge in real, authentic life situations using strategies to solve problem.
- be accomodated for struggling students who have difficulties in responding to some items beyond their ablilities.
- provide accurate, valid and reliable information for future decision-making. The information obtained could be used to determine how to create better opportunities for students' learning.

3.2.8.3. Types of Assessment

3.2.8.3.1. Formative Assessment

Assessment is the process by which teachers collect information regarding their instruction and students' learning (Hanna & Dettmer, 2004). Based on the student's performance after collecting these data have been collected. Therefore, based on the assessment data, strategies are implemented to strengthen the identified gaps, flaws, or deficiencies during the decision-making process. We distinguish two main types of assessment: formative assessment and summative assessment.

Formative assessment provides feedback to the teacher on how well students are learning and information about the teaching effectiveness through students work related to goals and standards (Nicol & Macfarlane-Dick, 2006). Formative assessment engages the teacher into reflection on whether there is a discrepancy between actual outcomes and desired outcomes (Attwood, 2009). In other words, the teacher embarks on an on going exploration of students' learning and reflective practice. Reflective practice on the part of the instructor breaks the hierarchical relationship between instructor and students and promotes deep learning since both parties (teachers and students) are engaged in dialogue with students receiving feedback information, and teachers engaging in discussion about that feedback (Laurillard, 2002).

To sum up, the benefit of dialogue during formative assessment is undoubtedly fundamental in improving the effectiveness of the teaching learning experience (Covic & Jones, 2008).

3.2.8.3.2. Summative Assessment

Summative assessment is designed to make a final judgement about students' achievement in a course, to certify achievement and award a qualification (Awoniyi & Fletcher, 2014). It is used to measure the students' achievements and see whether they can move to the next level. It reveals the students' performance which can serve also as a tool for future decision making. Summative assessment is highly influenced by "what is taught, how it is taught, what is learnt and how it is learnt" (Stobart, 2008).

3.2.9. Interdisciplinary Assessment Models

To foster 21st century learning, teachers are to assess their students' knowledge differently. Any form of assessment should not be based solely on recalling information, or answering content questions (Popham, 2008b). For teachers to support students in an ID programme, authentic assessment strategies need to be implemented. According to Kolb (1984)

when authentic assessment is used, students are exposed to the same kinds of tasks that they may encounter in their future workplace.

Unlike traditional assessment that requires students to memorize facts, authentic assessments require students to apply higher-order thinking abilities and knowledge. However, shifting to a new mode of assessment, is not without difficulties for teachers as measuring students' skills like collaboration, teamwork, or critical thinking, PW, presentations… demands new criteria, new standards, new strategies. Luckily, teachers can use some alternative forms of assessment like: Rubrics, journal assessment, student portfolio, self assessment, peer assessment… Each of these tools is described in detail in appendix C.

3.2.10. Summary

With globalization, technology, social media, competitive market, environmental challenges, there is a dire need to develop the skills and knowledge students need to cope with the new requirements of the 21st century in order to succeed. The requirements are referred to as '21st century skills' by educators, researchers and policy makers.They include: collaboration, teamwork, critical thinking, problem solving, creativity, innovation, communication skills...

Students, then, need to be provided with knowledge content that prepares them for the real world of the 21st century. To acquire these skills, today's students need to be taught differently to face the challenges in their future professional environment and be prepared to go beyond the mastery of their field content, display high order thinking, and apply their knowledge in real life situations. Therefore, to bridge the gap between theory and pratice (possibility of applying knowledge outside the class), researchers have endorsed ID approach to move from knowledge transmission, rote learning and memorisation to a new mode of teaching. Students are fully engaged in the teaching learning process through innovative strategies and encouraged to go beyond the limits of a single content area to foster those skills.

3.3. Section three: Applicability of Interdisciplinarity in a Maths Class through Project Based Learning: The Case of Mathematics Students at NHSM, Algiers

3.3.0. Introduction

To asssist students face the challenges of the 21st century, teachers need to impart knowledge of a discipline within a context and along with other subjects in order to solve problems. Research has shown that when students are taught within an integrated syllabus, they demonstrate academic performance equal to or better than students in a single discipline–based program (Drake, 1991).

In a world that has become more and more interconnected and interdependent as stated by Drake (1991), education must change and knowledge is to be presented in an interconnected and interdependent way. Ironically, although mathematics, in real life, is used in different fields, it is taught separately and in total disconnection with other subjects, making it hard for students to apply their acquired mathematical knowledge to solve real life problems when they leave school.

For students to embark on research, solve problems, do surveys, write reports, reperesent data graphically, they need to see the link between different subjects. It lies, then, on teachers to teach them accordingly so that they can apply and/or transfer knowledege out of the box to solve problems in their real life and understand the connections of the various disciplines that seemed disconnected at first (Frykholm & Glasson, 2005).

3.3.1. Brief Definition of Mathematics

According to Wikipedia (2010), mathematics is the study of finding and organizing abstract objects, methods, theories, and theorems that have been developed and proven to meet the needs of empirical sciences. In contrast, Peterson (2012) views mathematics as a broad range of fundamental ideas, including quantity, counting, shapes, size, and spatial relationships (up and down). Numerous disciplines, including the natural sciences, engineering, medicine, finance, computer science, and the social sciences, rely on mathematics, which Carl Friedrich Gauss referred to as the "queen of sciences."

3.3.2. The Importance of English for Mathematics Students

As a result of globalization, more and more individuals are trying to learn English either for personal reasons (travelling, corresponding with overseas friends…), or to find a job in a variety of sectors like: commerce, finance, medicine, agriculture, technology, and education (Agustin, 2015). Then, English is no longer only a means of communication but a tool for enhancing scientific knowledge (Rohayati, 2018). These claims have been supported by many researchers (Wells, 2003) who found out that language proficiency can be very useful in communicating in another subject as mathematics which is not limited only to calculations, numbers, or quantity but can be used as a way of communicating (Planas et al., 2018).

For students to progress in their field, they are much required to take a course in English for a number of semesters as it constitutes a gateway to achieve success in their field and their academic and professional career (Iriance, 2016). As a result, since all sciences, related to

mathematics, are constantly being updated and most of the updates are in English, it becomes evident that English for mathematics students is very important.

Teachers teaching English classes to maths students are required to bridge the gap between maths that uses symbols and numbers and English that uses words to communicate, by engaging students in the teaching learning process (Nashruddin, 2019). To do so, and for efffective instruction of English to maths students, a NA has to be conducted at the beginning of the course. It should be made before a plan is established accordingly to teach students language related to their field and within a context in order to enable them use the acquired knowledge in English, transfer it to their field, and use it outside the class.

3.3.3. The Relationship of Mathematics with other Subjects

If the term of ID entails the integration of two or more subjects into relevant connection with the purpose of enhancing and enriching the teaching learning process and gain substantial knowledge about subjects, then mathematics can serve well that purpose (Cone et al., 1998). What makes mathematics fit for ID education is that it can be integrated with mostly all scientific areas (see appendix D).

Mathematics, being ID by nature, has the merit to facilitate the understanding of a given topic/issue from different aspects in a world full of problems that cannot be solved in isolation (Repko, 2009). As a result, integrating mathematics, the queen of sciences as described by Galileo, with other subjects would be valuable and beneficial (Ni Riordain et al., 2016) to students who will be able to develop knowledge, increase their problem solving skills, and gain self-confidence and passion for learning (Repko, 2009, Newell, 2001).

3.2.4. Summary

ID teaching, an approach that enables knowledge acquisition from different disciplines, focuses on students' interests, connects subjects, and covers real life issues. In this section, an overview of mathematics and its characteristics have been dealt prior to showcasing how it can be related to different subjects and be integrated in the English syllabus. By referring to various sources on ID, the researcher found out mathematics can be used in almost all subjects.

To enhance students' motivation in learning any subject, it would be common sense that knowledge be presented as interconnected and interdependent to use Drake's terms (1998). Applied with mathematics students, ID teaching helps them integrate skills and knowledge of mathematics and other school subjects to solve problems as will be discussed in this study.

3.4. Section four: Project Based Learning as a Vector to Achieving Interdisciplinarity

3.4.0. Introduction

Today's employment market focuses on the graduates' ability to work in constantly changing contexts, and deal with complex problems, take decisions, collaborate and take responsibilities. As such, prior to joining the workforce, students are to possess the 21st skills which cannot be acquired through the traditional way of teaching but through students' engagement.

One way to make students engaged and active in the learning process, PBL can be an innovative method to enhance students' learning through authentic tasks based on their interests (Grant, 2002). In a PBL class, students build knowledge by trying to solve a complex real-life problem with peers. As they do so, they are taught to take in charge their own learning through collaborating, investigating, examining a number of sources, negotiating solutions and solving the problem (Grant, 2002).

PBL has a great advantage over traditional teaching as it promotes a myriad of 21st century skills like like dealing with real problems, critical thinking, looking for information, synthesising data, finding solutions, interacting, debating and finding solutions as demonstrated by various studies by Mosier, Levin, & Perkins (2016) and Osuna & Rosas (2017).

3.4.1. Historical Background

Although PBL first appeared in the 1970s, the notion of PBL was created around 1897 when J. Dewey stressed on the importance of student-centered and experiential learning. Dewey (1938) and Gutek (2014) believed that schools and the classroms setting are supposed to be an image of real life situations, giving a chance to students to be part and parcel of any learning activities. In Dewey's mind, students are unique individuals able to construct their own knowledge and learn by doing hands-on activities and solving problems. Actually, this is what PBL seems to achieve: Turning students to active thinkers and researchers while enjoying the acquisition of higher order thinking skills (Gultekin, 2005).

3.4.2. Defining Project Based Learning

Due to numerous definitions of PBL given by different scholars, only few pertinent ones to the study will be discussed. According to Thomas (2000):

> "*Project-Based Learning is a model that organizes learning around projects based on challenging questions or problems, that involve students in design, problem-solving, decision making, or investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations"* (p. 1).

It is also defined as an ID, student-centered activity with a clearly defined project outcome (Han et al., 2015).

Blumenfeld et al. (1991) describe PBL as a comprehensive approach to classroom teaching and learning that is designed to engage students in the investigation of real-world problems with two essential components:

- a driving question or problem that serves to organize the project activities;
- activities that result in artifacts leading to a final product that addresses the driving question with full students' autonomy to develop their own approaches to answering the question.

3.4.3. Benefits, Drawbacks, and Challenges in the Implementation of Project Based Learning

3.4.3.1. Benefits of Project Based Learning

Studies conducted by Bhagi (2017) have demonstrated that students, who learn through PBL, get higher scores than students in traditional education. Unlike traditional teaching, the PBL makes students responsible, aware of what they are doing and why they are doing a particular task. Furthermore, they learn to work in groups, cooperate, think critically and creatively (Krajcik & Blumenfeld, 2006) impacting not only their performance but also their attitude towards learning (CareAcademy, 2018). Also, to Thomas (2000), PBL transforms students' work habits and effectiveness, and its benefits, listed below, were highlighted in the 19th century by Dewey (1938) who emphasised the importance of imparting instruction through students' involvement in the teaching learning process. Some of the PBL benefits are listed here below:

- Students are engaged in authentic, real-world projects that promote their critical thinking skills and problem-solving abilities (Woenardi et al., 2022)
- Students, in a PBL class, learn to set goals, manage their time effectively, make informed decisions, and take responsibility for their learning (Bagheri et al., 2013).

- By working together, students learn to accept other peers' perspectives, learn from each other, gain a deeper understanding of complex issues, build upon each other's strengths, and develop communication skills (Aksela & Haatainen, 2019).
- Students get the real picture of future professional environments, where solving a complex problem requires the expertise of every individual from different fields in the workplace (Morais et al., 2021).
- It promotes the development of students' creativity, a skill which is as important as literacy as put by Taddei (2013).
- It develops students' self-confidence since the project ends up with a product (Fried-Booth, 2004).
- It emphasises on content rather than on precise language objectives (Railsback, 2002).

In sum, PBL has the merit of promoting students' critical thinking and communication skills by allowing them to work in groups in order to find materials to solve real-life problems (Ali, 2019). In opposition to the traditional lecture method that is a one-way conversation, the instructor delivers the information to students (Gholami et al., 2016) with little little conversation taking place during the lecture (Sarıhan et al., 2016).

Considering the numerous benefits of PBL, it is important to bear in mind that careful planning and assessment methods on the part of teachers are much required to provide better teaching and produce better learning as stressed by Doppelt (2009).

3.4.3.2. Drawbacks of Project Based Learning

Although PBL possesses several advantages, researchers have also found some deficiencies that may affect its implementation. Some of these deficiencies of PBL are as follows:

- Implementing PBL in a large class can be ineffetive and can result in students' demotivation as it will be difficult to make all the students concentrate on learning tasks and perform cooperative learning activities efficiently (Gülbahar & Tinmaz, 2006).
- PBL requires a lot of time to solve complex problems (Grant, 2002).
- Novice teachers might feel intimidated when using PBL (Grant, 2002).

- Since PBL's success lies on cooperative learning, struggling students may encounter difficulties in collecting and synthesizing information (Land & Greene, 2000; Marx (2000).
- PBL can be seen as time consuming and demanding in terms of preparation, time, materials, organization and student discipline as pointed by Kratochvílová (2006).
- Students sometimes are not mature enough to work on their own (Haines, 1989).

To minimize these disadvantages when implementing PBL, researchers in the field suggest to assist students in dealing with the problem, set time limit for students to submit the project, require cheap, available tools, and choose a feasible topic with accessible location for students so that students would not have to move from one place to another.

3.4.3.3. Challenges in Implementing Project Based Learning

In addition to the drawbacks of PBL, there are also many challenges (Bogler, 2016). Some of the challenges that both teachers and students may encounter are as follows:

- The first challenge that may arise when implementing PBL is making students work as a team. Many issues may arise in group work (McCharty, 2019). When students are operating in a group, some of them may not be active in solving the task.
- Teachers may resist in adopting PBL due to their unfamiliarity with the methodology. Besides, accustomed to the traditional teaching methods, PBL may constitute extra workload, and time demanding (Mihic & Zavrsˇki, 2017).
- Teachers have to ensure that the learning objectives behind PBL is in alignment with the syllabus that entails careful planning and suitable projects (Juandi et al., 2021).
- Asssessing students in a PBL class is not that easy as the usual assessment tools used in a traditional class. Adopting the same tool would be inappropriate since PBL, by definition, places a greater emphasis on problem-solving, collaboration, and students' capacity to apply their knowledge and skills in real-world situations and on authentic performance-based tasks (Evans, 2020). Therefore, teachers are left with the task of developing appropriate assessment strategies in consonance with the nature of PBL that can be challenging indeed.

In order to address the challenges mentioned afore, it is imperative that teachers be provided with PD sessions and training programs to help them implement PBL effectively (Warr & West, 2020). Some options for PD programmes can be found in appendix E

Supporting teachers through training programs will not only dissipate teachers' resistance but foster a culture of innovation in trying to embrace PBL as well. As for designing authentic assessments in full alignment with the PBL objectives, teachers can use both formative and summative assessments and provide students with clear rubrics to guide them in their own evaluation.

Lastly, but not really, time allocated to PW in PBL should be framed within timelines to avoid time constraints and negative impact on the syllabus coverage.

3.4.4. Goals of Project-Based Learning

The PBL's primary goals are to boost students' enthusiasm and make them work in a stress free, supportive atmosphere. To maximise the benefits of PBL implementation and for careful planning, teachers should be aware of the goals of this approach. Some of the goals are as follows:

- teach students skills like organizing and planning research-based learning processes, which will lay a solid foundation for their future in a global economy
- foster social skills and creative thinking.
- immerse students in the learning process and provide opportunities of getting responsibilites (Thomas, 2000).
- empower students to search their study materials and enable them to become more information literate (Naidoo, 2010).
- make students independent learners by allowing them to identify their own learning needs (Barrows, 1996).
- teach students to set objectives, manage their time and sources.

The purpose of PBL is to make students develop some autonomy, learn to think out of the box through accessing information, synthesising the data and apply them to bring answers to the driving question they set at the beginning of the project. In so doing, they learn to make connections between various themes and disciplines to become lifelong learners as stated by Boss and Krauss (2007).

3.4.5. Planning Project-Based Learning in an English Class

Although it is featured by some sort of autonomy, PW in a PBL class cannot be subjected to unpreparedness and/or left entirely to students. On the contrary, PBL necesssitates careful planning which starts with a topical issue to end up with a product (Hutchinson, 1992).

When implementing PBL, teachers need to familiarize students with PW through practice which can include how to write a driving question, find resources, gather information… using the steps as advocated by Allan and Stoller (2005).

3.4.5.1. Key Considerations in Implementing Project Based Learning

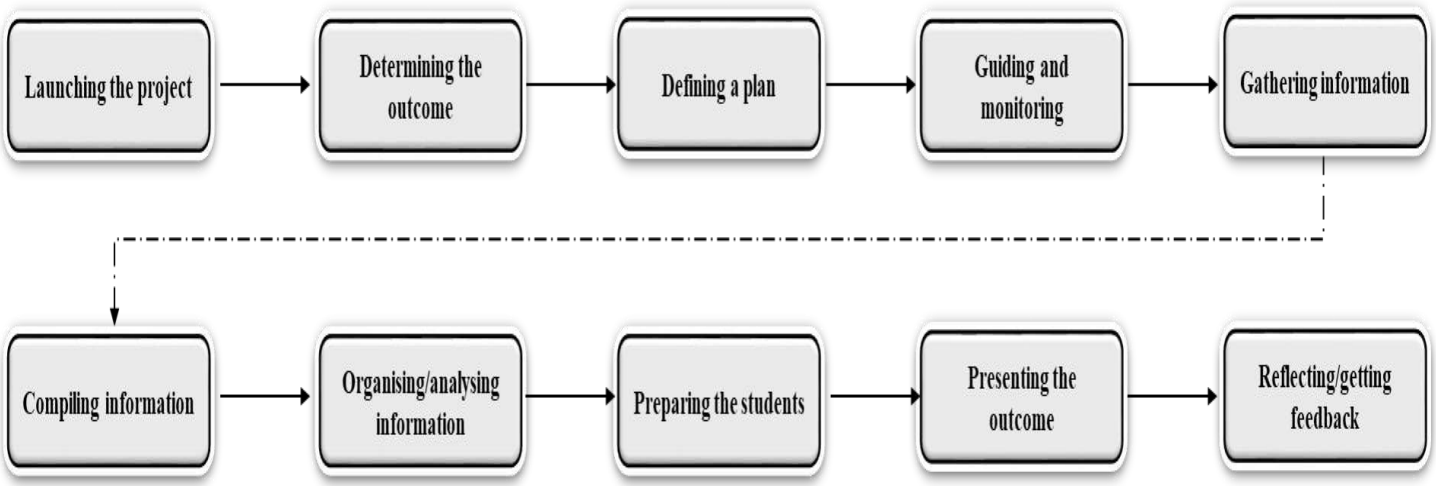
All researchers agree that PBL should in no way be a substitute for other teaching methods but a complementary one (Svobodová et al., 2010). Prior to organising a PBL unit, some considerations need to be taken into account. Being student centered, PBL should derive from the students' needs and interests and involve more than one discipline leading to a product (Coufalová, 2006). Haines (1989) claims that once the PW is launched, students should feel they are responsbile from beginning to end and that it should be carried out within a group wherein every individual is involved in a co-operative, stress free atmosphere. Hence, for a PBL unit it be successful researchers have stressed the importance of having a driving motivating question which is elaborated, explored and answered throughout the project (Krajcik & Mamlok-Naaman, 2006).

Another element to consider when implementing PBL is that it should lead to teach 21st century skills like problem solving, critical thinking, teamwork, cooperating… PW in PBL is not to be equated with projects in traditional classes (see appendix F for the differences). It should be implemented in a way to maximize the chances for students to work with authentic issues that they may face in their real world (Thomas, 2000). Taking these consideartions into account result in making projects play an important role in the teaching learning process.

3.4.5.2. Steps of Project Based Learning

Once the students have been taught how to realize their project, teachers can, then launch the PW. There are several recommendations on developing projects but no agreed upon the best framework (Haines, 1989); however, for an ESP classroom, the most consistent one is the Sheppard and Stoller (1995) framework which embodies ten steps schematised in Figure 2.2 below:

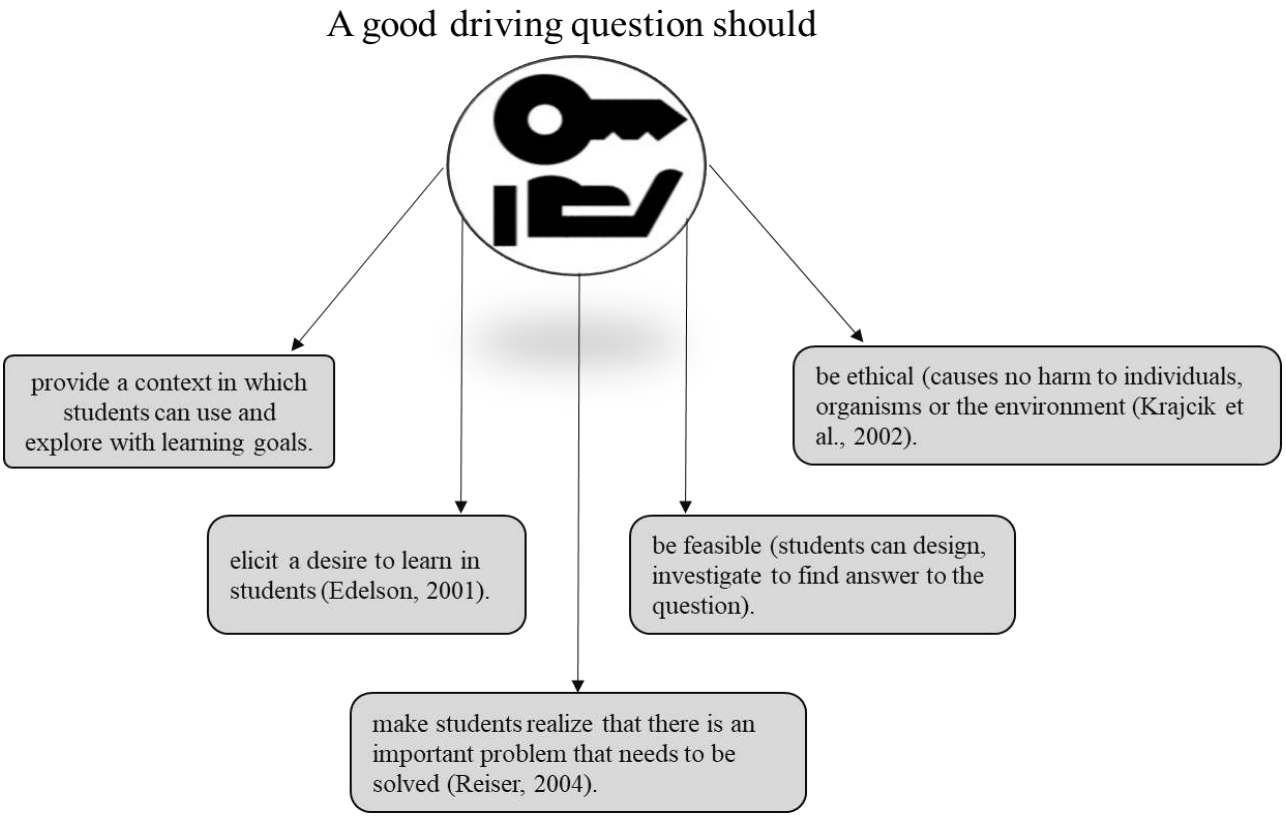
Figure 2.2.: *Project steps (Designed by the researcher)*



Step 1. Identifying and Launching the Project

Students identify a real problem or issue, and make investigation using real-world sources of information through interview, internet sites, magazine articles,… (Li Y et al., 2011). Once the theme has been identified, the teacher with students select a topic that will serve as project and start working on a driving question. A good driving question is the key to successful PBL as stressed by Larmer and Mergendoller (2015a). According to Larmer (2014), a good driving question should be open-ended, provocative, complex and should be linked to the core of educational goals that a teacher intents to teach. The criteria of high quality driving questions are depicted in Figure 2.3.

Figure 2.3.: *Driving Question Criteria (Designed by the researcher)*



Step 2. Determining the Final Outcome of the Project

Having the objectives of the project in mind, both the students and teacher determine the final outcome of the project depending on students' interest, style of learning, experience or creativity (Patton, 2012). The final product can be: a poster, an oral presentation, a report, debate, a video, a caricature, a survey, an essay... Larmer and Mergendoller (2010) state that students should be allowed to express their preferences as regard to the final product. In this step, students should be highlighted on the way they will be assessed, and the rubric that will be used and their audience.

Step 3. Defining a Plan

In this step, students are divided into small groups managed by a group leader to discuss the "wh" of the project and the outline through brainstorming as suggested by Mergendoller and Thomas (2005). Each member is assigned a well defined role and clarified tools to be used. After assigning the roles, the project completion has to be negotiated and a consensus has to be

reached as far as the timing for gathering, sharing, and compiling information, and then presenting their final project. Students have to understand the importance of time frame for the project completion.

Step 4. Guiding and Monitoring

There are times when students get stuck with what to do and how to do a particular task. In this case, they should be guided in obtaining resources (books, websites, brochures…), or in conducting interviews, writing reports/letters, taking notes, summarising,….

Step 5. Gathering Information

After being informed about the skills, strategies, and language needed for the project, students start collecting information using methods acquired or learnt in step 4 (interviewing, writing report, summarising, taking notes…).

Step 6. Compiling Information

At this stage, students compile, analyze, and synthesize the information that they have collected from different sources on their own through: categorizing, making comparisons, classifying, using charts, tables, graphs…. Students might need sessions if need be.

Step 7. Organising and Analyzing Information

After compiling information, students organize information and then discuss the value of the data they have collected, keeping the information that is critical for the completion of their projects.

Step 8. Preparing Students

At this stage, the teacher prepares students for the language and skills (revising, editing, debating, arguing…..) needed for the final activity to help them successfully present the final outcome of the project.

Step 9. Presenting the Product

Students present the final outcome of their projects, as planned in Step 2.

Step 10. Reflecting

Very often, this step is being neglected. Students should reflect on what they did, the language mastered, and knowledge acquired during the project. They could be asked to make

recommendations for future researchers. The presentation should be closed with teachers' feedback pointing out any deficiency during the presentation, language and content learning (Lu & Bi, 2016). Any feedback should be timely, constructive focusing on strengths and areas to be improved.

3.4.5.3. Evaluation

If the success of PBL is reflected on how well students are able to solve a problem, think critically, interact with peers, use deductive/inductive reasoning, teachers' role is to assess outcomes. Given the fact that a PBL class is different from a traditional class, students need to be assessed differently with varied methods with the purpose of providing students with feedback and suggestions (Li et al;. 2011). Any assessment done in a traditional way is regarded as contrary to the concept of PBL teaching. PBL teaching needs a new assessment system that would motivate students to strive to work on their own since their learning behaviors and motivation are often influenced by the assessment methods and results (Li Y et al., 2011).

One way to do this is to use a combination of formative assessment and summative assessment as proposed by Yu et al., (2012). For the formative assessment, teachers could use observations, conversations, quizzes, exams, task assessments, group reports, individual reports, documentation of work as proposed by Zhen and Liu (2020). As for the summative assessment, students could be asked to write an essay about their experience with the project, lessons learnt, reflection about the work or research they have done (Zhen & Liu, 2020). For effective students' assessment, in addition to the cited above tools, PW rubrics (see appendix G) and feedback can measure well the outcomes of the learning process different from traditional classes. As a matter of fact, rubrics, which consist of a list of criteria defining and describing the work components, enable students to know about the goals and how they will be assessed.

3.4.6. Teachers' and Students' Responsibilities in Project Based Learning Instruction

3.4.6.1. Teachers' Responsibilities

Although PBL is a student-centered teaching method, it requires teachers to assume several roles throughout the whole process (Mergendoller & Thomas, 2005, p. 40). They are expected to assume the role of a facilitator and interact moderately with students during the teaching process. They should give appropriate guidance or intervene when the students are not able to move on in their work, or point out their mistakes and let them find the correct answers

by themselves (Yang, 2009). Indeed, teachers' support in searching for relevant materials, using the resources, finding solutions is much required (Yang et al., (2009) and can be extended even to the group's dynamics by ensuring that all team members are involved the task which is itself a PBL prerequisite that no member is left is behind.

3.4.6.2. Students' Responsibilities

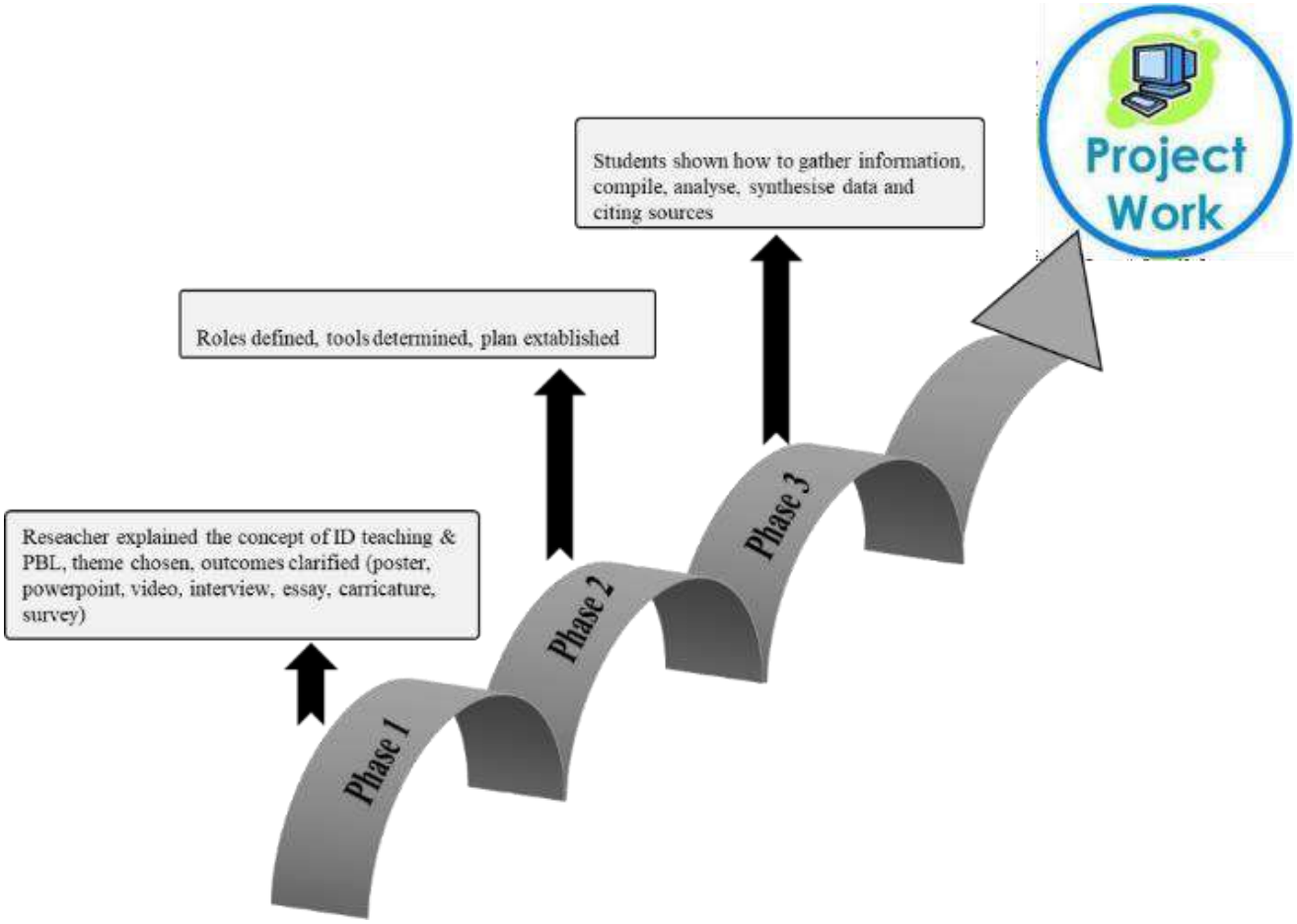
As opposed to teacher-centered classes where students are passive recipients, Fleming (2000) argues that the role of teachers in PBL is shifted to students (Fleming, 2000) who become active participants in the learning process. For projects to be successful in a PBL class, students should assume some roles. Firstly, they should display some sort of readiness to take part in a team project to solve a problem, argue, negotiate, and share information (Papamarcos, 2002). During the process they should bring skills that would eventually end up with a product. They should also be aware that it is their readiness that will determine the success of the project. Secondly, taking in charge one's learning implies that one team member should take the role of coachee whose role is to be on an angoing dialogue with the teacher to get advice and instruction (Bolton, 1999). Thirdly, during the project realization and after, the students' role should not be limited to taking part but extended to learning and mastering the skills associated with their project (Papamarcos, 2002).

3.4.8.3. A Project Based Learning Model Lesson

A project wast initiated at NHSM at Abdelhafid Ihaddaden Science and Technology HUB, Algiers in October 2024. Discussions related to the "wh" of the project started in the first week of October in the Department of Mathematics. During the discussions, several topical issues were proposed: Car accidents, mobile use, drug addiction, Internet addiction, environment. In the end, the environment topic was retained and it was agreed that the project be finalised within a period of three weeks to four weeks, starting from November 1, 2024. The class was divided into six groups with four members in each group. Each group was to find a driving question about an environmental issue: noise pollution, global warming, desertification, plastic plight…. Students were highlighted about the goals, steps, expectations and assessment tools through a form (see assessment rubric in appendix G).

It was hoped that the students after the completion of the project would improve their language skills (reading, speaking, quoting, summarising,…) and their communication skills as well. The project's proceedings are schematized in Figure 2.4. below:

Figure 2.4: *Project Work Proceedings (Designed by the researcher)*



General theme: **Environment**

Introduction:

In this model, twenty six intermediate students (2nd year) from the department of maths at NHSM at Abdelhafid Ihaddaden Science and Technology HUB, Algiers, participated in a project related to environment.

Project work goals:

The aim was to encourage students to collaborate to raise peole's awareness about environmental issues while improving their reading, writing, listening, speaking, vocabulary skills, and communicative competence and familiarising them with research methodology.

Participants:

The participants were 2nd year students in the maths department, NHSM at Abdelhafid Ihaddaden Science and Technology HUB, Algiers who voluntarily agreed to participate in the project. Prior to embarking on the project, the researcher gave a three-day lecture. Each lecture lasted about sixty minutes. The class was divided into groups. Each group was delegated the task of appointing a team leader, who in his/her turn delegated tasks. The project was to be finalised within a period of three weeks to four weeks with the possibility of getting in touch with the researcher via email or phone.

Steps:

To get the maximum benefit of this project work, the researcher used the ten-step process suggested by Stoller (1997) summarised as follows:

Step 1: Students and instructor agreed on a theme for the project.

Step 2: Students and instructor determinedthe outcome of the project.

Step3: Students and instructor structured the project.

Step 4: Instructor supported and showed the students how to gather information.

Step 5: Students worked on their own and gathered information.

Step 6: Instructor prepared students to compileand analyze data.

Step 7: Students analyzed the compiled information.

Step 8: Instructor prepared students for the language demands of the final activity.

Step 9: Students presented the final product.

Step 10: Students evaluated the project with teacher's feedback.

A project entitled "The Impact of Marine Debris on Marine Life" was selected as a reference for future researchers (see appendix H).

3.4.9. Summary

PBL is a useful, innovative approach to help students construct their own learning instead of receiving it passively via lectures. Indeed, throughout all the process, students were fully engaged in the task working at their own pace.

In this section, the benefits, principles, challenges… associated with the implementation of PBL have been discussed. However, of all the PBL benefits, one should retain that in addition to being student centered, it is ID which entails students are fully involved in more

than one discipline using authentic materials to solve a problem which gives them a sense of being useful to their community. If properly conducted, PBL can be an enjoyable motivating learning experience.

Knowing that it is not free of challenges, teachers are required to address them in order to maximize its benefits. One way to address them is to be aware of the importance of:

- having an authentic problem that is relevant to students, and a driving question from which students can start off their project.
- providing students with opportunities to promote: critical thinking, collaboration, teamwork, negotiating, arguing, synthesising and analyzing information.

These skills if learnt in class, offer the students of transferring them out of the box, improving their commnication and interpersonal skills in their future workplace.

Chapter Three: METHODOLOGY

"If we teach today's students as we taught yesterday's, we rob them of tomorrow."

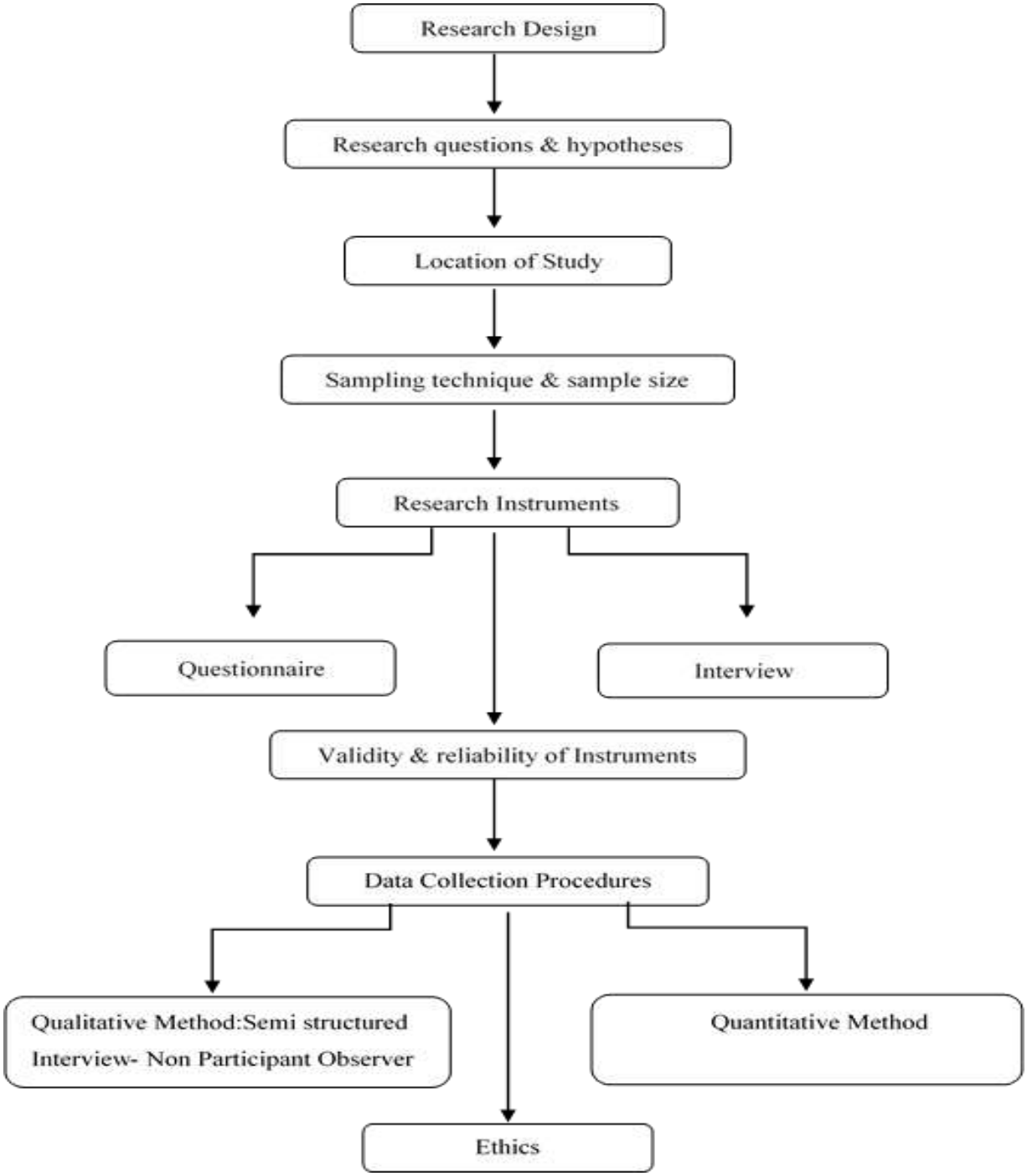
—John Dewey

CHAPTER THREE: METHODOLOGY

4.0. Introduction

This chapter presents the methodology used by the researcher used for the study. To conduct this study, several components, depicted in Figure 3.1., were taken into account.

Figure 3.1.: *Components of the Followed Methodology*



The purpose of the study was to highlight the importance of ID teaching in the 21st century and examine the impact of PBL as an approach to fulfill the role of delivering effective ESP instruction to 2nd year maths students in an English course (module).

This chapter describes the methodology used to test the hypothesis claiming that when students are taught through ID instruction with PBL approach, they benefit greatly and perform better in comparison to traditional teaching. The researcher ensured that a description of the participants and the setting for the study were included in the chapter, along with the data gathering procedures and instruments.

The aim of this study is to research the applicability of ID in a mathematics class in along with the challenges using both qualitative and quantitative methods though the researcher favoured qualitative method as the answers to the "how", "to what extent" and "why" questions allow a profound understanding of the participants' views as asserted by Robson and McCartan (2015). The qualitative data were collected through semi-structured interviews with teachers and lesson observation while the quantitative data were collected through online surveys filled by students. As for interviews, only nine university teachers honoured the invitation.

The study was conducted at NHSM at Abdelhafid Ihaddaden Science and Technology Hub, Algiers as a case study to gather in-depth data regarding the applicability of ID teaching. The School was familiar to the researcher as she worked there as a part timer where she was in charge of ESP to maths students which facilitated the research as far as infrastructure and administrative aspects, teaching staff are concerned.

4.1. Research Design

A research design can be described as a plan to obtain answers to the research questions and deal with issues that may come up when conducting the research (Polit & Beck, 2004, p. 49). However, Polit and Beck (2004, p. 209) cautions that a good research design should be guided with the aim of answering the research question (s) in the best possible way.

To answer the research questions and gather comprehensive data regarding the implementation of PBL instruction and its correlation with students' academic achievements, the researcher used both quantitative and qualitative methods. For the quantitative method, a descriptive survey was used to gather data just after the task as advised by Cohen and Manion (2002). Such a practice enabled the researcher gather fresh information.

For the qualitative method, two instruments were used: Teachers' interviews and non-participant observation. Teachers' interviews were to provide the researcher with an opportunity to know more on their personal experiences with PBL and gain credibility of the the study. As a second instrument, the researcher attended the class as a non participant observer to gain a deeper understanding of the students' attitudes and behavior when working on PW. Observation was interesting and quite fit for research as it was conducted with participants and their teacher in their natural setting which provided logical deductions. These claims are in line with Creswell (2013) who avows that qualitative methods are more adequate as they (qualitative methods) investigate and explore with the researcher as a key instrument.

4.2. Research Questions and Hypotheses

In order to address the purpose and problem in this study, the following research questions and hypotheses have been designed to learn more about teachers' experiences with PBL and investigate the correlation between PBL incorporation in an ID syllabus and 21st century learning.

4.2.1. Research Questions:

The study addressed the following three research questions:

RQ1: To what extent are teachers familiar with ID instruction?

RQ2: To what extent are teachers familiar with PBL in HE?

RQ3: To what extent is ID teaching using PBL as a tool is in alignment with the 21st skills acquisition?

4.2.2. Hypotheses

H1: Most likely teachers are not familiar with interdisciplinary teaching approaches

H2: Most likely teachers are conducting PW in a conventional way.

H3: It is hypothesised that PBL implementation is in full accord with the teaching of 21st century skills difficult to acquire in a conventional class.

4.3. Location of Study

NHSM at Abdelhafid Ihaddaden Science and Technology Hub is the first Algerian engineering school in mathematics welcoming the best baccalaureate holders from the following streams: mathematics, exact sciences and technical mathematics. It aims to:

- train high-level engineers in mathematics;
- offer attractive courses for students;
- support innovation in large companies;
- inform and interact with society on all aspects of mathematics;
- award the engineering degree and giving the possibility of doctoral studies.

Being the center of excellence, its mission is to:

- train an elite of mathematicians in the vast field of research and development;
- provide mathematics education that is adapted to the needs of business and industrial engineering;
- ensure the training of high-level executives in various specialties of Applied Mathematics.

4.4. Study Sample Population

The study target population included: University teachers teaching different courses in English and students enrolled at NHSM.

The students, male and female, who volunteered to participate in the study, were from different regions. They have more or less a similar level in mathematics but their level in English varied from average to excellent. The English teacher in the School, who was of great support, participated also in the PBL unit with valuable advice and feedback, and the Dean was kind enough to authorise the study.

University teachers were also invited to participate in the study, but many did not honour the invitation. Although the number of participants was not large enough, the researcher was provided with valuable information that enabled her to gain a deep understanding of the case regarding the implementation of PBL. All the participants were certified teachers with a minimum experience of two years in teaching at university. For ethical reasons, no name was mentioned in the form used by the researcher during the interview.

4.4.1. Sampling Techniques

The researcher was interested in involving teachers in the research to get their views regarding ID incorporation and PBL as part of an ID syllabus. The choice of participants was random. Participating teachers exercised in different universities throughout the country.

The English teacher, in the department of mathematics, was also involved in the research as she expressed her wish to support, assist and provide all the conditions for effective and deep investigation. Part of her generous, kind and unconditional support was the provision of: lesson plans, data about the school, background of the students, and chief above all her time.

4.4.2. Sample Size

Only twenty six students (n= 26) studying at NHSM were involved in the study and nine (9) teachers from various universities inside the country. The total sample size, then, comprised thirty five (35) subjects.

Polit and Beck (2004 , p. 289) define a sample population in a study as a group that has has to adhere to meet a set of criteria. The target population which the researcher would like to build her claims on in this study was teachers teaching any subject in English and investigate to what extent they apply ID approach using PBL in the way it is recommended. The information obtained could enable the researcher suggest ways to improve PW work implementation

4.5. Research Instruments

The researcher used three different research instruments: interview, non participant observation and a questionnaire to obtain sufficient information on the incorporation of PBL in ID syllabus, analyze the data and get correct conclusions.

4.5.1. Interview

A semi-structured interview guide protocol (Appendix I) was used to enable the researcher get information about PBL, its potential in connecting different disciplines and link the information with the data collected from the students' questionnaire.

During the interviews, which were flexible, collegial and friendly, the researcher interacted with the respondents with a stress, free spirit using open-ended questions, which enabled the participants to express themselves freely. With the use of open ended questions, the researcher was able to ask for clarifications whenever there was a felt need.

The interview provided information about teachers' perspectives concerning the implementation of PBL and the questions focused first how well teachers were familiar with ID instruction and how they conducted PW. The participants' responses were so profound and revealing that the researcher was highlighted about the barriers challenging the use of PBL within an ID syllabus

4.5.2. The Questionnaire

In this study, a self-constructed five section questionnaire was administered and distributed to students (Appendix J).

4.5.3. Non-Participant Observation

In addition to interview and survey as research instruments to collect data, a non-participant observation was added to get in an depth knowledge of the study. Indeed, non-participant observation is more and more used as a valuable tool in qualitative research studies. Marshall and Rossman (1989) define observation as "the systematic description of events, behaviors, and artifacts in the setting chosen for study by the researcher" (p.79). By using observation as a tool, the researcher can get a snapshot of the situation in the natural environment of the participants while performing an activity. It is quite valuable as it provides the researcher opportunity to:

- work in a context that would guide her in constructing an interview protocol or guide as underlined by DeWalt & DeWalt (2002).
- be exposed and involved in the routine of the participants and in the setting chosen by the researcher (Schensul, Schensul, & LeCompte, 1999, p.91).
- determine how the participants behave, how they use their time on the activity…. (Schmuck, 1997).
- increase the validity of the study in addition to interviews, surveys…, (DeWalt & DeWalt, 2002).

Being present on site and in touch with the participants over a period of time would lead to the researcher's involvement in the process of experimentation and eliminate any negative reaction towards an outsider.

All in all, the decision to use observation as an instrument was motivated by the researcher desire to gain an in-depth understanding of how the students interacted with one another when working on a task as a group. For this purpose, the researcher attended three

sessions in October, 2024 as a non-participant observer using an observation checklist (Appendix K) as a tool for taking for in field notes.

4.6. Validity and Reliability of the Instruments

Validity and reliability are important for establishing the rigor of a study, and for influencing the acceptance of its results in practice. They both help comparing different studies and generalizing findings and make informed recommendations.

4.6.1. Validity

Validity seen by Bond (2003, p. 179) as the core of any form of assessment that is trustworthy and accurate, refers to the degree to which a tool measures what it is intended to measure. It is crucial for ensuring not only that research outcomes are accurate and meaningful but enables the researcher to draw appropriate conclusions, make informed decisions based on the findings and enhances the credibility and applicability of the results.

To ensure validity in quantitative research, there should be congruency between study data collection tools and theoretical constructs (Bannigan and Watson, 2009); otherwise, the results cannot be said to be valid. On the other hand, qualitative validity refers to the experience of both the subjects and researcher and biases that might influence their perspectives regarding the topic being researched (Golafshani, 2003). Since the researcher neither taught the subjects (students), nor met the interviewees but one, the possibility of influence, regarding participants' responses was minimised.

4.6.2. Reliability

A test is seen as being reliable when it is used by a number of different researchers under stable conditions, with consistent results and the results not varying. It can be seen as a degree to which a test is free from measurement errors (Heale & Twycross, 2015). Because reliability is crucial to ensure that the quantative research findings are replicable and trustworthy, the data collection tool was used both at NHSM and Ghardaia University to yield consistent results. As for for the qualitative reliability it was ensured by documenting verbatim transcripts of individual accounts, record keeping as recommended by Merriam and Tisdell (2016).

Overall, validity helps the researcher to determine either the questionnaire is good for the survey research or not while reliability refers to the consistency of the result. Whether quantitative or qualitative method is used, it should be ensured that the results are credible. Non-participant observation has helped in ensuring the reliability and credibility of the results obtained from the students' questionnaire.

4.7. Data Collection Procedures and Analysis

Triangulation was used as the main data collection procedure. According to Cohen and Manion (2002) triangulation refers to the use of more than one technique of data collection. The instruments used were: online questionnaire, interview, and non-participant observation.

4.7.1. Questionnaire

In this study, a self-administered structured questionnaire (Appendix J) was used. Polit and Beck (2004, p.729) define questionnaire as: "an instrument for gathering information from respondents through self-administration of questions in a paper-and-pencil format". In another research paper, Polit & Beck (2017, p. 275) affirms that a self constructed questionnaire eliminates all biases.

To obtain data, students were asked to fill in an online questionnaire. Indeed, thirty nine subjects participated in the survey. Once the deadline was reached, the researcher thanked all the participants, shut down the site and started the analysis. The designed questionnaire helped to generate interesting information on the applicability of PBL using the ID approach.

4.7.2. Semi-Structured Interview

Prior to conducting the interview, the researcher:

a. contacted the subjects by phone or email;
b. informed them about the purpose of the study;
c. asked permission to record the converstation;
d. agreed on a meeting convenient to subjects via Skype.

The study was designed to conduct one interview with each teacher with the purpose of extracting data. A semi-structured interview guide form, following a protocol and consisting of open-ended questions was used in the study and all the questions in the interview guide were relevant to the research questions ((Appendix I).

The advantage of semi structured interviews is that the interviewer has the opportunity to ask for clarifications by asking probing questions. Very often, in semi strutured interviews, the conversation leads to a topic that was not in the the researcher's mind, giving in this way more insight about the data.

Nine university teachers participated in the interview via Skype as it was the most appropriate tool for all the participants. The interviews, which lasted from 33 to 90 minutes (see Table 1), covered teachers' familiarity with ID instruction, its challenges and benefits. Their view of PW implementation in a traditional was also discussed. Notes were taken during the interviews, and after the interviews the recordings were transcribed, used for analysis and led to gathering and obtaining valuable information.

Table 3.1.: *Interviews' duration*

Participants	Date	Duration
P1	06-09-2024	35
P2	08-0-2024	75
P3	08-0-2024	26
P4	09-09-2024	25
P5	11-09-2024	90
P6	19-09-2024	51
P7	22-10-2024	40
P8	12-11-2024	30
P9	24-11-2024	33

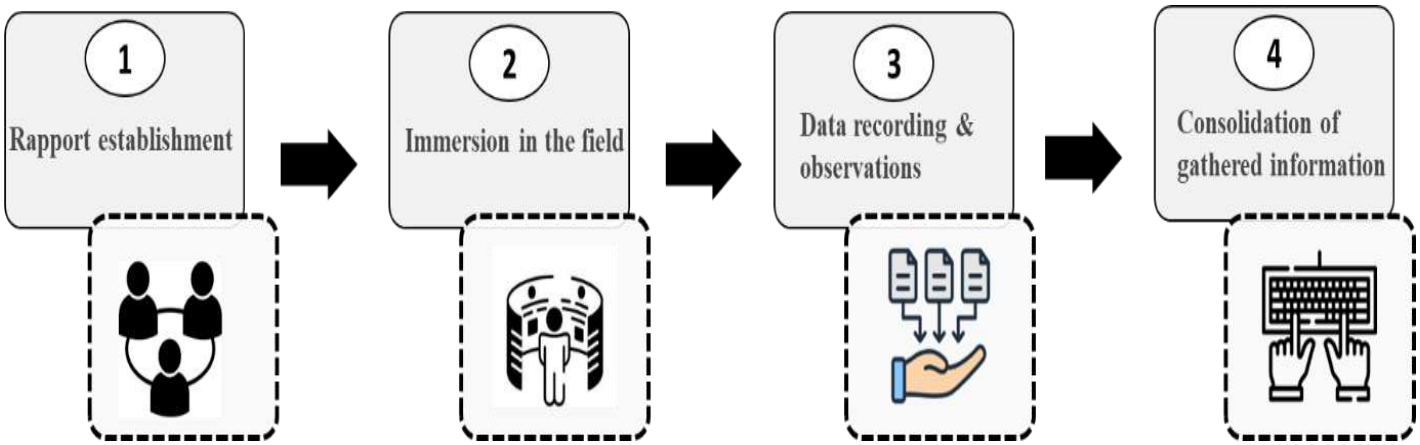
The transcribed notes were written in the form of narration to gather information, and the meaning was extracted from each recording to identify the similarities and differences among all recordings as advised by Rucker (2016). Indeed, the recorded conversations allowed the researcher to have the paticipants' statements verbatim (exact words) and replay them as many times as needed.

Guided by the research questions in chapter one and the interview protocol, the researcher was able to formulate more open-ended questions to guide the interview which allowed broader questions to determine how well teachers implemented PW, know about the barriers that hindered their implementation of PBL strategies and their experience with ID instruction.

4.7.3. Non- Participant Observation

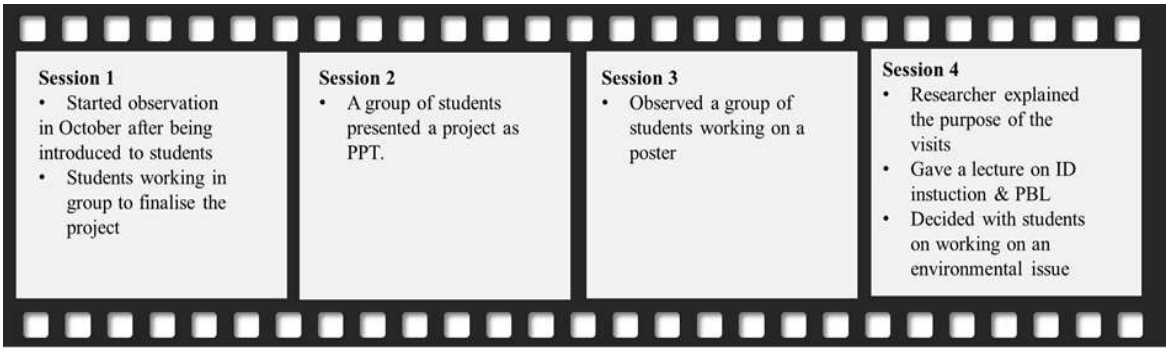
Upon the management's approval to conduct the study at NHSM in September, the researcher made four tips to Algiers in October and attended the sessions as a non-participant observer using Howell's stages (1972) described in *Figure 3.2.* to obtain more data and evaluate the participants' behavior over time in the students' environment.

Figure 3.2.: Howell's Observation Stages (Designed by the researcher)



The decision to use non- participant observation was motivated by the researcher desire to gain an in-depth understanding of how the students interacted when working on a task as a group. The snapshots of sessions attended the whole month of October were diagrammed as a sequence in Figure 3.3.. During the observation, the researcher noticed that the students were highly motivated in working in groups, and they used English most of he time. The atmosphere was relaxing and friendly. During the first session, the students were finalising a project titled "Start Up". In the second session, the student were tasked to design a poster about their own school (NHSM). Both of the projects were to be presented in front of visiting officials.

Figure 3.3.*: Researcher's Observation Film (Designed by the researcher)*



4.8. Data Analysis

Two methods were used in the study: Qualitative method and quantitative method. This section discusses the analysis and interpretation of data collected from the interviews administered to teachers, from field notes through non-participant observation at NHSM in October and from the survey.

Data collection and analysis for this study were completed in three phases: Semi structured interview, non-participant observation and questionnaire. In the first phase, nine instructors honoured the invitation. The questions in the interview were meant to generate data in a stress-free atmosphere where there was no tricky questions, no trapping. The researcher ensured that the interviews would provide insights about ID syllabus with PBL as pedagogy. In the second phase, twenty-nine students were subjected to observation during PW work instruction. The third phase commenced when the researcher dispatched a survey to all the students who conducted and/or presented a project in class or submitted it online. Responses in the questions were based either on a 4-point Likert scale (Strongly Agree, Agree, Disagree, Neutral, Disagree, and Strongly Disagree) or multiple choice statements.

4.8.1. Qualitative Methods

After completing the interviews (n=9), and transcribing while listening to the audios, the researcher proceeded to extract sentences related to the research questions and code them under patterns (Appendix L) .

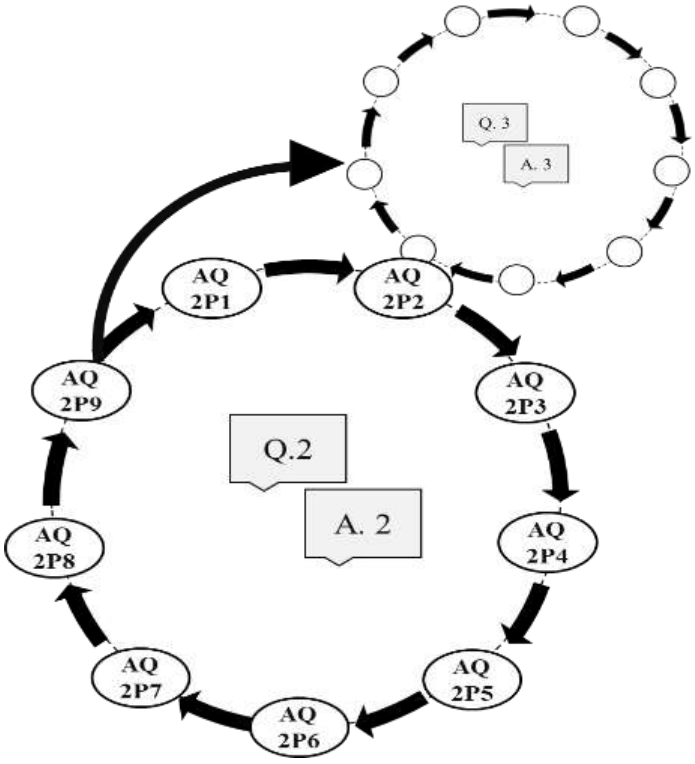
4.8.1.1. Teachers' Interviews

The researcher opted for a semi stuctured interview as it has the benefit of providing great opportunities to follow up on topics or issues that were not predicted in the interview guide, and, as a result of this, obtain valuable information on the subjects' views about the topic. The length of the interviews went on from thirty three minutes (33) to ninety minutes (90). Teachers' feedback on ID instruction was collected during interviews which were recorded and transcribed for further analysis. The interviews were not only characterised by getting insights about ID but also data on the barriers of its implementation. The transcriptions were printed after the researcher was done with all the interviews. After printing the transcriptions, the process of categorization started with the use of code for each category .

Then, on November 27, 2024, the researcher started analyzing data obtained from the subjects in this study. The analyses of the collected data were done in three stages. The first stage consisted of printing the transcripts of each participant while the second one consisted of compiling the responses of each question and reading them. After going through the reading and the compilation process, the researcher highlighted all the key words to obtain the frequency, or number and determine labels/themes.

The process used was cyclical making the researcher read each answer of each question nine times (Figure 3.4.). Such a process was valuable as it brought to the surface all the similarities, differences, and inconsistencies of the subjects' answers and the provision of a "sense of the whole" to use Bengston's terms (2016, p. 11).

Figure 3.4.: *Interviews' Data Collection Process (Designed by the researcher)*



The third step commenced when the researcher reached answer ten of the last transcript. The third step consisted of finding all answers, or key words relevant to the study's purpose by

compressing long responses to make the answers manageable as far data analysis is concerned as suggested by Kvale and Brinkmann (2009). By the end of the third step, three themes, quite relevant to the study, were pinched out of the data:

a. Teachers' perceptions and familiarity with ID (as shown in Table 3.3.)
b. Teachers' perceptions of students' attitudes (as shown in Table 3.4.)
c. Skills gained in a PW class (as shown in Table 3.5.)

To achieve this, all the conversations guided by an interview protocol were geared towards the research questions:

RQ1. To what extent are teachers familiar with ID instruction?

RQ2. To what extent are teachers familiar with project based learning in higher education?
RQ3. To what extent is ID using PBL as a tool is in alignment with the 21st skills acquisition?
RQ4. What are the challenges of using PBL in Interdisciplinary teaching of ESP?

The teaching experience of teachers who participated in the interview has been tabulated with the use of code as shown in Table 3.2. Table 3.2. presents demographic information for the population of participants (n=9) describing their years of teaching experience in HE. The table depicts that 11% from the population has less than four years experience in teaching as for instructors whose experience varies from five to nine years, the table reports four subjects which corresponds to 45%. The remaining respondents' years of experiences varies from ten to fourteen years (22%) and more than fifteen years (22%). All of the respondents have taught and/or still in charge of more than one course.

Table **3.2.:** *Years of Experience*

Years of Experience	Code	Number of Subjects	%
0- 4	A	1	11%
5-9	B	4	45%
10-14	C	2	22%
15-above	D	3	22%

On whether teachers were familiar with ID, 33% of the subjects surveyed said they were. Of these subjects (33%), two thirds (66%) applied it properly (bringing topics from other disciplines) which is in alignment with the 21st century learning skills. During the conversations the terms "discipline" and "subject" were often used interchangeably. The predominant opinion of teachers (66%) was that merging two modules could be viewed as ID teaching.

Nevertheless, all subjects who used PW (88%) said they used a rubric when assessing their students' work. As for topics choice, 50% of subjects said they assigned topics to students for the whole semester while 50% said they left it to the students' own discretion. All the participants agreed that giving a chance to students to present after working on a project would enhance greatly students' learning.

Table 3.3.: *Teachers' Familiarity with PW in ID Instruction*

Items	Code	Number of respondents (n=9)
Familiarity with ID instruction	FID	3
Use of projects in class	UoP	8
Alignments of projects with 21st century learning	A21	2
Assessment	UoR	8

The third step, which commenced when the researcher reached answer ten of the last transcript, consisted of picking out all responses, or key words relevant to the study's purpose. To make the responses manageable, the researcher proceeded by compressing long sentences as suggested by Kvale and Brinkmann (2009). The compression led to getting teachers' perceptions of students' attitudes in a PW class (see Table 4) and the skills gained when implementing a project unit (see Table 5).

Table 3.4.: *Teachers' Perceptions of Students' Attitudes*

Descriptive Adjectives	Code	Number of frequencies
Engaged	EN	6
Motivated	MO	5
Active	AC	5
Confident	CO	4
Responsible	RE	3

Table 3.5.: *Skills Gained in an ID Class Using Project*

Items	Code	Number of frequencies
Independent learning	S1	5
Teamwork	S2	8
Communication	S3	4
Critical thinking/ptoblem solving	S4	5
Public speaking	S5	5
Debating	S6	6

In an attempt to find out to students' attitudes in a PBL class and determine the outcomes, the researcher reread the transcripts and tabulated the most cited adjectives describing students' attitude when conducting a project (Table 3.4.). The most cited adjectives were: engaged, motivated, active, confident, responsible. Concerning the steps in conducting a project, of all subjects, only 22 % used it as a process while 88.88% followed the traditional way which consists of either assigning a topic or leaving it to students' discretion to choose.

Regarding teachers' collaboration, of the subjects interviewed, 22% said they met colleagues, not with the purpose of collaborating but most of the time with the purpose of enquiring about an issue while 78% (as shown in Table 3.6.) said. The respondents said there was no such a practice due to time constraints, differences in views. Worse perhaps, it was found

out that there was no collaboration even when the instructors shared the same the same course(s).

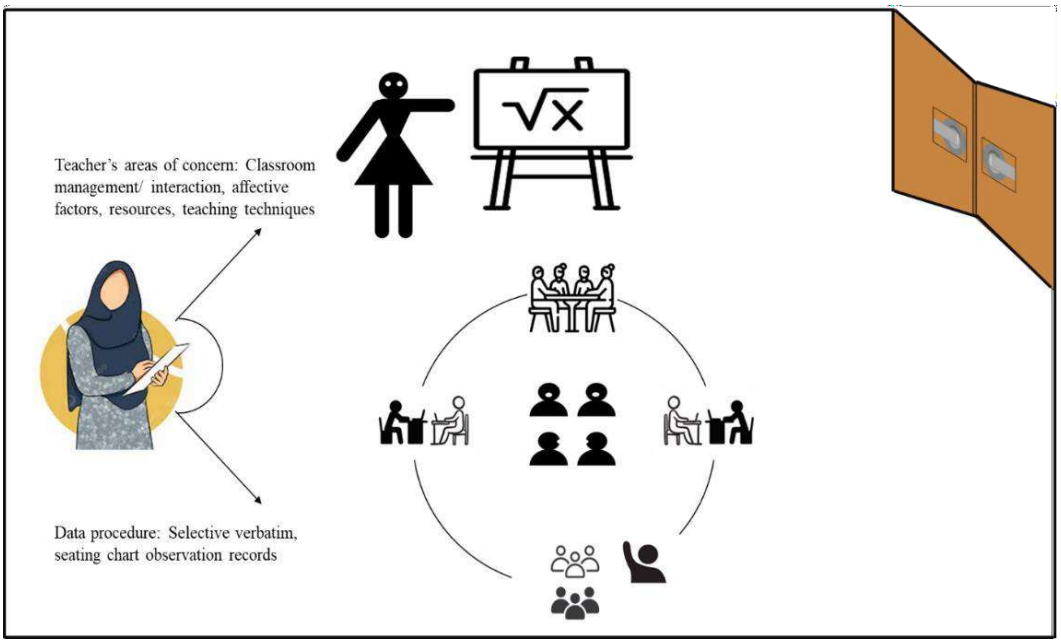
Table 3.6.: *Teachers' Collaboration*

Collaboration	Number of Respondents (n=9)	%
Partial Collaboration	2	22%
No Collaboration	7	78%

4.8.1.2. Non-Participant Observation

The non-participant observations conducted by the researcher were meant to find out about the students' behavior when working on projects in class in an English course for maths students. To achieve this, before embarking on the observation process, the researcher designed a checklist on the basis of Stoller's areas of concern (2003, pp. 24-25): Classroom management, classroom interaction, affective factors, resources, teaching techniques, and data collection techniques (Appendix M). During all the sessions, the researcher immersed herself within the students' community without being involved too much (Figure 3.5).

Figure 3.5.: *Observation Scene (Designed by the researchers)*



The non-participant observations revealed that the students were engaged in their projects throughout the class periods. There were five teams working on different projects (cited earlier). Each team was made up of five members with a team leader in each team.

Throughout the PW sessions, most of the students were fully engaged in conversing in English. The average students were also active and engaged in the discussion trying to benefit from their peers' expertise (ICT). Some students were giving suggestions regarding design and colours to be used in slides, while others were suggesting further touches. What was impressing was that no member tried to be authoritarian. It was quite obvious that students were used to working in groups with their English instructor. During the powerpoint preparation, students were excited to see their project finalised and presented in class.

In another group, the students were cooperating, sharing, exchanging information using one of their colleague's laptop. One feels that it was a mini family where every member was working for the benefit of the rest.

In addition to communication among all the members, a lot excitement and fun were observed not only because of the PW but because the atmosphere in such a class was different from the traditional one. Indeed, the students felt they were autonomous, free to move around the class. On one occasion, one student was solicited by another group to resolve a technical issue on removing a slogan from a picture.

In effect, the researcher did not pinpoint any boredom or negativity regarding the PW activity on the part of the students. On the contrary, every member felt motivated in contributing to the success of the group.

It would be unfair not to mention the role of the teacher in this unit (PW). Although, much of the focus was on students, it could not be helped to highlight the five areas suggested by Stoller (2003) when observing teachers:

- Classroom management: Discipline quite obvious, lesson well planned, group cohesion…;
- Classroom interaction: Balanced teacher's talking time- students' talking time, interaction between all members in class, high level of participation…;
- Affective factors: Class characterised by positive attitude towards learning, trust building, motivation, positive teacher's feedback;
- Resources: Blackboard frequent presentations; handouts; laptops, data show;

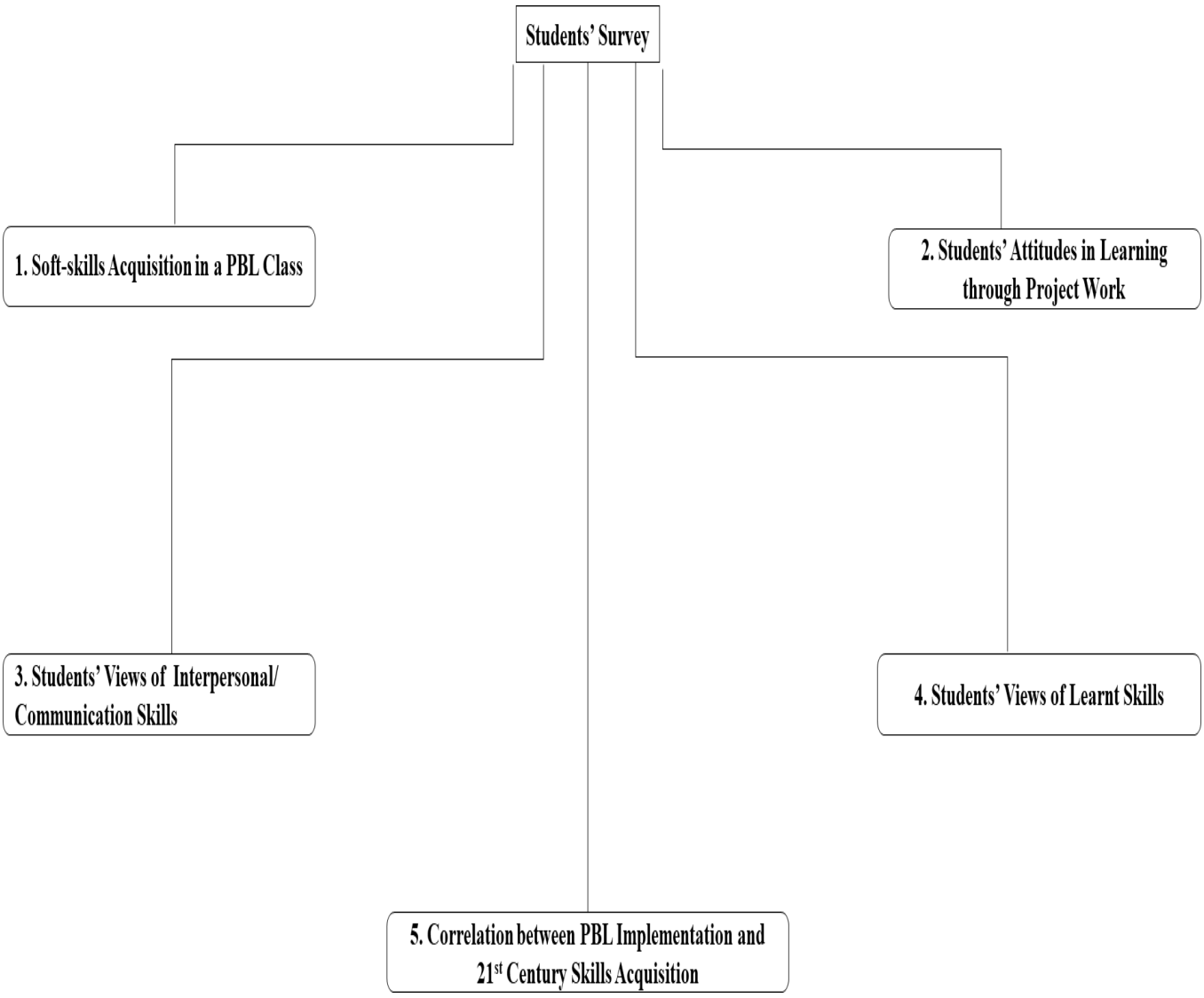
- Teaching techniques: Clarity of instructions, feedback provision, high order questions.

The observation provided the researcher with valuable information not only about about the group dynamic and how members communicated with one another and their level of engagement in the learning process but also about the instructor whose teaching practices were in full alignment with modern education.

4.8.1.3. Quantitative Method

In this section data obtained from the online survey with thirty nine respondents (n=39) are presented. The survey (Figure 3.6.) comprising five sections is diagrammed below.

Figure 3.6.: *Survey Description (Designed by the researchers)*



Section one: Soft-skills Acquisition in a PBL Class

Number of respondents: 39

Table 3.7.: *Soft-skills Acquisition*

Statements	Number of responses 39	Code	%
a. How do you think project-based learning impacts your motivation?	39	ME	**84.6%**
		MD	**7.79%**
		CS	/
b. Which of the following was/were developed after working on several projects?	13	CT	**33.3%**
	23	COM	**59%**
	18	COL	**46.2%**
	25	CRE	**64.1%**
c. What skills do you think project-based learning helps develop?	16	PS	**41%**
	16	TM	**41%**
	13	LEA	**33.3%**
	3	PSK	**7.7%**

Table 3.7 indicates that an overwhelming number of interviees (84.6%) said that PW increased their motivation in learning. Of the four Cs (critical thinking, communication, collaboration, and creativity), the highest perecentage went to creativity and innovation followed by communication (59%). In response to what skills students developed, a percentage of 41% was given to both problem solving and time management.

Section 2: Student's Attitudes in Learning through PW

Number of respondents: 39

Table 3.8.: *Students' Attitudes in Learning through PBL*

Student's Attitudes in Learning through Project Work

Statements	Number of responses	S A	A	N	D	SD
a. Project-based learning engages students in the teaching learning process.	39	15	12	8	4	/
		38.4%	**30.7%**	**20.5%**	**10.2%**	/
b. Project-based learning increases levels of interest and participation.	39	17	16	/	4	2
		43.5%	**41%**	/	**10.2%**	**5.1%**
c. Project-based learning improves attendance.	39	15	21	3	/	/
		38.4%	**53.8%**	**7.6%**	/	/
d. Project-based learning promotes student-teacher relationship.	39	14	18	7	/	/
		35.8%	**46.1%**	**17.9%**	/	/
Mean		**39%**	**42.9%**	**11.5%**	**5.1%**	**1.2%**

There were thirty-nine responses for each of the four questions in section two. Of all the respondents, an average of 39% strongly agreed with the four statements. When moving to the seond column, the percentage is a bit higher with 42.9% of participants who agreed. Within

the same column, the attendance parameter got the highest percentage (53.8%). The mean of those who gave no response was 11.5%. The students (n=4) who disagreed constituted 10.2% for statements ‘a’ and ‘b’ with no response to statements c and d. The fifth column saw only 2 responses (5.1%) for the first two questions while no response was given to the statements a and c.

Section 3: Students’ Views of Communication/ Interpersonal Skills

Number of respondents: 38

Table 3.9.: *Students’ Views of Communication/ Interpersonal Skills*

Statements	Number of responses	Code			
		GE	SW	VL	NA
a. I improved my social skills when meeting and talking with my classmates during the project process.	38	**39.5%**	**42.1%**	**18.4%**	/
b. Working on several projects made me accept other people’s ideas when they were right.	38	**52.6%**	**23.7%**	**18.4%**	/
Mean		**46%**	**32.9%**	**18.4%**	
c. I learnt how to listen actively to my colleagues while on task.	36	**69.4%**	**22.2%**	**8.3%**	/
d. Working in groups helped me generate ideas and share them with group members confidently.	38	**55.3%**	**26.3%**	/	**7.9%**
e. I learnt how to ask and respond appropriately among group members.	38	**26.3%**	**52.6%**	**18.4%**	/
Mean		**50.3%**	**33.7%**	**8.9%**	**0.8%**

Table 3.9. can be split into two sub sections: Communication skills and interpersonal skills. Statements “a” and “b” come under the communication skills heading while “c”, “d”, and “e” have been categorized as interpersonal skills. In the communication skills section, 46% of participants said they saw their social bonds improved between members of the group to a great extent. The listening skill got the lion’s share with 69.4% of respondents who claimed that they developed greatly their listening skill by becoming active in the listening process. With a mean of 50.3%, it can be said that students improved their interpersonal skills to a great extent compared to communication skills 46%.

Section 4: Students' views of Acquired Skills

Number of respondents: 37

Table 3.10.: *Students' Views of Acquired Skills*

Statements	Number of responses	Code			
		GE	SW	VL	NA
a. Good team-work contributes to the successful outcome of the project.	38	**78.8%**	**20.5%**	/	/
b. I got a better understanding of the topic when I participated in the project.	38	**60.5%**	**26.3%**	/	/
c. After working on several projects, my writing was…	37	**12.4%**	**15.9%**	**25%**	/

Constructs	GE	SW	VL	NA
Teamwork/Creativity	79%	21%	/	/
Engagement	61%	27%	/	/
Writing	13%	16%	25%	/

The figures in this table are revealing. 79% of the subjects believed that the success of outcome of the project be it presentation, product, picture…. is the result of the group as a whole. 61% of the subjects admitted that they understood the topic/theme when working in groups, sharing ideas and listening to others. Such a feeling shows the value of working together. As for the writing skill, of all the subjects participating (n=37), 25% reported that their writing did not improve that much.

Section 5: Correlation between PBL Implementation and 21st Century Skills Acquisition

1. What role do you think technology plays in facilitating your work to conduct your project? Select all that apply.

Number of respondents: 37

Table 3.11.: *Role of Technology in Conducting PW*

Constructs	Number of Responses	%
a. Research expansion	32	86.4%
b. Research facilitation	31	83.7%
c. Presentation support	35	94.5%
e. Information literacy	34	91.8%
f. Subjects connection	33	89.1%

Section 5 titled "Correlation between PBL implementation and 21st century skills acquisition" comprises two sub sections. Answer to question 1 in the first sub section gives data on the role of technology in supporting students to conduct their project. An overwhelming number of subjects (94.5%) said that technology contributed greatly in getting information, and presenting it in front of an audience. A great number of respondents said that not only did technology enhance their knowledge (91.8%) as far as computing is concerned but facilitated their research (83.7%). The fifth "construct" reveals that a great majority of students (89.1%) have realized that working on a project with a good driving question as a starter is very likely to be in need of more than one subject.

2. Please tick the option that best reflects how you feel.

Number of respondents: 38

Table 3.12.: *Knowledge Transfer*

Statements	Number of Responses	Y	N
a. The new method of project work helped me transfer knowledge from other subjects to finalise my work.	38	32 **84.2%**	6 **15.7%**
b. Using information from other subjects to complete the project made learning richer and connected.	38	31 **81.5%**	7 **18.4%**

Constructs	Number of Responses	Y	%	N	%
Knowledge transfer	38	32	84.2%	6	15.7%
Enriching experience in ID	38	31	81.5%	7	18.4%

The second sub-section provides further details and/or confirms the figures of the first sub-section. In statement "a" (labelled knowledge transfer), on whether the new method of PW allowed the students to transfer knowledge, 84.2% agreed to a great extent it did since they used their background of mathematics to calculate the percentage, the statistics…as opposed to 15.7% who did not feel they are able to apply knowledge in other field or use it. As for statement "b" (labeled enriching experience in ID), 81.5% said that they felt empowered by using different subjects to complete their project while as opposed to 18.4% who stated that their experience with ID istruction through PBL did not enhance their learning.

4.9. Findings

In this section, data results collected from observations, interviews and questionnaires are presented. This study aimed to investigate to what extent the use of PW goes beyond the teaching of convential skills and to what extent it promotes the acquisition of new ones that are in alignment with the 21st century schooling.

4.9.1. Qualitative Methods' Results

4.9.1.1. Teachers' Interviews

In line with the research questions and data analyses of the qualitative methods, the results of the research were based on two methods: semi-structured interviews and non-participant observations. After reading, compiling and compressing the participants responses, three themes were generated from the tabulation of the interviews: Teachers' familiarity with ID teaching, students' attitudes in a PBL from teachers' perspectives and skills gained in ID classes. The outcomes of the observations conducted as a researcher and as a non-participant observer provided the researcher with valuable information.

The three generated themes have been graphically represented through pie charts using a code for each theme (for codes refer to appendix L)

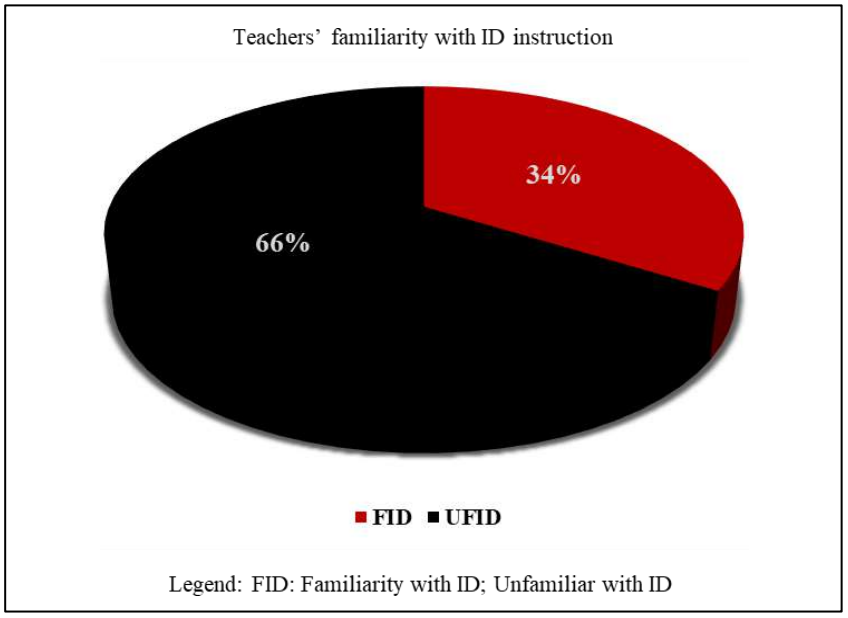
a. Project familiarity with ID instruction (Table 3)
b. Students' attitudes from teachers' perspectives (Table 4)
c. Skills gained in an ID class using project (Table 5)

a. Teachers' Familiarity with Interdisciplinary Instruction and Project work

The first research question, "To what extent are teachers familiar with ID instruction?, aimed to know whether teachers at the university level connected disciplines in their instruction.

The interviews revealed that of all the participants (n=9), three instructors (33.33%) were familiar with IDY (Graph 3.1.). Of the three subjects, only 22. 22% used it properly as per the literature review. It is worthy to note that interdiscplinarity was very often equated to merging subjects (modules) by an overwhelming number of teachers (n= 6). However, although teachers conducted PW differently, the great majority of the participants (n=8) used a rubric for assessment and provided feedback at the end of each presentation.

Graph 3.1.: ***Teachers' Familiarity with ID Instruction***

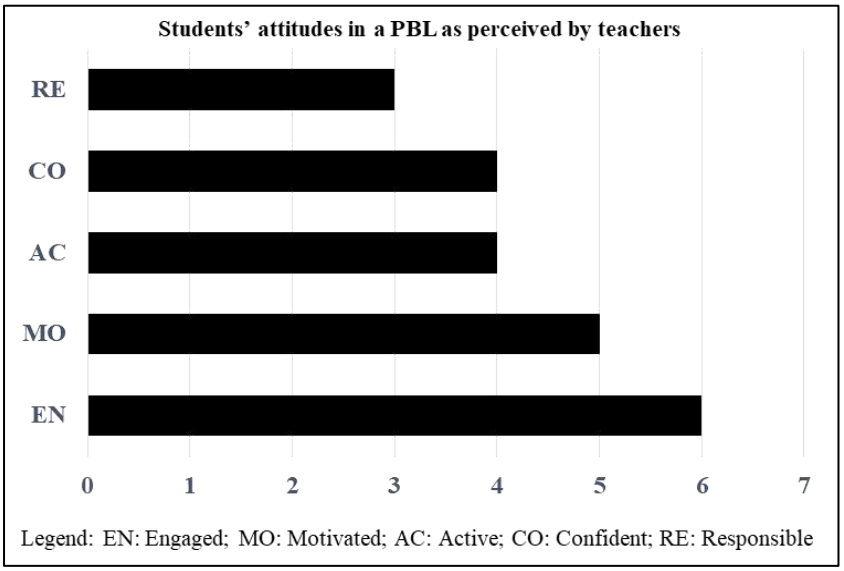


c. Students' Attitudes from Teachers' Perspectives

The histogram (Graph 3.2.) reflects teachers' views regarding their students' attitudes in a PBL class. Out of the twenty-one key words related to PW and 21st century learning, five descriptive adjectives surfaced: Engaged, motivated, active, confident, responsible. After tabulating the frequencies, the findings were represented in a histogram (Graph 3.2.) to highlight the number of utterances. Students' motivation holds the highest number. According to the participants, students' motivation resulted in the increase of attendance level. The number of the attendance item is similar to that of collaboration. When implementing PW, the items "participation" and "autonomy" came up five times as students felt they were active and responsible for their own learning. It was stated in the interviews by an overwhelming number of teachers that in being autonomous, the students approached kearning with a high level of commitment, dedication and cooperation when working in groups. The participants said that

unlike, lecture based approach, students were fully engaged because they felt that each member with different learning style can conribute to the final outcome.

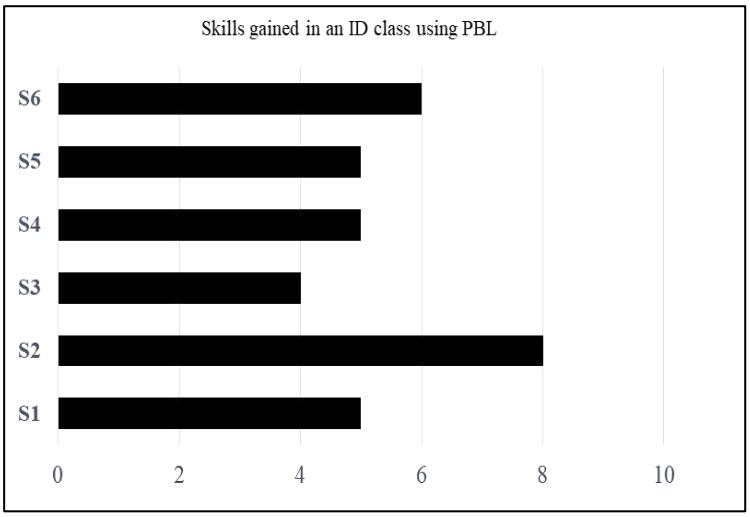
Graph 3.2.: *Students' Attitudes in a PBL as Perceived by Teachers*



d. Skills Gained in an ID Class Using Project

Feedback from the participants revealed that PW implementation led to the acquisition of several skills related to 21st learning all of which are depicted in highlighted in Graph 3.3.

Graph 3.3.: *Skills Gained in an ID Class Using PBL*



Working in groups (teamwork) was mentioned eight times. The majority of participants (22.22%) said that working on projects made students develop collaboration and teamwork skills. Working in groups not only made them responsible but tolerant and flexible in accepting colleagues' opinions as well which developed other skills like flexibility and adaptability. This finding is in line with the recent studies of Choi, Lee and Kim (2019) who found out that PBL being a student centered form of teaching provides opportunities for students to work collaborative projects, develop creativity and solve problems.

A large proportion of participants 19.44% cited "debating" was promoted in a variety of ways such as asking questions, answering questions, defending an opinion, negotiating, or highlighting a point in the project. This implies presenting in front of audience enabled students to develop their public speaking skill. Debating as a skill had an indirect significant influence in encouraging reluctant or shy students to improve their speaking skill. This finding is also in consistency with the recent studies of Artini et al. (2018) regarding to the development of the speaking skills in a PBL class.

The implementation of PW in class promotes independent learning as mentioned by the participants five times (13.88%). As for communication, it was cited four times in eight interviews. Nearly (13.88%) of particiants reported that PW promoted students' social relationship between students who demonstrated active involvement to solve the problem or issue raised in their project (13.88%) in a critical way. Upon examining the skills cited by the participants, it comes to the reader's attention that they are all compatible not only with 21st century learning but with 21st century students' way of learning as well.

One of the interesting findings is that PW has the power of not only encompassing several skills, in alignment with the requirements of the 21st century, but stimulating students to experience authentic situations and transfer information gained in their real-life.

4.9.1.2. Non- Participant Observation

During the researcher's observation, it was evident that the students were fully engaged in the task. When attending the sessions, one feels that the students were not only enjoying the activity but learning other skills like: collaboration, communicating, problem solving, sharing ideas, etc. In sum, this mode of teaching, as observed by the researcher, was taking them beyond academic content skills making earning more personalized and according to their needs and

styles.

Many students showed positive attitudes when working in groups. In terms of behavior, during the whole sessions, the students were not distracted doing something else. On the contrary, they were focused and interested either in learning, explaining, or sharing. From the affective point of view, the students were enjoying being together in small groups and working on a task.

Based on the researcher's observations and notes, one of the findings that emerged was that they (field notes) were in full consistency with the literature about the advantages of PBL. The researcher was able to find out that there was consistency between the interviews, the questionnaire and the theoretical research. Students were seen to display enthusiasm, excitement, motivation, and a high level of engagement to come out with a product. During the sessions, not only were the students developing skills like: creativity, collaboration, communication, critical thinking, but they were also learning the value of managing their time and responsibility. As a result, it can be claimed that to some extent that the findings are a representation of reality of what happens when PBL is implemented effectively.

In sum, the analyzed data, obtained from the sessions as a non participant, seems to be in line with the literature about the effectiveness of PBL in promoting students' engagement.

4.9.2. Quantitative Method's Results

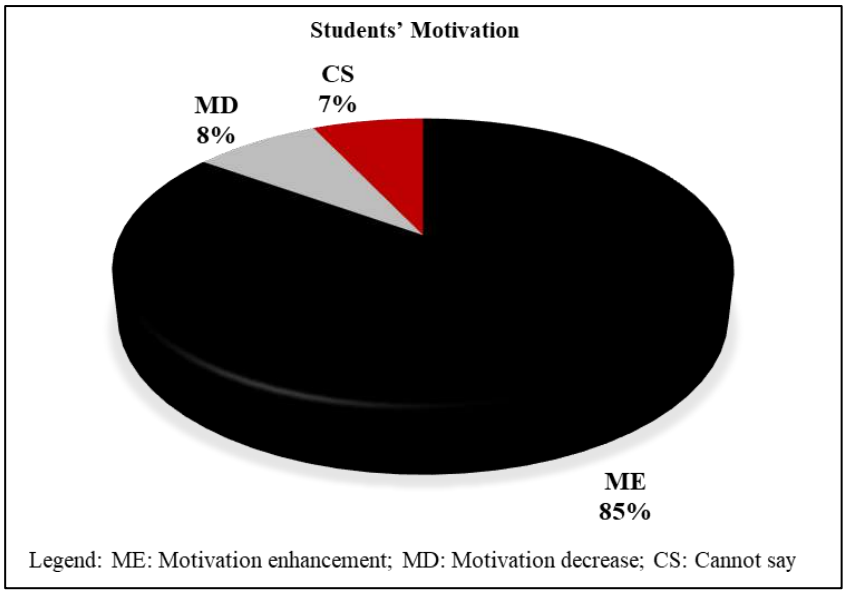
The purpose of this study was to find out not only to what extent teachers were familiar with ID instruction (1), the way PW was conducted (2) but explore the experience of participating students' in a PBL unit. The students who participated in the experience were enrolled in the department of mathematics at NHSM. At the end of the project and after its submission, students were asked to participate in the online survey related to their work on the project which lasted three weeks. Thirty nine students who participated in the five section survey answered most of the questions. Some of the items have been coded according to themes. The five sections were:

Section 1: Soft-skills Acquisition in a PBL Class (Table seven)
Section 2: Student's Attitudes in Learning through PW (Table eight)
Section 3: Students' Views of Communication/ Interpersonal Skills (Table nine)
Section 4: Students' Views of Acquired Skills (Table ten)
Section 5: Correlation between PBL Implementation and 21st Century Skills Acquisition (Tables 11 and 12).

Section 1: Soft-skills Acquisition in a Project Based learning Class

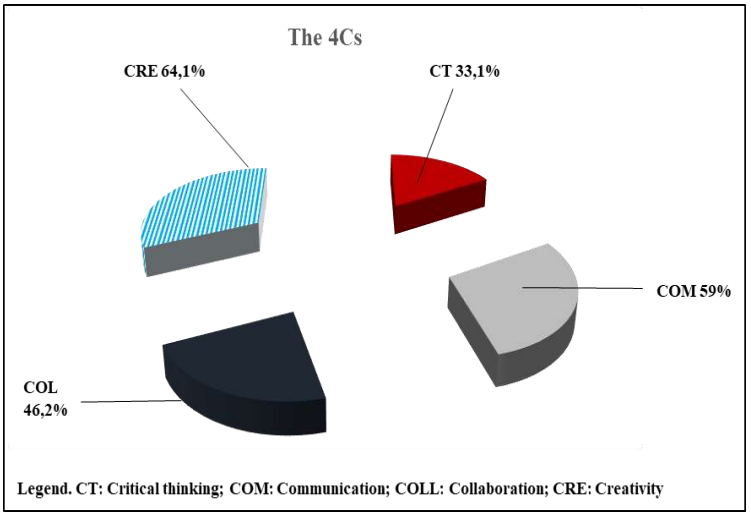
The responses to section one were all reported in percentage form as illustrated in Graph 3.4. (refer to Table 7 for corroboration). Regarding PBL's impact on students' motivation, the results are significant. The data in the bar graph shows that on the adoption of PBL in an English class, 84.6% reported that they were highly motivated them while 7.79 said it did not promote their motivation.

Graph 3.4.: *Students' motivation in an ID class using PBL*



Students' motivation is certainly due to the fact that working in groups enhanced three main skills: creativity (64.1%, communication (59%) and collaboration (46.2%) as showcased in the students' responses to questions two and three in Graph 3.5. The majority of the respondents mentioned that such an activity helped them greatly develop these skills of all of which are part of 21st century learning. The results displayed in Graph 3.5. imply that the implementation of PW incorportated the 4Cs (creativity, collaboration, communication, critical thinking) without teaching them openly and that all the group members communicated and collaborated to solve a problem and share it with their audience by creating a product (Table 3.7).

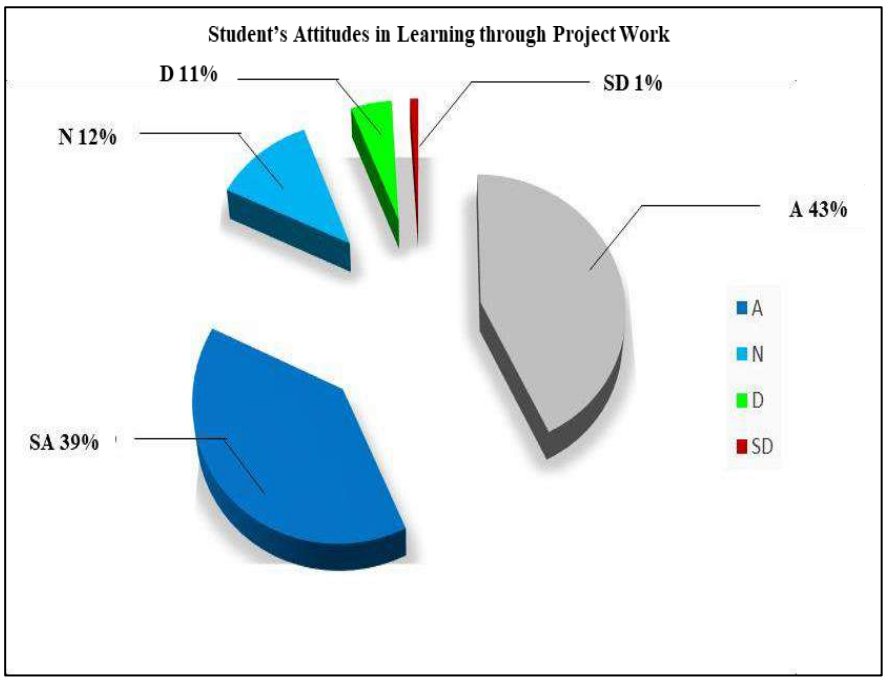
Graph 3.5.: *The Four Cs*



Section 2: Student's Attitudes in Learning through Project Work

Section two which includes four statements revealed that 42.9% of the respondents agreed that PW made them more active in the teaching learning process. Within this column, high percentages have been recorded when it comes to attendance and level of participation (41%) which is in line with students' engagement. The positive feedback towards PW improved teacher's – students' relationship according to the results (refer to Table 3.8. for corroboration).

Graph 3.6.: *Students' attitudes in learning through PW*



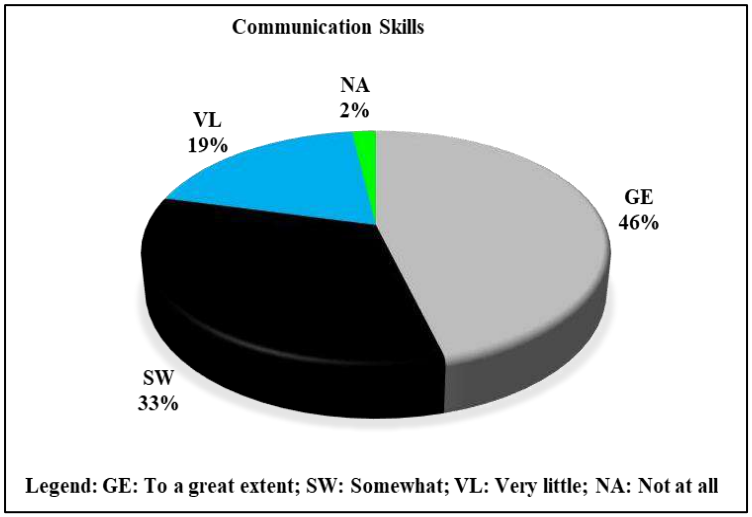
The results in this section reinforce those depicted in section one. For statement "a" of all the subjects (n= 39), most of the respondents (n= 27), that is, 69.1% felt that PW made them engaged in the teaching learning process in comparison to the remaining number of respondents (n= 12) with a precentage of 30.7% . For statement "b", 84.5% of those who strongly agreed and agreed said that the use of PW increased their level of interest, engagement and participation. These findings are consistent with the results for statement "c". With 92.2% of the respondents, it can be deducted that PW classes have led to an increase of students' attendance. Reponses from students regarding statement "d" indicate that PW classes have fostered teacher's – students' relationship (81.9%). The number of respondents who expressed negativity or neutrality towards PW ranged from 6 to 12 with a percentage of 42.7% for statement "a", 16.3% for statement "b", 7.6% for statement "c".

The findings reveal that not only did PW classes motivate students but increased the level of participation, engagement and attendance.

Section 3: Students' Views of Communication/Interpersonal Skills

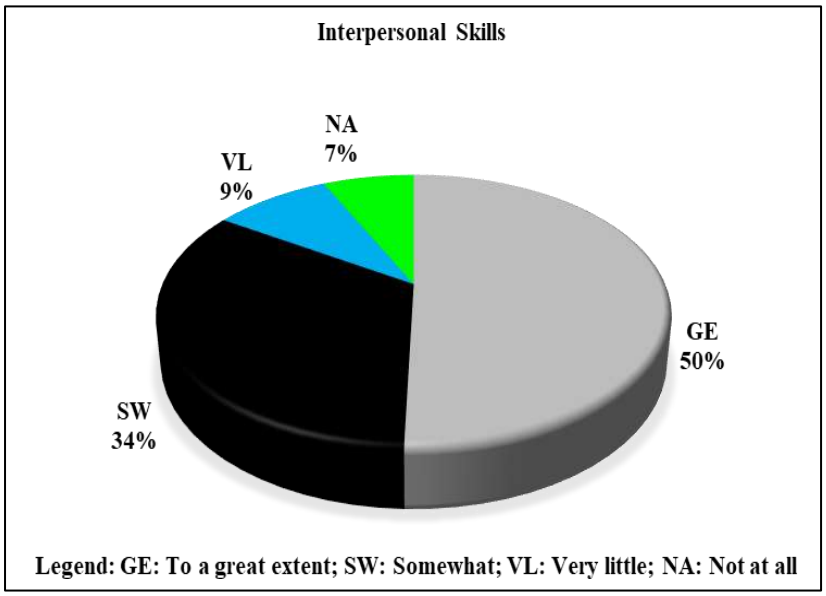
Social skills' improvement (statement a) and accepting peers' ideas (statement b) have been sheltered under "communication skills" heading. 46% of respondents said that to a great extent, they saw their social skills improved after meeting with peers and teacher to discuss the project. For the same statements, 33% found to some extent their social skill improved when they got involved in the task (project). This implies that students by working together learnt from each other or impacted on each other.

Graph 3.7.: *Students' Views of communication skills*



Sheltered under "interpersonal skills", active listening (statement c), sharing ideas (statement d) and enquiring (statement e) provided valuable information about interpersonal skills. Fifty-one percent of respondents (51%) reported that when working in groups for a project felt their listening skill enhanced which in turn affected their way to asking questions and responding to questions while 34% reflected to some extent their interpersonal skills like sharing, listening and responding were enhanced. Nine percent of the respondents said they witnessed very little interpersonal skills' improvement. The remaining percentage refers to the population that did not provide any response (refer to Table 3.9 for corroboration).

Graph 3.8.: *Students' Views of Interpersonal Skills*

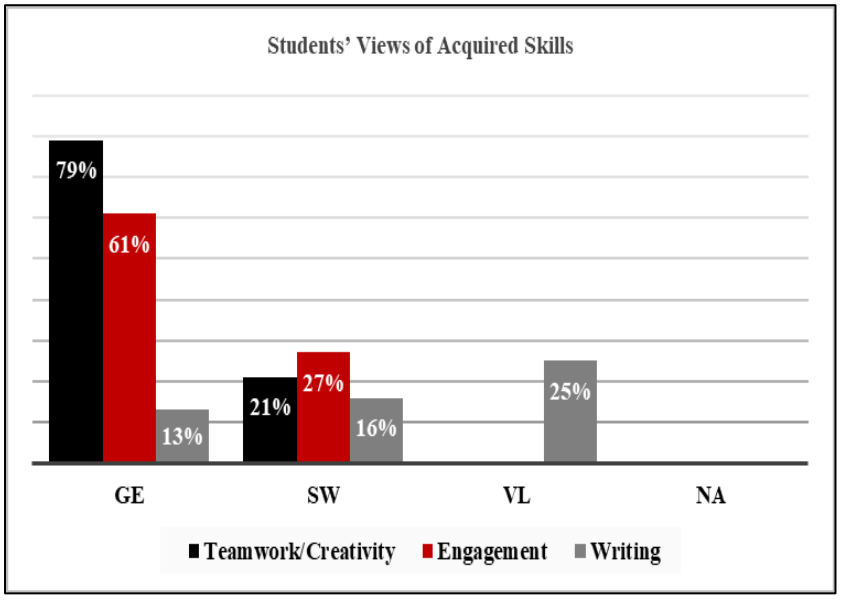


Section 4: Students' Views of Acquired Skills

The result of 79% for the teamwork and creativity construct showcases that working together with the purpose of creating a product impacted positively on students' motivation to learn. Being different from traditional classes where most of the teaching is administered by the teacher, respondents expressed their preference to work in an environment whereby they are part of the learing process instead of sitting and listening for long hours to their teacher. Sixty one percent reported that they felt fully engaged during the whole period of their project conception. The statistics proved that, PBL as an approach, promotes independent learning, collaboration, communication all of which lead to experiencing real life situations. However, only 13% reported that their writing skill has largely improved while 16% claimed it has somewhat improved. These findings can be said to be acceptable as the respondents' main

objective of learning English was not for academic purpose or career but for personal use as explained in one of their informal meetings with the researcher (refer to Table 10 for corroboration).

Graph 3.9.: *Students' Views of Acquired Skills*



Section 5: Correlation between PBL Implementation and 21st Century Skills Acquisition

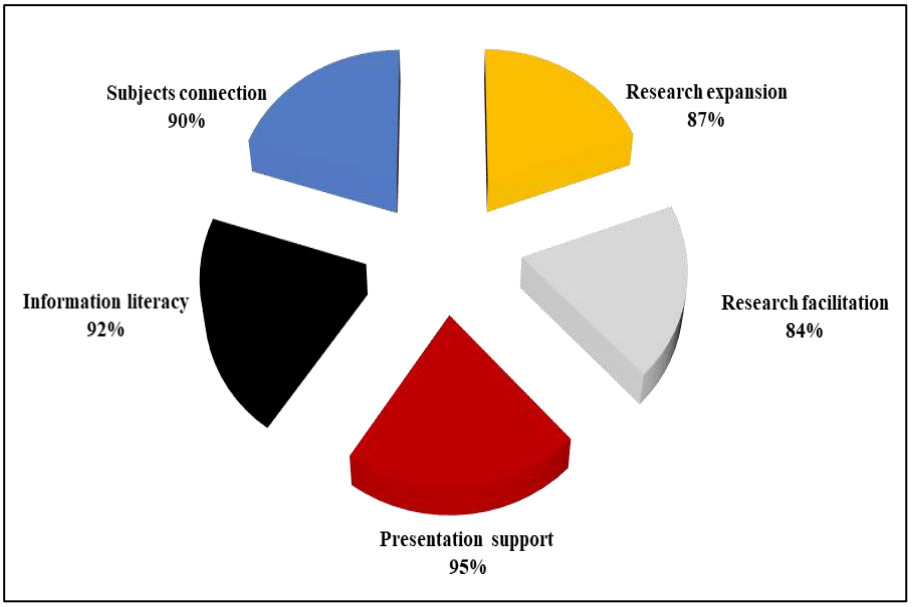
1. What role do you think technology plays in facilitating your work to conduct your project?

On the role of technology, 95% of the participants reported that technology supported them in visualizing information and making it more interesting and understandable (Graph 3.10.). As such, they felt more confident in speaking in public using mulitimedia. This implication is significant as it correlates with the results of information literacy. Ninety two percent (92%) of the subject said that their computing skills have greatly been enhanced (making tables in powerpoint, inserting images/videos….). Also, working in groups with more knowledgeable classmates made them understand several issues. Ninety percent (90%) felt that after working on their project, they realized that without some subjects they would not have been able to conduct their work properly.

The results of research expansion (87%) coupled with research facilitation (84%) indicate that technology has not only a wide body of opportunities to get information but facilitated its presentation. Together these two results display the power of technology in a PBL

class in giving students a chance to search for information about a given topic, learn how to synthesize it and present it in a form of a product (refer to Table 3.11. for corroboration).

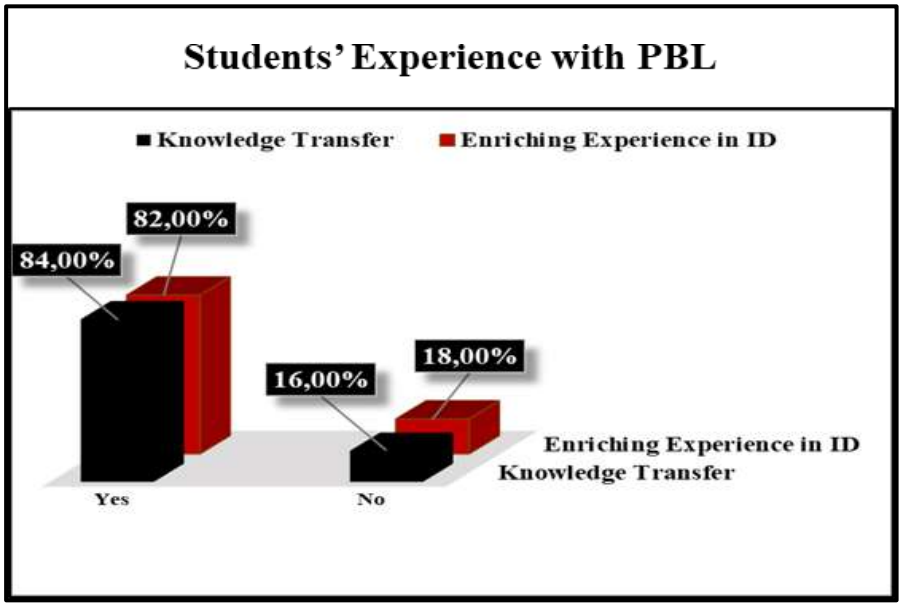
Graph 3.10.: *Role of Technology in a PBL Class*



2. Please tick the option that best reflects how you feel.

The results in this graph are consistent with the results in the previous question. In effect, PBL enabled students to transfer their knowledge (mathematics) in other fields, and applied it through graphical representation. Eighty four students (84%) reported that PBL made them use more than one subject, and 82% said that being a non convential way of working on a project, PBL was a rich experience. Based on the results, with such a pedagogy, students learnt by doing in a stress free environment (refer to Table 12 for corroboration).

Graph 3.11.: *Students' Feedback on Knowledge Transfer*



4.10. Ethics

To collect data, the study used three instruments: semi structured interview, non-participant observation and a questionnaire.

For the semi-structured interview, the researcher ensured that the rights of teachers participating in the interview are protected. Upon meeting with the participants first via phone, the researcher informed them about the purpose of the study, and the need of data to get an indepth understanding of the topic. The participants were also informed that the conversation would be recorded, and then transcribed with the researcher's assurance that all the forms will be anonymized and confidential. All the interviews were conducted at teachers' time and day convenience. During the interviews, the researcher was careful enough about the wording (choice of words, question framing…) to avoid any offence.

For the second instrument, non-participant observation which started in **S**eptember 2024, the researcher paid a visit to the General Director of NHSM in person on site and explained the purpose and importance of the study, and the findings it will generate for the benefit of education. The General Director of the school was kind enough to grant permission to conduct the experiment within the NHSM premises with mathematics students. In addtion to this, researcher was authorised to attend also the English classes in order to conduct the research

after which the researcher met with two teachers in charge of the English course. Both teachers welcomed the idea of attending their classes after the researcher had explained the importance of observing students while on task to gain an in depth understanding of mathematics students studying English and informed them that it was purely for academic purposes.

For the questionnaire, since students were to be involved directly (by seeing the researcher often in their class) and indirectly (by participating in the survey), there was a felt need to inform them of the importance of the study and the result it will generate. After lecturing the students in October, the students accepted to take part in the study voluntarily.

4.11. Summary

The results from the instruments used in this study revealed that the implementation of PBL in a language class provided opportunities for students to work on their own in a stress free setting with a high level of motivation and engagement. Unlike conventional teaching based on lectures, handouts and textbooks, students made sense of their learning. They perceived it (learning) as a rich, authentic and long lasting positive experience.

The data of the first research question "To what extent are teachers familiar with ID instruction?" when referring to the analysis of the interviews revealed that most of the interviewees (66%) used it interchangeably with "merging subjects". In one interview, one participant expressed his/her wish that training programs should be frequently scheduled so that teachers can benefit from one another since there was no collaboration amongst teachers (22%). However, despite teachers' varied answers as regard to ID instruction, an overwhelming majority of teachers agreed that the implementation of PW, though traditionally, in class promotes relationships among team members and fosters students' engagement. Such a finding is in line with the studies of Pinter and Cisar (2018).

Data taken from the interviews regarding the second research question "To what extent are teachers familiar with project-based learning in HE?" reveal that most of the subjects that participated in the study reported that students were either assigned a topic, or left to their own discretion to choose a topic after which they are required to present it in class with a rubric as as an assessment tool.

As for the third research question "To what extent is ID using PBL as a tool is in alignment with the 21st skills acquisition?" the results were significantly of great value. The implementation of PBL enabled students to their digital literacy skills.

The findings showed the major group of participants (84.6%) agreed that they were highly motivated in a PBL class and that they developed the 4 Cs (creativity, collaboration, communication, critical thinking) which is compatible with the 21st century learning skills and in line with the studies of Nani and Pusey (2020).

A more significant finding was the set of skills students acquired. In addition to the social skills (communication, active listening, sharing information/ideas…) that students developed, they learnt the importance and benefit of teamwork (79%) as showcased in Table 3.10. and Graph 3.9. Without it (teamwork), there was no way they could gain the skill of creativity which is fruit of all the group members. Nevertheless, 13% said they did not feel their writing skill has improved. This finding suggests that much work should be directed to this skill though the students in NHSM have already expressed that writing was not important for their career. Still, this low percentage of respondents reporting that their writing skill did not improve suggests the importance of investigating and later working on it.

Perhaps, one of the highest percentage was reported in section five with 95% of respondents who saw that their presentation skills were enhanced due to technology (Graph 3.10.). With the support of technology, the participants showed a high level of confidence and satisfaction as far as research facilitation is concerned (84%). It can be inferred that working on a project with the support of technology drove students to develop a positive attitude towards learning. Moreover, 90% realized that they cannot enrich their work unless it is connected to other subjects. This realization had an important implication of knowledge transfer and experience with PBL (Graph 3.11.). Eighty four percent of subjects admitted that PBL enabled to transfer knowledge from one subject to another, and 82% said such an approach enriched their experience due to its authenticity as opposed to the traditional mode of teaching.

General Conclusion

"Education is what remains after one has forgotten what one has learned in school."
—Albert Einstein

General Conclusion

5. Introduction

This chapter presents the researcher's discussion, conclusion, implications, limitations of the study, and recommendations for further research and offers some final thoughts regarding the importance of adopting an ID syllabus in an ESP class based on the study findings. As stated earlier, three instruments were used in this thesis: Interviews, questionnaire and non-participant observation. Interviews were conducted with teachers (n=9) via Skype while the survey was administered to students (n=39) in order to get their feedback as regards to PBL teaching. As for observation, it was conducted by the researcher herself. After the researcher correlated the results obtained from the three instruments, she embarked on chapter five.

5.1. Discussion

The main purpose of this study was to find out the extent to what teachers were familiar with ID and investigate the effect of PBL on university students. It was also intent to show the importance of engaging students through PBL pedagogy and break away from the traditional way of conducting a project. The project initiated by the researcher, in October involving an ID activity, revealed that adopting PBL as a teaching approach can be valuable according to the findings as it helps students develop 21st century skills they need in their future life.

The overall findings via the three instruments are in alignment with the literature review in this study which highlights the importance of providing students with effective instruction in accordance with their learning styles, according to their needs, interests and relevant to the 21st century learning.

According to the interviews' findings regarding research question one of this study, it was found that an overwhelming majority of participants was not familiar with ID teaching. Indeed, of all the subjects interviewed (n=9), eight teachers used PW in class (89%); however, out of the eight teachers, only two teachers (34%) used it with an ID approach. A great majority of interviewees was not familiar with ID which implies that more training sessions should be considered to support its implementation in ESP classes as reported by one instructor (11%). and activate the culture of moving from the conventional way of presenting a project in class.

Although many teachers were not familiar with ID instruction, they all agreed that it could be of great value to promote the 21st century skills, and many of them have cited items

like critical thinking, collaboration, communication, creativity, adaptability, flexibility, teamwork, and brainstorming

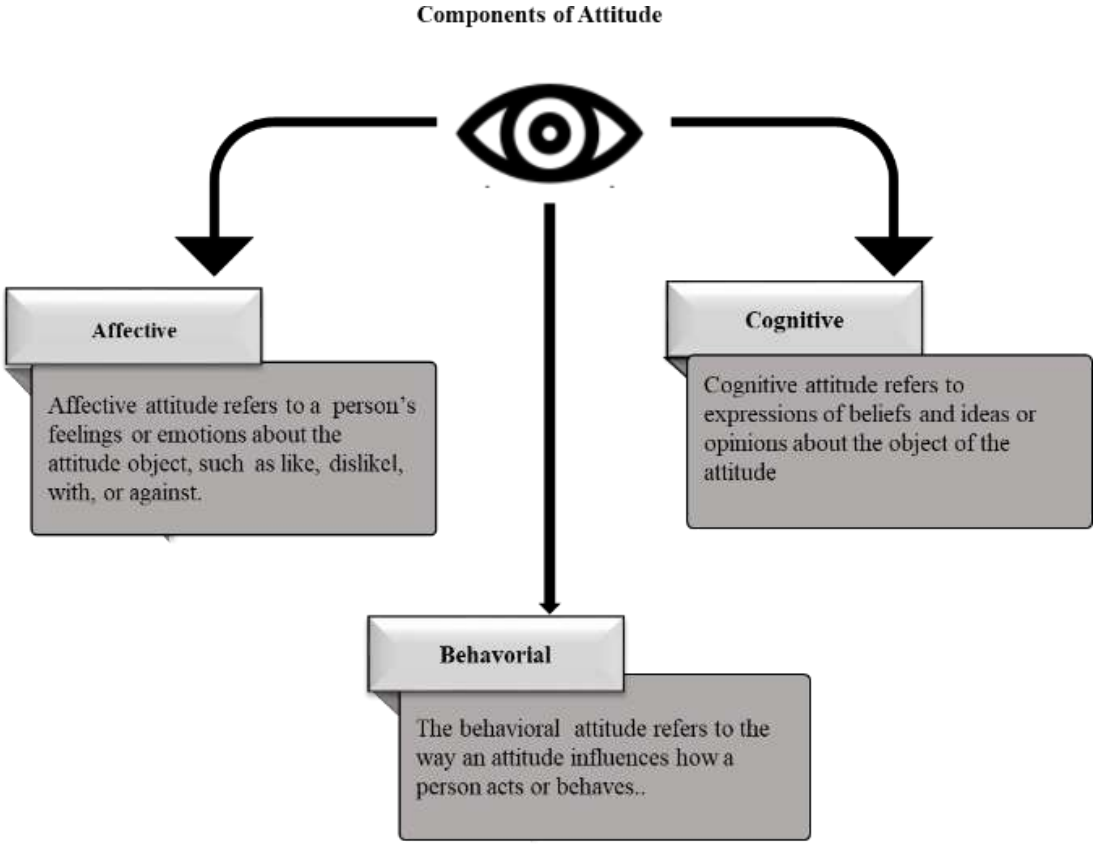
Regarding research question two, data from the interviews revealed that PW was mostly assigned by teachers, presented in class by a group of students, and assessed through a rubric.

The second instrument used in this study was “non-participant observation”. It was conducted during the last week of October, 2024 and aimed to examine students’ behavior and attitudes towards the PW discussed earlier. Twenty-six students and one instructor were subjected to observation session with a full focus on the students.

The observation concentrated mainly on the students’ attitudes when on task to obtain data for the study and corroborate the data with the questionnaire’s findings. For this purpose, a checklist was used (appendix K) to note down every detail and ensure that nothing has been neglected. Moreover, the researcher’s presence did not seem to have disturbed the students since they were already accustomed to her presence from the beginning of October.

In summary, the observation revealed some positive attitudes and engagement in class. According to Stark et al (2013), attitude is the tendency to respond positively or negatively towards a certain thing (an idea, object, person, or situation). For Brown (1994), attitude can be said to be positive when it bears three components: affective, behavioural / conative, and cognitive (see Figure 4.1. for more details).

Figure 4.1.: *Attitude Components*



Based on the components highlighted in the figure above, the observation session geared attention towards the three components as regards to PBL implementation. Concerning the affective component, many subjects showed excitement and joy working together. Working in a stress free environment made them motivated to see their project achieved. On the behavorial aspect, the participants showed positive attitudes towards learning. They were entirely involved in the teaching learning process (taking notes, outlining, debating, arguing…). All in all, language was no longer a barrier. Regarding the cognitive aspect, the act of observation revealed that all the students who were working in the project were displaying some cognitive aspects like: listening, brainstorming and sharing information, grasping the purpose of the project, problem solving, presenting, speaking in public…

With the aim of finding out whether students were fully engaged in a PBL class, the researcher used Johnson's indicators. Johnson (2012) asserted that students are engaged when they display the following actions:

- They are busy reading critically either individually or in groups using a pen or pointing at something.

- They are taking notes, creating, planning, discussing, debating and asking questions.
- They are inquiring, exploring, explaining, evaluating and experimenting.
- They are interacting with other students, gesturing and moving.

As a matter of fact, it was found during the observation that students were busy working on task throughout all the process. There were times when some students were heard using few phrases in Arabic from time to time, but they were focused on the activity. The class was not that noisy which is an indicator that the students were used to work together in groups. These evidences corroborated with the results of Table 7 where students reported that they learnt the four Cs (collaboration, communication, critical thinking and creativity).

According to qualitative data, in section one, most of the students (84.6%) reported that their motivation was enhanced when working on a project with a driving question over a period of time. Of some indicators highlighted in Table 7, the percentage of creativity got 64.1%, followed by communication (59%). Data in Table 7 that highlights the soft skills' acquisition shows that PBL highly promoted the acquisition of the 21st century skills.

Upon close examination of Table 8, data revealed that students expressed positivity in terms of engagement, participation, attendance and teacher-student relationship during the whole process. The results of this study show also that there is a significant relationship between communication and interpersonal skills (46% for the former and 50.3% for the latter), which implies that by working in groups, the students developed several skills like: active listening, brainstorming, sharing, asking and responding to questions. As a matter of fact, through PBL, 50.3% of the subject learnt to work together as indicated in Table 9, developed their interpersonal skills, and viewed the topic from different perspectives and approaches which enabled them to value the importance of learning from their peers and sharing expertise. In sum, PBL provided the students with an opportunity to:

- work on real world problems
- apply their knowledge and skills that prepare them for the complexities of the outer world.
- make learning meaningful and relevant
- connect theory with real-life issues

By learning how to connect knowledge acquired in class with real world problems, students developed the skill of adaptability and flexibility to problem-solving, survival skills in their future workplace.

The data obtained from Table 10 in this study showed that PBL using ID syllabus provided students (60.5%) with a better understanding of the topic and a clear picture of the relationship between disciplines (89.1%) as highlighted in Table 11. The students who participated in the project (81.5%) were positive about PBL and expressed great joy when working on their own over an issue and suggesting a product as revealed in Table 12. Additionally, a percentage of 84.2% of subjects realized that through PBL, they learnt to use more than one subject to apply their newly gained knowledge in another field (Table 12). They reported that it provided them with opportunities to work on a topic they chose and that was of interest to them and empower their interpersonal skills.

The data obtained from Table 11, in this study, showed that PBL using ID syllabus provide sdtudents (60.5%) with a better understanding of the topic and a clear picture of the relationship between disciplines (89.1%).

The researcher also found out that technology was of great support to students' work and creativity (86.4% for research expansion, 83.7% for research facilitation, 94.5% for presentation support, and 91.8%, for information literacy. From the students' answers to the questions about knowledge transfer and experience, it can be seen that an overwhelming majority of subjects (81.5%) said that they saw their experience enriched after working on a project in with peers. In addition to experience, the students mentioned that they gained competence in ICT from their colleagues.

Through the use of project-based learning, the data analysis corroborate with the literature review in this study stating that the students develop several skills at a time, work for a purpose, are engaged and acquire life long learning.

5.2. Conclusion

ID teaching has been identified as a key to students' success in the 21st century. With an ID approach, not only do teachers foster critical thinking, promote communication and collaboration but enrich their students' learning experience and prepare them to face the challenges of a rapid, interconnected world (Ferrer, et al. (2019).

Through ID teaching, students learn to view a problem from different perspectives and develop a competence to transfer acquired knowledge to new situations in real life. In the case of this study, students realized that mathematics, the mother of all sciences, is closely connected to other subjects in an educational setting and real-life that made them value the importance of learning other subjects.

This study has attempted to look at the benefits of ID teaching when using PBL. It is true that most of the teachers interviewed were not familiar with ID teaching, but all of them reported that the use of projects in class can provide students with opportunity to develop some sort of autonomy and promote responsibility. Therefore, it is important to explore and investigate in this area. Despite the small size of the population (students), quite comfortable with technology, the thesis proved that PBL can be successful if properly implemented, and that it allows a smooth shift from teacher centered approach to student centered teaching approach by integrating two or more disciplines.

PBL pedagogy can be an effective tool to provide students with a meaningful context for language learning (Brevik & Rindal, 2020). It has the merit of:

- making students transfer knowledge and apply it to new situations out of the box;
- teaching students that they need more than one subject to survive in modern society;
- getting students interested in the work and using their time wisely;
- teaching students differently.

The project ENMAT.COM with mathematics students initiated at at NHSMB has furtherly illuminated the connections between mathematics, English and ICT. More than this, it integrated several skills like: critical thinking skills, problem solving, communication, collaboration…

In this study, although the sample population was relatively small, it was found through the analysis of the survey and observation sessions that the results were consistent with the results of studies discussed in the literature. Moreover, upon close examination of findings and analysis, the results that emerged showcased a high level of students' engagement and motivation, and a high rate of attendance which was also witnessed during the whole process. These factors have several implications. They imply that through PBL students saw in the activity a purpose and value in what they were doing. PBL also provided a vehicle for students to gain valuable life skills like: flexibility, adaptability, autonomy, active listening, leadership, sharing,… Skills that are not taught in traditional classes.

All in all, based on the documentation consulted for this thesis, it can be said that PBL had a positive effect on students' atitudes towards learning and academic achievement that goes beyond the conventional way of teaching. However, despite some low results in some areas, the overall findings are in line with studies that claim that PBL is an effective strategy in modern education.

This thesis reported an innovative project in a mathematics class studying English. The project, named ENMAT.COM, consisted of combining English, maths and computing, aimed at making students work on a project that would solve an issue and encompass the three disciplines. Being the first innovation in NHSM, the project was met with great excitement and encouragments on the part of students, teachers and school management. The students who were informed about the initiative did not hesitate for one minute to work on it as they were curious in being led to a different learning approach that deals with a real life problem.

5.3. Limitations

In the present study, the main focus was on students' views about one PW assigned in October 2024 through a survey and observation. This can be said to be a limitation. Perhaps, further study with more projects, would provide more profound interesting results. As regards to this study, several limitations have to be highlighted. These include:

- The number of students who volunteered to take part in the project was not that large. Repeating the same experience with other students from other departments with a larger number of students would be helpful to determine whether the results would be more or less the same.
- During the researcher's observation session, it was stated that all the students were fully engaged in the task. However, future research needs to investigate profoundly on this aspect in case the students' engagement was the result of respect towards the visiting faculty (researcher) or real feeling towards the novel pedagogy. It is true that the aim of the observation was to confront the data gained with the data of the survey, but perhaps future studies would explore the teacher's role in class while students are on task.

5.4. Implications

The study has highlighted the importance of considering PBL as an effective pedagogical methodology to move from lecture based instruction to teaching that would result in independent life life long learning which would prepare students for the future and face the challenges in their workplace upon graduation. It has been demonstrated through the literature and the findings that PBL approach establishes a stress free atmosphere that broadens learning opportunities, enhances confidence and motivation to meet the learning goals.

In a PBL class, students enrich their learning experience through the use of authentic situations, or issues while developing 21st century skills that would enable them to use knowledge from several disciplines and cope with any novel situation.

The findings of this study dedicated to PBL in English for mathematics students enabled the researcher to identify implications in a 21st century class. Some of which are:

- It contributed greatly to the enhancement of interpersonal/communication skills.
- It led students to use the language within a context and with a clear purpose.
- It fostered social bond (group work) amongst students to solve a problem.
- It immersed the students fully in a linguistic bath whereby the language used is closer to reality.
- It allowed the students to be fully immersed in an environment where they have to communicate constantly.
- It stimulated students to experience a real-life situation and learn how to cope with it.
- It made students trigger every effort to do research, synthesise information, summarise/paraphrase findings, create a product or find a solution before they take pride in presenting it to an audience.

The study revealed that IDY using PBL as a strategy went beyond the teaching of conventional skills like listening, speaking, reading and writing. It offered numerous benefits, including enhanced student engagement, deeper learning, note taking, summarising, teamwork, collaboration, etc. By teaching through subjects integration, gained a holistic understanding of concepts and how they are connected which led to the improvement of their critical thinking, communication, and problem-solving abilities (Morrow & Richards, 1996).

In sum, using the study has demonstrated that interdisciplinary by focusing on teaching common themes without restricting students' thinking to a specific discipline of knowledge, students are provided with an opportunity to work on their own to solve a problem while learning several skills at a time (Cohen & Staley, 1982) which was depicted in the project work initiated at NHSM.

Based on the findings of this study, PBL has demonstrated to be quite effective not only in increasing the students' level of attendance, participation, and engagement but kept on them on task even outside the classroom setting.

5.5. Recommendations.

Based on the findings of this study, the following recommendations are made:

- Since the lecture based mode of teaching is no longer motivating 21st century students, then teachers should provide their students with a pedagogy that encourages them to be part of the teaching learning process and learn by doing and one way to do this is PBL.
- The roles of teachers in PW are very crucial for the success of not only the students' work outcome but also how much students are guided so that they learn by themselves (Donnelly and Fitzmaurice, 2005).
- It was understood from teachers' interviews that they conducted projects on the basis of the following formula: Choose, present and get a grade. Effective implementation needs more than choosing and presenting. The roles of teachers are various, and one of these roles is following up the students on an ongoing basis with the provision of feedback and time for reflection. Students, though working on their own, need to be guided and assessed on an going basis.
- Policy makers have the responsibility to address problems related to the use of technology to encourage teachers embrace the pedagogy of the 21st century.

With the new generation of students, regarded as digital natives, teachers should be trained in how to use the computer technology, be informed of the 21st century students' needs. As such, it is recommended that teachers attend more professional training sessions, get documented, or collaborate with colleagues to cope with the new requirements of teaching in general, and PBL specifically. This is being said, it is hoped that it would be beneficial to have more PD sessions at the local, regional, and national level to help teachers get familiar with ID instuction and equip them with the pedagogical they need to face the new generation.

Although this study focused on PBL with students enrolled in the department of mathematics, the findings and the students' project samples illustrated in appendix N should encourage readers to use it in another subject.

Résumé

Cette étude a examiné l'enseignement de l'anglais aux élèves de l'ESP par une approche interdisciplinaire afin d'améliorer l'intégration de l'anglais, des mathématiques et de l'informatique grâce à l'apprentissage par projets. L'objectif était de faire évoluer la manière dont les connaissances sont transmises aux élèves du XXIe siècle et de les préparer au monde réel. L'étude visait à démontrer, à travers une littérature abondante, que les élèves avaient besoin de plus que des compétences académiques de base pour s'épanouir après l'obtention de leur diplôme. Elle visait à démontrer la faisabilité d'une approche interdisciplinaire dans une classe d'ESP, utilisant l'apprentissage par projets, et à analyser les avantages et les défis de sa mise en œuvre dans le système éducatif. Bien que plusieurs études aient été menées sur les programmes interdisciplinaires, la nécessité d'une mise en pratique concrète en classe était, selon le chercheur, essentielle. De plus, l'objectif était de permettre aux élèves de mieux comprendre les liens entre les différentes disciplines, de mieux réussir dans les matières enseignées et d'appliquer les connaissances acquises en classe de manière originale. L'étude était guidée par quatre questions de recherche. Le chercheur a tenté d'explorer dans quelle mesure les enseignants connaissaient l'interdisciplinarité, la manière dont le projet est utilisé pour répondre aux besoins des élèves du XXIe siècle, et de déterminer s'il était en adéquation avec l'éducation moderne, ainsi que les défis et les limites qui auraient pu entraver son application dans le système éducatif algérien. Son objectif était donc d'explorer l'efficacité de l'apprentissage par projet pour l'enseignement de l'anglais aux élèves de mathématiques. Des données empiriques ont été recueillies au moyen d'entretiens avec les enseignants, de questionnaires, d'observations en classe et d'une abondante littérature relative à l'importance de l'enseignement interdisciplinaire au XXIe siècle. Lors des entretiens semi-directifs, neuf enseignants ont participé à l'étude, tandis que trente-neuf élèves ont pris part à l'enquête. Quant à la troisième observation en classe, elle a été menée par le chercheur en tant que non-participant. Les données ont été analysées à l'aide de statistiques descriptives, de distribution de fréquences, de tabulations et de pourcentages. L'étude a été menée à l'École nationale supérieure de mathématiques (NHSM) d'Alger. Les résultats ont révélé que la plupart des élèves (84,6 %) ont fait preuve d'une attitude positive envers le projet initié et mené en classe à la NHSM, et ont fait preuve d'un fort engagement et d'une grande motivation. Ils ont pu constater que toutes les matières étaient liées d'une manière ou d'une autre. Les entretiens avec les enseignants ont révélé que la plupart d'entre eux n'étaient pas familiarisés avec l'interdisciplinarité et menaient les projets de manière traditionnelle. Ils ont également admis que cette approche nécessite une gestion du temps, une collaboration interdisciplinaire et une formation des enseignants. Suite à l'étude, peu de recommandations ont été formulées. Premièrement, il a été recommandé d'offrir aux enseignants la possibilité de participer à des programmes de développement professionnel continu sur l'application efficace de l'interdisciplinarité et d'expérimenter l'apprentissage par projet. Ensuite, il a été fortement recommandé d'élaborer un plan d'action pour faciliter la coopération des enseignants et promouvoir la pratique réflexive. Enfin, il a été recommandé que les programmes scolaires soient adaptés aux besoins, aspirations, intérêts et styles d'apprentissage des élèves du 21e siècle.

Mots-clés: Apprentissage par Projet ; Interdisciplinarité ; l'étudiants au centre d'enseignement ; Apprentissage du 21^{e} Siècle ; Engagement d'étudiant ; Le System d'education Algerian

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https://my.pblworks.org/resources

https://www.weteachnyc.org/resources/collection/project-based-learning/

https://itali.uq.edu.au/teaching-guidance/teaching-practices/active-learning/project-based-learning

https://www.scgssm.org/resources/inquiry-project-based-learning

https://www.easternct.edu/center-for-teaching-learning-and-assessment/teaching-resources/project-based-learning.html

https://newtechnetwork.org/resources/what-is-pbl/

https://www.educationworld.com/a_lesson/project-based-learning-resources.shtml

https://sdgs4future.org/en/education-concept/pbl-project-based-learning/?gad_source=1&gclid=CjwKCAjwzMi_BhACEiwAX4YZUGMrbyr8pZsAUo-f5i531AdARzKojIViKfci155AL3qvvf6N7JKnFxoC9BkQAvD_BwE

https://www.smartlablearning.com/project-based-learning-examples/

https://www.prodigygame.com/main-en/blog/project-based-learning/

https://www.teachthought.com/education/examples-of-project-based-learning/

https://www.teachthought.com/education/pbl-ideas/

https://www.unrulr.com/post/100-project-based-learning-ideas

https://www.ereadingworksheets.com/e-reading-worksheets/school-project-ideas/

https://www.magnifylearningin.org/driving-questions

https://www.e2-project-based-learning.org/Driving-Questions-examples.html

https://www.pblworks.org/what-is-pbl

http://www.hku.hk/space/publications/et/ech4.pdf

http://repository.uin-malang.ac.id/9627/1/9627.pdf

https://www.projectclue.com/education/project-topics-materials-for-undergraduate-students/the-impact-of-project-based-learning-on-academic-achievement

hhttps://www.myproject.ng/project/the-impact-of-project-based-learning-on-academic-achievement

Suggested video segments on PBL

https://www.youtube.com/watch?v=LMCZvGesRz8

https://www.youtube.com/watch?v=V2Oa4OkkTtw

https://www.youtube.com/watch?v=qJHRgF6m5bs

https://www.youtube.com/watch?v=EuzgJlqzjFw

https://www.youtube.com/watch?v=hnzCGNnU_WM

https://www.youtube.com/watch?v=geeoy3BMmE0

https://www.youtube.com/watch?v=crMM4z3oKmQ

https://www.youtube.com/watch?v=RGoJIQYGpYk

https://www.youtube.com/watch?v=08D0dBGIzYQ

https://www.youtube.com/watch?v=-OWX6KZQDoE&list=PL686AB7D8711BC1CB

List of Appendices

Appendix A

Engaging Activities

Name of Activity	Description
Jokes and cartoons	Jokes and cartoons are two methods that may be used to engage students. These work best if the joke or cartoon is directly related to the topic that will follow, and stimulates critical thinking in students prior to beginning the topic. These may directly raise questions, either from the instructor or from the students that lead to productive discussion. Poems and songs add a similar dimension to the process.
Beginning class with a question	Beginning class with a question to make students involved with each other and with the instructor. A variation is in sharing a picture and asking "what do you see?". The answers given, by individuals or small groups, lead directly to the topic of the day.
Socratic Seminar	Socratic Seminar is used to help students apply the activity to their learning. The pedagogy of Socratic questions is open-ended, focusing on broad, general ideas rather than specific, factual information. The questioning technique emphasizes a level of questioning and thinking where there is no single right answer.
Talking to the Text	Talking to the Text (TttT) means having a conversation with the text through which the reader learns how to figure out the meaning of a text based on his/ her schema. As the reader is paying more attention to the text, s/he makes sense of the text. When adopting TttT, the students learn how to be autonomous and reflective.
SQ3R	Survey, Question, Read, Recite, Review) Have students preview the title, pictures, graphs, or captions, then read the first and last paragraph of the article. Make a list below of the main points or objectives you find (Surveying). Then, have students write questions based on their survey of the text (Questioning). After that, have students read and answer the questions they wrote down as they a read (Reading). When done, have students look over their questions and be able to recite the answers without looking them up (Reciting). Finally, have students summarize what they wrote (Reviewing)

Source: https://waesol.org/wp- content/uploads/2019/06/Bencherab-and-Sulaivany-Teaching-Reading-out-of-the-Box.pdf

Appendix B

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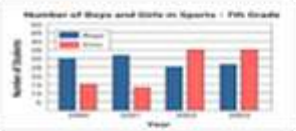
Advantages and Disadvanatges of Interdisciplinary Approach	
Advantages	**Disadvantages**
Allows transfer of knowledge	Flexibility may lead to lack of organization.
Enables reinforcement and understanding	Low achievers may feel lost
Makes learning relevant	Demanding on the teacher.
Encourages student centered approaches (group work)	Difficult to plan and implement
Enhances communication: student- sudent; student-teacher; teacher-teacher	Demands much supervision from teachers.
Encourages more collaboration	Assessment difficult.
Teacher acts as a facilitator	

Appendix C
Project Assessment Tools

Formative Assessment Strategies	Summative assessment Strategies
Formative assessments refer to tasks given to students throughout a unit of work to check progress and to help fine tune the teaching approaches and learning arrangements for the students so that they remain on target (March, 2000). Some formative methods that can be employed are: **1. Written and verbal work assignment** The projects are based on real-world problems to which students are required to provide solutions. Teachers assign written work based on a real world problem for students to find solutions through literature review. Students' work is assessed through presentations/debates during which they demonstrate their ability to communicate their ideas verbally. **2. Rubrics and feedback** The most common assessment and evaluation tools used in collaborative learning are rubrics (Thaler, Kazemi, & Huscher, 2009) which highlight students about their teachers' expectations and goals on the basis of a set of criteria of the work. **3. Portfolio** Portfolio assessment is a method that documents students' activities (Doppelt, 2009). It reflects what students have learned throughout the course, showcases their activities and monitors their progress. **4. Observation** Observation enables teachers to monitor students' progress during the project. While on task, teachers may advise students facing difficulties. Teachers can discover what their students needs to be corrected by watching them closely, and the information gained helps teachers remedy review their upcoming lesson plans as stated by Ginsburg (2009).	Summative assessments refer to task given to. It is based on a test and is used to measure and record overall achievement (Marsh, 2002). In PBL it is used to know: • about students' understanding of the work covered • how well they have learned the planned outcomes This type of assessment can take the form of giving students a problem and have them deal it. (Ginsburg, 2009). The students' responses will provide teachers information about performance differences and the strategies used to solve the problem (Ginsburg, 2009). The use of the summative method in PBL enables teachers to identify students' difficulties, use the feedback to make learning move forward as claimed by Black & William (2009.

Appendix D

Mathematics Connection with Other Disciplines

Discipline	Example
Mathematics and Physics 	• The laws of motion, friction, expansion of solids, liquid pressure are explained using mathematics.
Mathematics and Biology 	• The calorie and nutritive values of food articles are calculated using mathematics. • To find the rate of respiration and transpiration we use mathematics. • The study of living cells, composition of blood, age and category of plants and animals are studied using mathematics.
Mathematics and Engineering 	• Engineering Sciences deal with surveying, construction, estimation, designing, measurement, calculation, drafting, drawing…All these use mathematics. • Measurement of land, average investment, average return, production per unit area, cost of labour, time and work, seed rate, manure rate, used agriculture need maths.
Mathematics and Economics 	• Researchers in economics use mathematical tools in their research work. • To explain marginal concepts like marginal utility, marginal cost, marginal revenue, etc., calculus is used today.
Mathematics and Geography 	• In geography to study the shape and size of earth, to measure area, height and distance, to study about latitude or longitude we need mathematical knowledge. • To study the rivers, mountains, canals, population, climate, etc. all these studies need the tools of Mathematics in one way or other.
Mathematics and Psychology 	• Experimental psychology is much based on mathematical calculations and applications. • Various mathematical techniques are used to collect, analyse and interpret psychological data.
Mathematics and Fine Arts and Drawing 	• Mathematical knowledge is applied to drawing and painting with symmetry, making right ratio and proportion, etc… • In music, almost all musical notes and system work on mathematical principles.

Appendix E
. Options for Professional Development

Type	Description
Exploration	Exploring allows teachers to explore their teaching and try to see it differently as advocated by John Fanselow's (1988). Exploring to see one's teaching differently can be achieved by: • Reading professional books and journals on teaching and learning languages • Establishing a mentoring relationship with a more experienced teacher • Keeping a teaching journal
Self-Observation	Bailey, Curtis, and Nunan (2001) point out that self-observation is the cornerstone for all professional development. It is a way to explore teaching for the purpose of seeing our teaching differently (collecting artifacts, audio taping, videotaping…)
Observing Other Teachers	Fanselow (1988) points out: "as teachers, we can see our own teaching in the teaching of others". When we observe others to gain knowledge of self, we have the chance to construct and reconstruct our own knowledge. According to Fanselow (1988), observing other teachers is a mirror of one is doing in class.
Collaborative Supervision	Collaborative approaches to supervision are mainly designed to help beginning teachers with the appropriate support from more experienced colleagues who have an ethical and professional responsibility of providing the required type of support upon request (Kutsyuruba, 2003).
Peer coaching	Peer coaching is a type of supervision in which teachers in a given school work collaboratively in pairs and small teams to observe each others' teaching and to improve instruction (Beach & Reinhartz, 2000).
Cognitive coaching	Cognitive supervision refers to becoming aware of one's own teaching effectiveness. It is an effective means of establishing sound relationships between two or more professionals of different status (beginners with experienced teachers, beginners with supervisors, or experienced teachers with supervisors) where the the coaches (experienced teachers or supervisors) act as a mediator between the beginner teacher to be coached and his or her own thinking.
Mentoring	Sullivan and Glanz (2000) as "a process that facilitates instructional improvement wherein an experienced teacher (mentor) works with a novice or less experienced teacher collaboratively and nonjudgmental to study and deliberate on ways instruction in the classroom may be improved (p. 213) define mentoring. It differs from peer coaching and cognitive coaching in that mentoring involves a hierarchical relationship only between a novice and senior (more experienced) teacher.
Portfolios	A teaching portfolio is defined as a process of supervision with teacher compiled collection of artifacts, reproductions, and testimonials that represents the teachers' professional growth and abilities (Riggs & Sandlin, 2000). In portfolios, teachers evaluate themselves and develop their teaching practice as well as pedagogical and domain knowledge with the evidence from collection of the artifacts (Reis & Villaume, 2002).

Appendix F

Difference between Project and Project Based Learning

Project	Project Based Learning
Often conducted individually	Completed in teams
Teacher: Knowledge dispenser	Teachers as a guide, facilitator
Often completed by following the direction of the teacher	Conducted after students' within pre-approved guidelines
Has one "right" outcome	Outcomes are varied, unanticipated outcomes and often pleasantly surprising
Most of the time irrelevant to students' lives	Connected to students' lives, to real life situations, authentic
Turned into the teacher for grading	Products, performances or services presented to a public audience
Students are assessed at the end	Students receive ongoing feedback related to established criteria and is based on learner outcomes

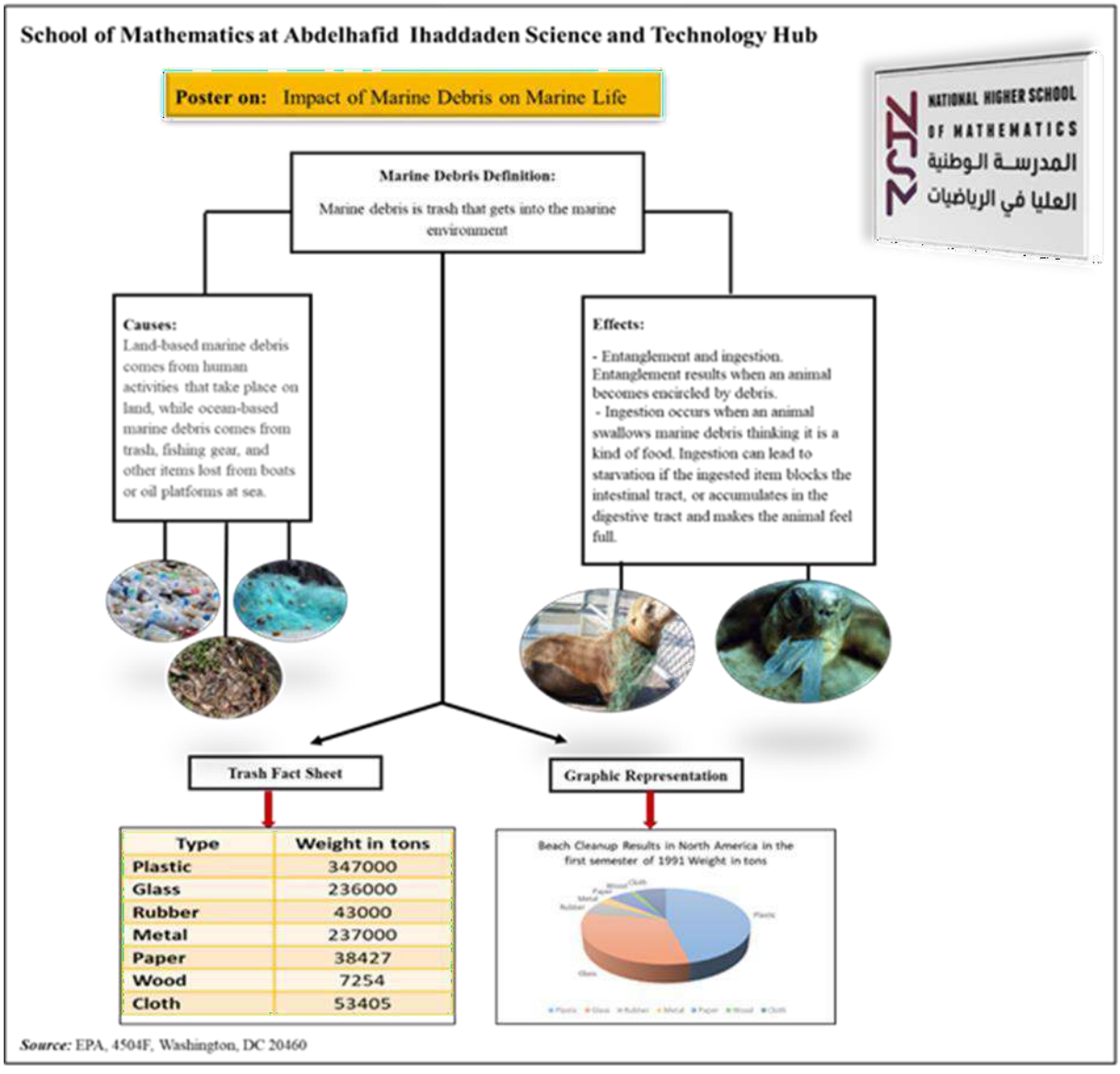
Appendix G

Project Work Rubric

Criteria	Exemplar (5)	Developed (4)	Limited (3)
Appearance/ Neatness	The text and the illustrations are visually appealing, clear, and colorful.	The text and the illustrations are clear and colorful. .	The text and the illustrations are fairly adequate and clear. .
Content Knowledge	Exceptional idea development with supporting details written in the author's own words, or correctly credited if quoted.	Satisfactory idea development with some supporting details written mainly in the author's own words, or correctly credited if quoted.	Unclear, incorrect, or limited idea development with lack of details. Author's own words are not used, or quotes are not correctly credited.
Image Communication	Images are highly engaging for content and audience.	Images are appropriate to content and audience.	Images detract from or are inappropriate for content and audience.
Mechanics	The project contains only minor mechanical errors.	The project contains some mechanical errors, but does not distract the reader.	Mechanical errors distract the reader.
Factual Information	Accurate information, interesting information, and relevant illustrations.	Information represented with minor errors, or irrelevant illustrations.	Information is largely incorrect, or illustrations are not accurate.

Appendix H

Students' Poster



Appendix I

Interview Guide Protocol

Introduction

Section I: Personal information

Teaching experience (yrs)

0 – 4 ( )

5 – 9 ( )

10 - 14 ( )

15 and above ( )

Professional qualification: .....

General questions about subjects teaching

1. Which subject did you specialize on?
2. How many subjects do you teach now?
3. Did you combine the subject with another when teaching? If yes, did you see the benefit of this type of teaching, and if so in what way?

Section II: Instruction delivery

How is instruction? Teacher centered ( ) Student centered ( )

Resources used

A. If teacher centered, put a tick in the right column in the table below:

Materials	Frequently	Occasionally	Rarely	Never
Hand outs				
Magazines/Journals				
Textbooks				
Extracts (articles)				
Other reference books				

B. If student centered, put a tick in the right column in the table below:

Methods	Frequently	Occasionally	Rarely	Never
Group work				
Discussion				
Dialogue				
Lecture Method				
Demonstrations				
Exercises				
Others (specify				

Section III: General teaching practices' views

1. How do you assess your students' projects?
2. What does interdisciplinarity mean to you?
3. To what extent do you think interdisciplinarity is possible within your professional context?
4. What are the contributions of an interdisciplinary study to the student?
5. Have you coordinated with other colleagues to try using interdisciplinary instruction/teaching?

a- If yes, to what extent did you benefit?

b- If no, what are the reasons/challenges for not coordinating?

Appendix J

Student's Questionnaire

Dear Respondent,

You are kindly requested to fill this survey about project-based learning. All the statements in the survey are meant to be used by the researcher as part of the research requirements. There are no correct or incorrect answers, and all answers will be kept confidential.

Survey on Interdisciplinary Teaching Using Project- Based Learning as a Pedagogy for ESP Students

Section 1: Soft Skills Acquistion in a PBL Class

Please select the option (s) that best reflects how you feel.

1. How do you think project-based learning impacts student motivation?

◯ Enhances motivation ◯ Decreases motivation ◯ No impact at all

2. Which of the following was/were developed after working on several projects?

◯ Critical thinking & problem solving ◯ Communication ◯ Collaboration ◯ Creativity and innovation

3. What skills do you think project-based learning helps develop?

◯ Problem solving ◯ Time management ◯ Leadership ◯ Presentation

Section 2: Students' Views of Teamwork

Please tick the option that best reflects how you feel: SA: Strongly agree; A: Agree; Neutral; D: Disagree; SD: Strongly disagree

Statements	S A	A	N	D	SD
a. Project-based learning engages students in the teachine learning process.					
b. Project-based learning increases levels of interest and participation.					
c. Project-based learning improves attendance.					
d. Project-based learning promotes student-teacher relationship.					

Section 3: Students' Views of Communication Skills

Please select the option that best reflects how you feel.

1. I learnt how to interrupt appropriately during interactions.

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

2. I improved my social skills when meeting and talking with both my teachers and classmates during the project process.

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

3. Working in groups helped me generate ideas and share them with group members.

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

Section 4: Students' Views of Students' Views of Interpersonal Skills

Please select the option that best reflects how you feel.

1. I learnt how to listen actively to my colleagues while on task.

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

2. Working in group made me become more confident to share ideas in an appropriate way.

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

3. Working on several projects made me accept other people's ideas when they were right.

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

4. I learnt how to ask and respond appropriately among group members.

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

5. Through group work I became more receptive and more sensitive to my colleagues' needs during the task.

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

Section 5: Students' Views of Students' Views of Learnt Skills

Please select the option that best reflects how you feel.

1. Good team-work contributes to the successful outcome of the project.

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

2. I got a better understanding of the topic when I participated in the project..

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

3. After working on several projects, my writing was…:

○ To a great extent ○ Somewhat ○ Very little ○ Not at all

Section 6: Correlation between PBL Implementation & 21st Century Skills

1. Please tick the option that best reflects how you feel: SA: Strongly agree; A: Agree; Neutral; D: Disagree; SD: Strongly disagree

Statements	SA	A	N	D	SD
1. Project-based learning is effective in promoting real-world skills.					
2. I learnt to apply what I learnt during the project process in other subjects.					
3. The activity was more authentic and relevant than in traditional classes.					

2. Which of the following do you think are the benefits of PBL?

a. Improves critical thinking b. Enhances creativity c. Promotes collaboration skills

3. What role do you think technology plays in enhancing project-based learning? Select all that apply.

a. Enhances presentations b. Improves communication skills c. Expands resources d. Facilitates research

b. e. Allows for multimedia presentations f. Engages students

4. What skills do you think project-based learning helps develop in students? Select all that apply.

a. Real-world application of knowledge b. Teamwork skills development c. Problem solving d. Creativity d. Leadership

5. Please tick the option that best reflects how you feel .

a. The new method of project work helped me transfer knowledge from other subjects to finalise my work.
a. Yes b. No c. Not really

b. Using information from other subjects to complete the project made learning richer.
a. Yes b. No c. Not really

Thank you for your participation!

Appendix K

Observation Checklist

Name of institution: NHSM

Date: October 6, 2024

Observer: Z. Ghani

Subject: Students finalising a powerpoint project on "start up"

Context: Students traming up to finalise or work on a project discussed earlier

Legends:

1. Apparent
2. Not really apparent
3. Quite apparent

CLASS ORGANIZATION

Instructional plan

- ☐ The session demonstrates clear lesson planning and logical sequence of ideas.
- ☐ The session provides clear instruction.

Clarity of objectives

- ☐ Realistic learning objectives
- ☐ The learning objectives connected to the lesson.

Time management

- ☐ Instructor prepares the room and relevant technology before the start of class.
- ☐ Instructor supports students outside of class to save time.
- ☐ Students are permanently reminded of time limits.

LEARNING ENVIRONMENT

Classroom climate

- ☐ Students' participation is encouraged.
- ☐ All students are included.
- ☐ Interaction between students is encouraged.
- ☐ Motivation is increased and fostered because of the instructor's practices.

Presentation substance

- ☐ Students are provided with concrete examples for the task.
- ☐ Instructor answers questions about content and form.

INSTRUCTIONAL CONTENT

Knowledge of subject

- ☐ Instructor knowledgeable about the course content.
- ☐ Instructor connects her subject with other subjects.

Context relevance and transferability

- ☐ Students are provided with real-world tasks.
- ☐ Students' knowledge background is activated.
- ☐ Types of tasks used in class can be transferred in real life scenarios.

STUDENT ENGAGEMENT

Appropriate content or level

- ☐ Cntent challenges students.
- ☐ Content promotes creativity.
- ☐ Instructor engages students in higher-order thinking skills.
- ☐ Instrcutor's delivery, questioning…) lead to critical thinking.

Active learning

- ☐ All students are on-task
- ☐ Students are actively participating in discussions, sharing their thoughts and ideas during the program.
- ☐ Students dispalying positive body language language.

FORMATIVE ASSESSMENT/FEEDBACK

- ☐ Instructor provides students constructive and encouraging feedback on how to improve their performance.
- ☐ Instructor provides information to students about their performance on class activities.

2/2

Appendix L

Coding List

Code	Reference
FID	Familiar with interdisciplinarity
UFID	Unfamiliar with ID
UoP	Use of projects
A21	Alignment with 21st century learning
UoR	Use of rubric
EN	Engaged
MO	Motivated
AC	Active
CO	Confident
RE	Responsible
S1	Independent learning
S2	Teamwork
S3	Communication
S4	Critical thinking/problem solving
S5	Public speaking
S6	Debating
ME	Motivation enhancement
MD	Motivation decrease
CS	Cannot say
CT	Critical thinking
COM	Communication
COL	Collaboration
CRE	Creativity & Innovation
PS	Problem solving
TM	Time management
LEAD	Leadership
PSK	Presentation skill
GE	To a great extent
SW	Somewhat
VL	Very litlle
NA	Not at all
Y	Yes
N	No

Appendix M

Areas of Concerns

General Areas of Concern	Specific Examples Concern
Classroom management	Organization; lesson cohesion; pacing of activities; digressions; transitions from activity to activity; pair/group/class work; exploitation of unexpected or unplanned classroom occurrences
Classroom interaction Affective factors	Teacher-student interaction; student-student interaction; student participation; amount of teacher talk
Affective factors	Student/teacher attitudes; perceived relevance of lesson; confidence building; student attentiveness; classroom atmosphere; student risk taking; teacher encouragement and feedback
Use of resources	Blackboard presentations; handouts; textbooks; equipment (e.g., overhead projectors, tape recorders)
Teaching techniques	Giving instructions; error correction; wait-time; eliciting language; providing feedback; asking questions; creating information gaps
Methodology	Teaching of reading, writing, speaking, listening, grammar, pronunciation, vocabulary, functions; teaching of communicative competencies; fluency versus accuracy; incorporation of culture; introduction, practice, review, and evaluation of language

Appendix N

Figures Recapitulation

Figure 1. *Materials' selection framework*

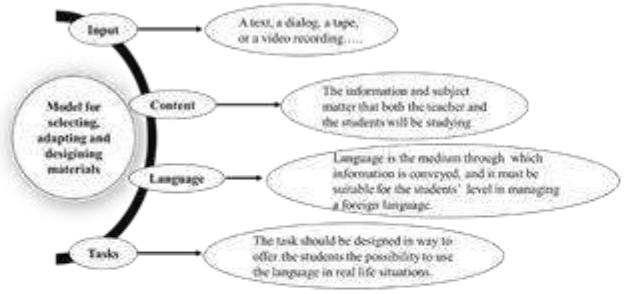


Figure 2. *Instruments guiding factors*

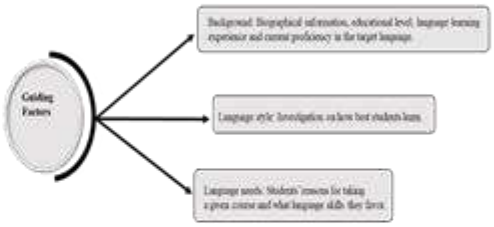


Figure 3. *Needs analysis process*

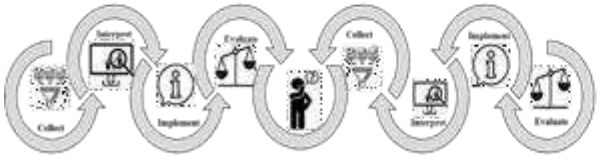


Figure 4. *Hutchinson and Waters' necessities, lacks and wants*

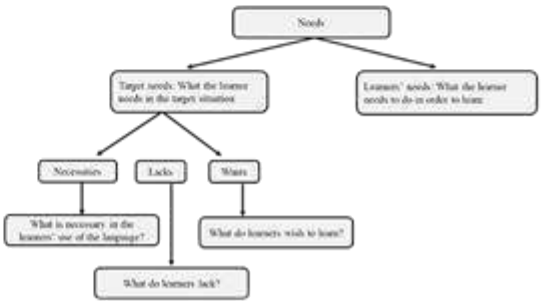


Figure 5. *Munby's Communication Needs Processor*

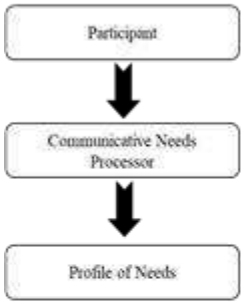


Figure 6. *Learners' profile*

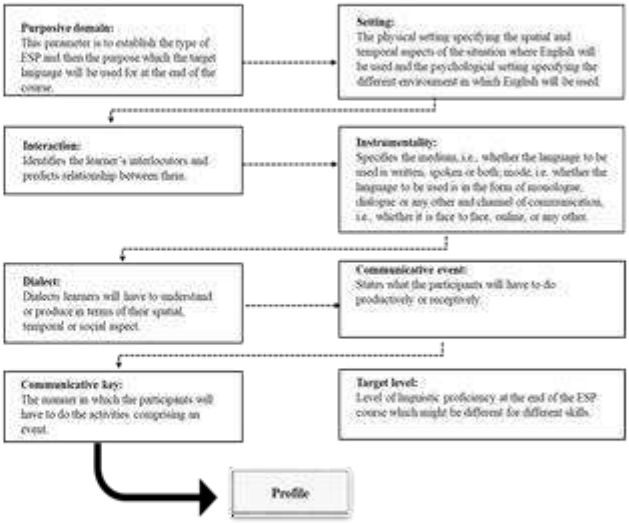


Figure 7. *Hutchinson and Waters' Model*

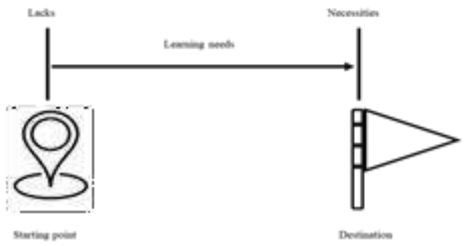


Figure 8. *Dudley-Evans and St John's Model of Needs Analysis*

Figure 9. *Dudley-Evans & St. John's terms*

Figure 10. *Partnership for 21st Century Skills*

Note. Partnership for 21st Century Skills is an organization that promotes the inclusion of critical thinking, problem-solving, and communication skills in the instruction of world languages, English, reading or language arts, science, math, economics, and the arts.

Figure 11. *Project steps*

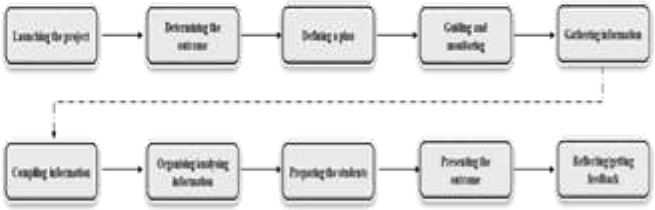


Figure 12. *Driving question criteria*

Figure 13. *Project work proceedings*

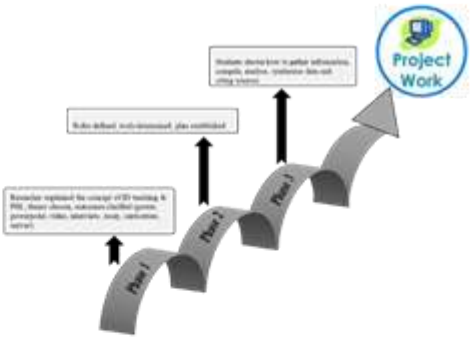


Figure 14. *Components of the followed methodology*

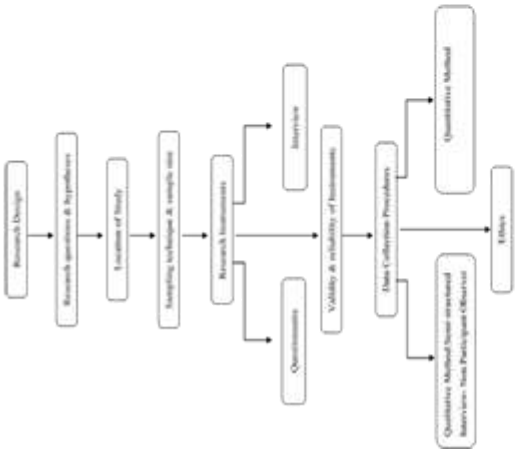


Figure 15. Howell's observation stages

Figure 16. ***Researcher's observation film***

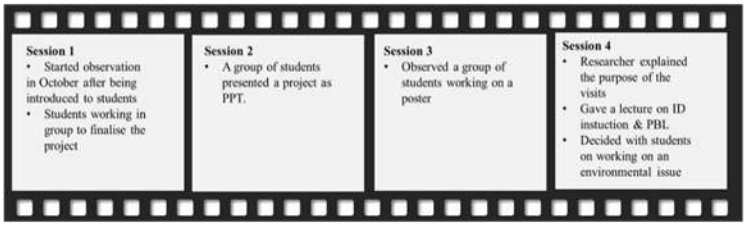


Figure 17. ***Interviews' data collection process***

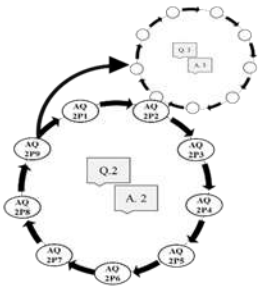


Figure 18. ***Observation scene***

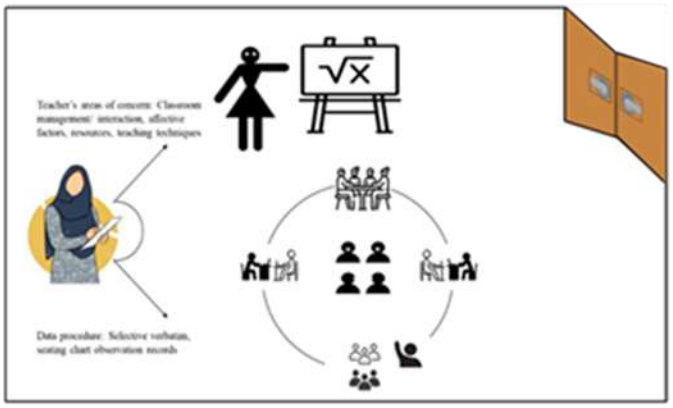


Figure 19. ***Survey desccription***

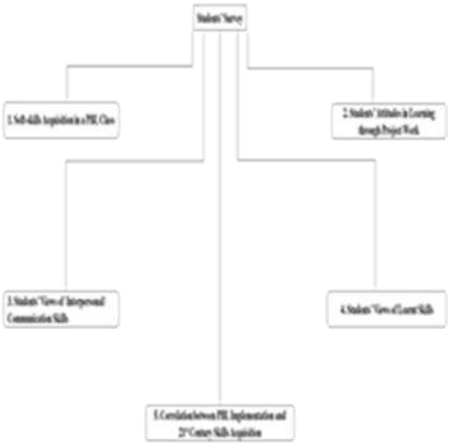
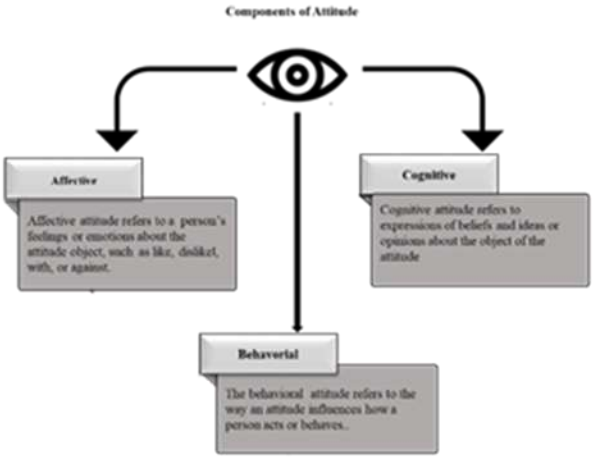


Figure 20. ***Attitudes components***



Appendix O
Tables Recapitulation

Table 1. ***Interviews' duration***

Participants	Date	Duration
P1	06-09-2024	35
P2	08-0-2024	75
P3	08-0-2024	26
P4	09-09-2024	25
P5	11-09-2024	90
P6	19-09-2024	51
P7	22-10-2024	40
P8	12-11-2024	30
P9	24-11-2024	33

Table 2. ***Years of Experience***

Years of Experience	Code	Number of Subjects	%
0-4	A	1	11%
5-9	B	4	45%
10-14	C	2	22%
15+above	D	1	22%

Table 3. ***Teachers' familiarity with PW in ID instruction***

Items	Code	Number of respondents (n=9)
Familiarity with ID instruction	FID	3
Use of projects in class	UoP	8
Alignments of projects with 21st century learning	A21	2
Assessment	UoR	8

Table 4. ***Teachers' perceptions of students' attitudes***

Descriptive Adjectives	Code	Number of frequencies
Engaged	EN	6
Motivated	MO	5
Active	AC	5
Confident	CO	4
Responsible	RE	3

Table 5. ***Skills gained in an ID Class using project***

Items	Code	Number of frequencies
Independent learning	S1	5
Teamwork	S2	8
Communication	S3	4
Critical thinking/ptoblem solving	S4	5
Public speaking	S5	5
Debating	S6	6

Table 6. ***Teachers' collaboration***

Collaboration	Number of Respondents (n=9)	%
Partial Collaboration	2	22%
No Collaboration	7	78%

Table 7. ***Soft-skills acquisition***

Statements	Number of responses 39	Code	%
a. How do you think project-based learning impacts your motivation?	39	ME	84.6%
		MD	7.70%
		CS	/
b. Which of the following was/were developed after working on several projects?	13	CT	33.3%
	23	COM	59%
	18	COL	46.2%
	25	CRE	64.1%
c. What skills do you think project-based learning helps develop?	16	PS	41%
	16	TM	41%
	13	LEA	33.3%
	3	PSK	7.7%

Table 8. ***Students' attitudes in learning through PBL***

Student's Attitudes in Learning through Project Work

Statements	Number of responses	S A	A	N	D	SD
a. Project-based learning engages students in the teaching learning process.	39	15	12	8	4	/
		38.4%	30.7%	20.5%	10.2%	/
b. Project-based learning increases levels of interest and participation.	39	17	16	/	4	2
		43.5%	41%	/	10.2%	5.1%
c. Project-based learning improves attendance	39	15	21	3	/	/
		38.4%	53.8%	7.6%	/	/
d. Project-based learning promotes student-teacher relationship	39	14	18	7	/	/
		35.8%	46.1%	17.9%	/	/
Mean		39%	42.9%	11.5%	5.1%	1.2%

Table 7. ***Soft-skills Acquisition***

Statements	Number of responses 39	Code	%
a. How do you think project-based learning impacts your motivation?	39	ME	84.6%
		MD	7.79%
		CS	/
b. Which of the following was/were developed after working on several projects?	13	CT	33.3%
	23	COM	59%
	18	COL	46.2%
	25	CRE	64.1%
c. What skills do you think project-based learning helps develop?	16	PS	41%
	16	TM	41%
	13	LEA	33.3%
	3	PSK	7.7%

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		43.5%	41%	/	10.2%	5.1%
c. Project-based learning improves attendance.	39	15	21	3	/	/
		38.4%	53.8%	7.6%	/	/
d. Project-based learning promotes student-teacher relationship.	39	14	18	7	/	/
		35.8%	46.1%	17.9%	/	/
Mean		39%	42.9%	11.5%	5.1%	1.2%

Table 10. ***Students' views of acquired skills***

Statements	Number of responses	Code			
		GE	SW	VL	NA
a. Good team-work contributes to the successful outcome of the project.	38	78.8%	20.5%	/	/
b. I got a better understanding of the topic when I participated in the project.	38	60.5%	26.3%	/	/
c. After working on several projects, my writing was…	37	12.4%	15.9%	25%	/

Constructs	GE	SW	VL	NA
Teamwork/Creativity	79%	21%	/	/
Engagement	61%	27%	/	/
Writing	13%	16%	25%	/

Table 11. ***Role of technology in conducting PW***

Constructs	Number of Responses	%
a. Research expansion	32	86.4%
b. Research facilitation	31	83.7%
c. Presentation support	35	94.5%
e. Information literacy	34	91.8%
f. Subjects connection	33	89.1%

Table 9. ***Students' views of communication/interpersonal Skills***

Statements	Number of responses	Code			
		GE	SW	VL	NA
a. I improved my social skills when meeting and talking with my classmates during the project process.	38	39.5%	42.1%	18.4%	/
b. Working on several projects made me accept other people's ideas when they were right.	38	52.6%	23.7%	18.4%	/
Mean		46%	32.9%	18.4%	
c. I learnt how to listen actively to my colleagues while on task.	36	69.4%	22.2%	8.3%	/
d. Working in groups helped me generate ideas and share them with group members confidently.	38	55.3%	26.3%	/	7.9%
e. I learnt how to ask and respond appropriately among group members.	38	26.3%	52.6%	18.4%	/
Mean		50.3%	33.7%	8.9%	0.8%

Table 10. ***Students' views of acquired skills***

Statements	Number of responses	Code			
		GE	SW	VL	NA
a. Good team-work contributes to the successful outcome of the project.	38	78.8%	20.5%	/	/
b. I got a better understanding of the topic when I participated in the project.	38	60.5%	26.3%	/	/
c. After working on several projects, my writing was…	37	12.4%	15.9%	25%	/

Constructs	GE	SW	VL	NA
Teamwork/Creativity	79%	21%	/	/
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c. Presentation support	35	94,5%
e. Information literacy	34	91.8%
f. Subjects connection	33	89.1%

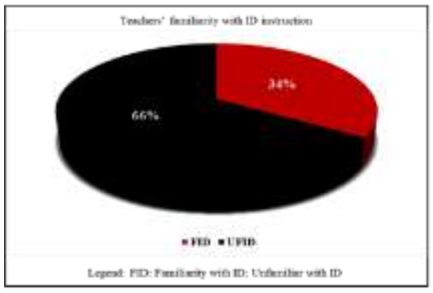
Table 12. ***Knowledge transfer***

Statements	Number of Responses	Y	N
a. The new method of project work helped me transfer knowledge from other subjects to finalise my work.	38	32	6
		84.2%	15.7%
b. Using information from other subjects to complete the project made learning richer and connected.	38	31	7
		81.5%	18.4%

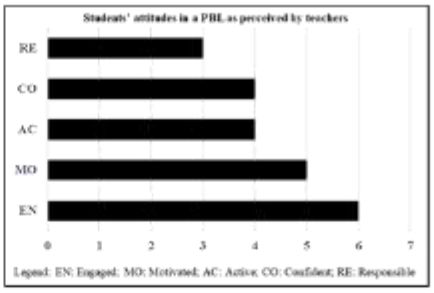
Constructs	Number of Responses	Y	%	N	%
Knowledge transfer	38	32	84.2%	6	15.7%
Enriching experience in ID	38	31	81.5%	7	18.4%

Appendix P
Graphs Recapitulation

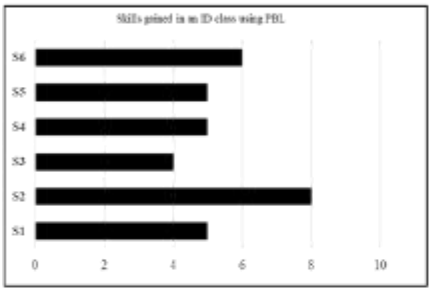
Graph 1. ***Teachers' familiarity with ID instruction***



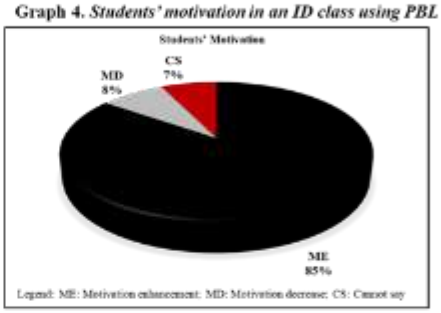
Graph 2. ***Students' attitudes in a PBL as perceived by teachers***



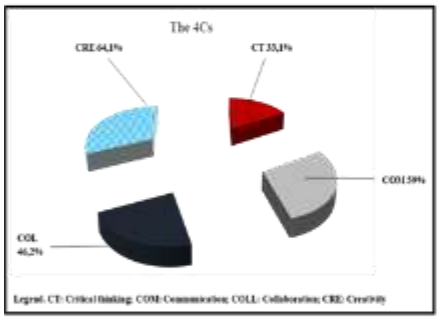
Graph 3. ***Skills gained in an ID class using PBL***



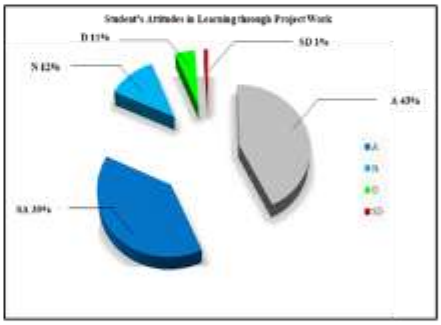
Graph 4. ***Students' motivation in an ID class using PBL***



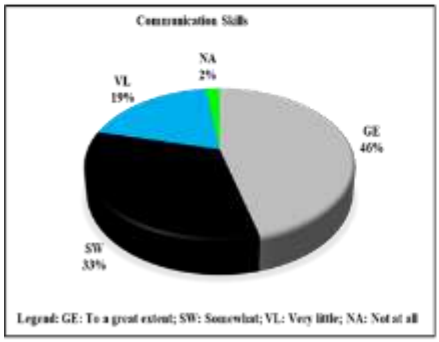
Graph 5. ***The four Cs***



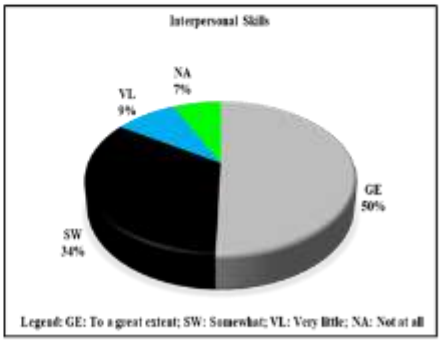
Graph 6. ***Students' attitudes in learning through PW***



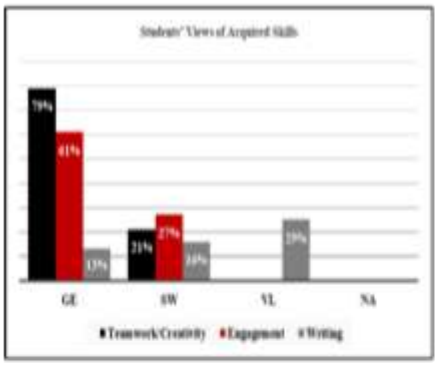
Graph 7. ***Students' Views of communication skills***



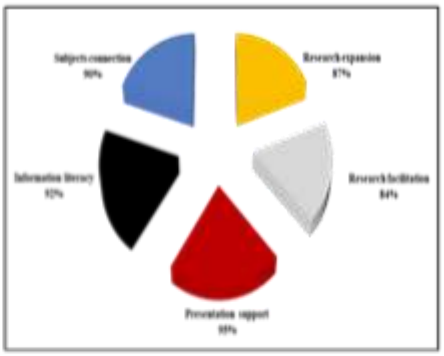
Graph 8. ***Students' Views of interpersonal skills***



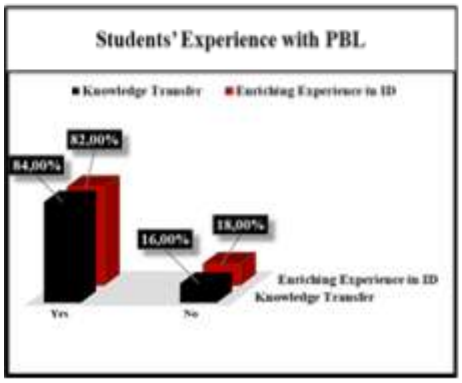
Graph 9. *Students' Views of Acquired Skills*



Graph 10. *Role of technology in a PBL class*



Graph 11. *Students' feedback on knowledge transfer*



Appendix Q
Engaging Activities Use Permission

Re: Permission

YM
Yahoo mail

On Thursday 16 January 2025 at 16:31:20 CET, Azzeddine Bencherab [redacted] wrote:

Dear Zohra,
So good to hear from you after all these years. Happy to learn that you have embarked on a new adventure: PhD.
Regarding my article on Teaching Reading out of the Box, you have my permission to use the engaging strategies for your research. You can cite it as:

Bencherab, A. & N.Sulaivany. Teaching Reading out of the Box by Activating Students' Background Knowledge, pp. 15-22. The Washington Association for the Education of Speakers of Other Languages (WAESOL Journal) accessed at: https://waesol.org/wp-content/uploads/2019/06/Bencherab-and-Sulaivany-Teaching-Reading-out-of-the-Box.pdf

Wish you all the best and keep in touch!
Azzeddine Bencherab

Appendix R
Stoller's Areas of Concern Permission

Fw: permission granted and more

YM
Yahoo mail

From: Fredricka Louise Stoller [redacted]
To: Yahoo mail <ghani.malo8@yahoo.co.uk>
Sent: Tuesday 7 January 2025 at 17:28:48 CET
Subject: Re: permission granted and more

Hi Zohra,

I am happy to give you permission to make use of the two tables from my 2003 *English Teaching Forum* article, referenced in your original email, in your doctoral research. I'm pleased to know that the two tables are so helpful.

Best wishes, Fredricka Stoller

F. L. Stoller, Emerita Professor of Applied Linguistics and TESL, Northern Arizona University, Flagstaff, Arizona USA fredricka.stoller@nau.edu

Appendix S

English Syllabus for Mathematics Students

History of mathematics

Definition

Theory and theorem

Areas of mathematics

1. Number theory
2. Algebra
3. Geometry

Relationship of mathematics with other sciences

1. Physics
2. Natural sciences
3. Finance
4. Biology and chemistry
5. Earth sciences
6. Social sciences
7. Computing
8. Engineering

Statistics

1. Definition
2. Introduction to statistics
3. Data collection
    1. Sampling
    2. Experimental and observational studies
        2.1. Experiments
        2.2, Observational studies

Types of data

1. Descriptive statistics
2. Inferential statistics

Pure and applied mathematics

Muslim/Arab mathematicians

Mathematics education

TD Sessions

Counting/comparing numbers

Calculating percentage

Roman numerals

Measurement

- Lengths
- Weights
- Capacities (volumes)

Telling the time/concept of time (hour, minute, second)

Operations

- Addition
- Substraction
- Division
- Multiplication

Fractions

- Add/substract fractions
- Multiply/divide fractions
- Decimals
- Fractions to/from decimals
- Add/substract decimals

Data and Graphing

- Line graph
- Bar graph
- Pie chart
- Vocabulary related to graphs

List of Project work in Project based learning (Master I and master II)

Name of Project	Purpose/requirement
Create Your Own Website	Design a solution to a problem. Create a website to advertise your solution with clear reasons and relevant evidence to influence buyers.
PSA (Public Service Announcement) Video Project	Create a PSA about a change you'd like to see in your institution and support your opinion by surveying: classmates, teachers, parents, staff) and by creating visual representations with pictures or bar graphs.
Take Action on Current Events	Take action on housing problem, pollution/noise in your city, price incease on certain products….
Bank Awareness & Volunteering	Spread awareness of a local bank to increase its donation.
Produce Your Own Podcast	Convey a compelling story or message using only an audio medium?
Field Trip with a Purpose	Solve an environmental issue in your city (e.g., reduce waste).
Shark Tank Pitch	Craft a compelling business plan that will make investors want to fund your company.
Apps analysis	Select any three social media apps and explain the purpose and features of the new app.
Debate	Debate the relationship between technology and humanity from a historical or modern perspective.
Social Media Analysis	Dissect the 'anatomy' of viral web content, memes, or social media arguments.
Analysis on consumption	Perform a cause-effect analysis on consumerism (or any self-selected topic)