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The Integration of Project-Based Methodology into Teaching in Machine Translation

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Abstract

This quantitative-qualitative analytical research aimed at investigating the effect of integrating project-based teaching methodology into teaching machine translation on students' performance. Data was collected from the graduate students in the College of Languages and Translation, at Imam Muhammad Ibn Saud Islamic University, Riyadh, Saudi Arabia. Quantitative data instruments included a Likert scale questionnaire, students' exam results, and students' assignments. Qualitative data was gathered using two groups, of 20 students each, from the same research population to explore the effectiveness of project-based teaching methodology. The first group of participants was taught for one semester using traditional teaching methods that depended on direct instruction and memorization of information while the second group of participants was involved in creative projects about various topics on machine translation. Content analysis was conducted to evaluate the participants' projects. A comparison of the two groups' final exam results and assignments was made to provide statistical evidence regarding the impact of project-based teaching approach on students' performance. The discussions of this research include topics on theories and systems of machine translation, the concepts of localization and hybridization, project-based teaching methodologies, and educational technology. The recommendations emphasize the importance of adopting brain-based strategies such as project-based techniques in teaching machine translation, providing professional development programs on using cognitive teaching approaches, and equipping translation laboratories with most recent technologies. The significance of this research derives from being a contribution in three specific areas: integrating education research into teaching machine translation to motivate students to improve their performance; employing educational technology to bridge the gap between theories and practice of machine translation; providing an implementation of creative teaching in machine translation through presenting students' creative projects. The integrative teaching model, which the researcher presented in this research, is a new approach for solving students' problems in machine translation.

Keywords: machine translation, project-based teaching, educational technology, creativity

1. Introduction

Machine translation is an automatic translation system that makes use of advanced computational linguistic analysis to process source documents automatically to create target texts without human intervention (Quah, 2006). Research (Arnold, 2003; Austermuhl, 2001; Bhattacharyya, 2015; Cronin, 2003; Garrison & Anderson, 2003; Hutchins, 2005; O'Hagan & Ashworth, 2002) indicated that modern technologies, used in developing machine translation, continue to provide new possibilities for machine translation to develop so as to impact daily professional and social life. With the advancement of technology, the need for machine translation has increased. For example, the Internet has connected people of different languages and cultures around the world in such a way as to make machine translation inevitable for translating webpages, and social networks sites. Moreover, with the spread of personal computers, machine translation is now available for various purposes. Systems of machine translation serve professional and non-professional translators in various fields in life. However, while strenuous research efforts have been carried out to develop machine translation systems, strategies for developing teaching and learning machine translation as an academic discipline are still needed. Teaching and learning machine translation is an arduous task due to its complex characteristics which require pedagogic knowledge in various fields including linguistics, translation studies, mathematics, statistics, and

computational sciences. Because machine translation is a multidisciplinary field, avenues for teaching machine translation, specifically to students who study it for the first time, need to be explored. Hence, the purpose of this research was to investigate the effectiveness of using project-based teaching strategies for teaching machine translation. Project-based methodologies are cognitive teaching tactics that are founded on brain-research. Project-based teaching strategies can also be integrated into problem, and inquiry-based techniques, and since the three approaches are closely connected with information processing learning theories, they can be implemented in machine translation classroom.

Therefore, this quantitative–qualitative research targeted the problems of teaching and learning machine translation. Evidence from the academic records of the graduate students at the College of Languages and Translation at Imam Mohammed Bin Saud Islamic University, Riyadh, Saudi Arabia indicated that students' scores were low. Students complained that they were studying machine translation for the first time because their undergraduate academic plan did not include any courses in machine translation. Students reported that the challenges which they encountered included not only difficulties in understanding the theories of machine translation, but also machine translation practices. Students also complained that lack of lab equipment hindered their learning. Evidence from students' assignments and final exam records pointed to students' low performance. Additional evidence from previous research (Duch, Groh, & Allen, 2001; Gredler, 2005; Schunk, 2011; Williams, 2006) indicated that teaching methodologies affected students' performance, competence, and skills.

Hence, the purpose of this quantitative- qualitative research was to investigate the impact of integrating project-based teaching methodology into teaching machine translation on students' performance. Data was collected from the graduate students at the College of Languages and Translation , Imam Mohammed bin Saud Islamic University, to identify students' problems, and provide empirical evidence regarding the relationships between project-based teaching strategies and students' performance in machine translation. Research (Duch, Groh, & Allen, 2001; Gulpinar, 2005; Sharan & Bierema, 2013; Schunk, 2011) indicated that project-based teaching is founded on brain-research which affected students' motivation, competence, and performance. This research data was analyzed employing the Statistical Package for the Social Sciences (SPSS). In addition, content analysis was used to analyze the qualitative data. The data analysis report provided solutions to the research problems to help students improve their performance in machine translation.

Furthermore, the importance of this research stems from being a contribution in the field of teaching machine translation to graduate students at higher education as it is one of the first studies to integrate project-based teaching methodology to bridge the gap between theories and practices of machine translation in order to help students foster their motivation, and improve their performance. The significance of this research also derives from being a contribution in three specific areas: integrating education research into teaching machine translation to motivate students to improving their performance; employing educational technology to bridge the gap between theories and practice of machine translation; providing an implementation of creative teaching in machine translation through presenting students' creative projects. In addition, the researcher's integrative teaching model, presented in this research, is a new approach for solving students' problems in machine translation.

1.1 Research Qestions

The current research study aimed at investigating the problems of teaching machine translation at higher education, and the he purpose of this research was to examine the determinants of the integration of project-based strategies into instruction. To examine the specific variables that could best predict the process of this integration and its impact on students' performance, the following three questions guided the research study:

1) What are the impacts of project-based teaching methodology on students' performance in machine translation?
2) What is the statistical relationship between project-based teaching strategies and students' grades in machine translation?
3) What is the relationship between educational technology and students' creativity in machine translation?

1.2 Assumptions and Hypotheses

This quantitative- qualitative, analytical research was based on the assumption that project-based teaching methodologies, which are based on the learning theories of brain-research, would affect students' performance in machine translation. Bridging the gap between machine translation theories and practice through involving students in creative projects would help to enhance students' motivation , competence, and performance. Integrating the project-based teaching approach into teaching machine translation would stimulate students'

creative abilities to carry out machine translation projects that would help students understand the concepts and practce of machine translation. Another assumption is that using educational technology tools would facilitaeate students' hybrid learning. Based on these assumptions, the research *hypothesis* states that there is a statistical relationship between project-based teaching methodology and students' performance in machine translation. The null hypothesis is that there is no statistical relationship between project-based teaching methodology and students' performance in machine translation.

1.3 Definitions of Terms

This research includes a number of technical terms that are used specifically in the areas of machine translation and education. The following are the definitions of such terms:

Alignment: is the process of binding a source-language segment to its corresponding target-language segment for creating a new translation memory database or to add to an existing one (Quah, 2006).

Computer-Aided Translation (CAT): machine translation that is used in localization (i.e. customization) industries (Hutchins & Somers, 1992).

Educational technology: refers to the use of technological tools in learning, including machines, networking, and media (Richey, 2008).

Example-based MT: this method relies on a bilingual database of example phrases derived from a large corpus of texts and their translations (Sumita & Imamura, 2002).

Filter: is a feature that converts a source language text from one format into another to give the translator the flexibility to work with texts of different formats; hence a translation-friendly format contains only a written text without any accompanying graphics. In order to obtain such a format, an import filter separates a text from its formatting code (Esselink, 2000).

Fully Automatic High-quality Machine Translation (FAHQMT): MT performed without any intervention of a human being during the process of translation (Bar-Hillel, 1960, 2003).

Fuzzy Matching: occurs when an old and a new source-language segment are similar but not exactly identical due to differences of language usages (Esselink, 1998).

Human-Aided Machine Translation (HAMT): A system wherein the computer is responsible for producing the translation with the interaction of human monitoring at many stages during the process of translation (Hutchins & Somers, 1992).

Hybrid Machine Translation (HMT): is based on using statistical and rule-based translation methodologies (Hutchins & Somers, 1992).

Machine translation (MT): An automatic translation system with no human intervention that makes use of an advanced computational linguistic analysis to process source documents and automatically create target texts (Quah, 2006).

Machine-Aided Translation MAT: is used by software community, which develops machine tools in order to perform the tasks of translation (Hutchins & Somers, 1992).

Machine-Aided Human Translation (MAHT): refers to the act of translation as cooperation between the human translator and the machine. The focus of machine-aided human translation is on the human translator who uses a number of tools such as a grammar checker, which examines the grammatical errors that appear because they do not conform to the pre-determined set of grammatical rules stored for a particular language (Hutchins & Somers, 1992).

Machine-aided Translation (MAT): The use of computer programs by translators to help them during the translation process (Hutchins & Somers, 1992).

Perfect Matching: is the exact match which occurs when a new source language segment is completely identical to the old segment found in the database , including inflections, spelling, punctuation (Austermuhl, 2001).

Project-based teaching methodologies: are cognitive teaching strategies that are founded on brain-research, and are connected with various learning theories such as information processing, inquiry-based, problem-based, constructivism, connectivism, and cognitive apprenticeship, among others (Schunk, 2011).

Segmentation: is the process of breaking a text up into units consisting of a word or a string of words that is linguistically acceptable; and this process is needed in order for a translation memory to perform the process of fuzzy and perfect matching (Quah, 2006).

Translation Memory (TM): is a multilingual text archive containing (segmented, aligned, parsed and classified) multilingual texts, allowing storage and retrieval of multilingual text segments against various search conditions (EAGLES, 1996).

Terminology Management Systems: refers to a systematic arrangement of concepts within a special language, and since this system is based on concepts not terms; therefore it is systematic not alphabetical (Bononnon, 2000).

Workbench/Workstation: is a single integrated system that is made up of a number of translation tools and resources such as electronic dictionaries terminology databases, a translation memory, an alignment tool, a tag filter, a terminology management system, and spelling and grammar-checkers (Quah, 2006).

1.4 Theoretical Framework

The theoretical framework of this research is based on linking the theories of MT translation to learning theories of cognition. MT does not depend on a single linguistic theory because the majority of MT systems are amalgams of different approaches and models (Hutchins, 2005). The current research focused on examining two approaches of MT theories, namely, the linguistic/translation, and the computational perspectives. The linguistic theories adopted in MT deal with different systems of MT analysis. Theories of Chomsky's (1957, 1965) transformational and generative grammar, Jakobson's (1959, 2000) functions of the language, Halliday's (1985) systematic functional grammar, and Nida's (1964, 1974) translation theory dichotomy of oppositions, Catford's (1965) contrastive analysis, and Newmark's (1988, 1998) semantic-communicative translation theory, were used in the first MT systems. The linguistic analysis depends on either word-for-word transfer, which is the replacement of one word in the source text with another word in the target text, or sense-for-sense transfer, which is preserving the meaning of the source text rather than precise wording. Reiss and Vermeer's (1984), and Vermeer's (1996) Skopos theory, which focused on the purpose of translation, allowing source language texts to be translated into a number of different target texts, were also applied. Lederer's (1994, 2003) interpretive model, and Manttari's (cited in Munday, 2009) translational action, when translation is performed by the information implied in the source text, has impacted the development of machine translation. In this regard, Baker (1999) argued that the corpus-based approach of the language of translation was useful for understanding the purposes of translation and its complex process. Hence, linguistic theories adopt either a formal approach, which represents the formalism school of grammar, when emphasis is put on the description of morphological and syntactic structures, or a functional approach, which characterizes the pragmatic school of language, when language is viewed as a form of social interaction.

Based on linguistic/translation theories, Hutchins and Somers (1992) divide MT system analysis into three different approaches, including: direct, transfer-based, and interlingua. The direct approach uses lexical analysis for direct translation in which each word in the source language is translated directly to its equivalent in the target language without any intermediate phases in the translation process. The transfer based-system uses syntactic and semantic analysis of the source language to transfer the meaning when the translation is achieved through three phases: converting source language texts into an intermediate representation, known as the parse trees; converting the intermediate representations into equivalent ones in the target language; then generating the final target language tex. The interlingua approach depends on converting the source texts into representations common to more than one language, and translation is accomplished in two stages: from source language to the interlingua and from the interlingua to target languages (Hutchins, 2005). Nida provided the basic approach for an applicable translation process that was employed in machine translation, known as rule-based MT. Rule-based MT systems made use of three phases of the translation process introduced by Nida , namely, analysis, transfer, and restructure. Whatever the difficulty in the translation process is, procedures must aim at the essence of the message and faithfulness to the meaning of the source language text being transferred to the target language text. According to Nida and Taber (1974), the process of translation consists of reproducing the target language texts to the nearest possible equivalent in the target languages, converting the semantic aspect, in the first place, then the stylistic aspect. Therefore, the early MT systems used large bilingual dictionaries and coded rules when generative linguistics and transformational grammar were applied to improve the quality of translations.

In this respect, Bennett (2003) confirmed that incorporating linguistic approaches when building MT architectures was necessary to produce effective systems that could be operated at acceptable speed on any standard computer. Holmes (1988, 2000) proposed a conceptual schema of MT approaches, which depended on translation theories. Holmes classified the translation theories and studies to be incorporated into MT into two main branches, namely, *Pure Translation Studies*, and *Applied Translation Studies*. *The Pure Translation Studies* branch includes levels and sub-branches of descriptive translation theories while the *Applied Translation Studies*

branch consists of four sub-branches, which include: policy, aids, and translation evaluation and criticism. Holmes explained MT theory in terms of the stages that are carried out in the automation of translation, which include: pre-editing of the source text; the input, which is the processing stage; the output, which is the product after being processed; and the post-editing of the target text. Quah (2006) noted that Holmes' schema is "flexible enough to allow changes and developments to occur when technology is involved in both the Pure and Applied Branches" (p. 37).

The second approach of MT theories is computational. The development of controlled Language in 1932 when simplified English was introduced by Charles Ogden via the publication of BASIC (British American Scientific International, Commercial) contributed in developing new MT systems. BASIC aims at using the type of English which is appropriate for science and commerce. In the 1970s, the Caterpillar Fundamental English (CFE) was introduced for commercial use by the Caterpillar Tractor Company. In the 1990s, Caterpillar Technical English (CTE) was developed by Caterpillar. The characteristics of CTE include standardization of English terminology, and comprehension of native and non-native English documents, which facilitated translation into other languages. The computational concepts motivated researchers to develop MT computational architectures which include several systems such as rule- based (RBMT), statistical (SMT), example- based (EBMT), and hybrid. The rule- based machine translation (RBMT) uses linguistic theories which emphasize rules such as lexical transfer, morphology, and syntactic analysis to convert the meaning from one language into another. The translation process in RBMT relies on analyzing the input text morphologically, syntactically and semantically to generate the output text via structural conversions. However, the statistical MT system (SMT) "is characterized by the use of machine learning methods" (Lopez, 2008, p.2), which means that SMT has a learning algorithm that is applied to a large body of previously translated texts, known as parallel corpus. SMT is based on probability by identifying patterns in texts translated by human translators, then selecting the highest probable translation. The example-based approach (EBMT) collects a bilingual corpus of translation pairs and uses the best match algorithm to find the closest example to the source phrase or sentence. The hybrid MT system combines the transfer approach with either SMT approach or the EBMT approach. Hence, the hybrid MT system deals with the full range of language phenomena, complexities of terminology and structure, misspellings, and ungrammatical sentences.

The other group of theories that constitutes the theoretical base of the current research encompasses the cognitive learning theories upon which the project-based learning/teaching strategies are designed. According to Schunk (2011), project-based teaching methodologies are founded on brain-research, and connected with various learning theories such as cognitive apprenticeship, information processing, inquiry-based, problem-based, designed-based, and constructivism. Research (Angelone & Shreve, 2010; Clark & Paivio, 1991; Deceased & Shermis, 2003; Jonassen, et.al, 2003; Illeris, 2009; Sharan & Bierema, 2013) indicated that cognitive learning theories impact students' intrinsic motivation and active learning. Therefore, the current research focused on integrating project-based methodologies into teaching MT to motivate students to understand translation theories, and to provide multiple learning opportunities to put such theories into practice.

2. Literature Review

The discussions in the literature review include topics on the development of machine translation, the systems of machine translation, the concept of hybridization and quality of translation, project-based teaching methodology, and educational technology. An evaluation of the use of machine translation in the real world is also provided.

2.1 The Development of Machine Translation

According to Wilks (2009), the period from 1400s to 1600s was the discovery era which necessitated enhancing communication among speakers of different language. In the 17th century, Leibniz and Descartes proposed their research on codes to relate words between languages. In the 1930s, Georges Artsrouni developed an automatic bilingual dictionary. In 1949, Warren Weaver presented his Translation Memorandum, which was the first proposal on computer-based machine translation. Weaver was influenced by McCulloch and Pitts' (1943) theory on mathematical modeling of the neural structure of the human brain when he proposed the applicability of cryptographic methods. The concept of cryptography is related to Claude Shannon's information theory. Shannon's theory is concerned with the basic statistical properties of communication. The most significant outcome of the Weaver's Translation Memorandum' was the decision in 1951 at the Massachusetts Institute of Technology to appoint the logician Bar-Hillel to research the use of mathematical formulae in machine translation.

In 1950s, the researchers at Georgetown University experimented with a fully automatic translation of more than sixty Russian sentences into English. Bar-Hillel (1953), argued that MT systems did not operate effectively

because the focus was on translating words rather than the meanings of the texts, and that FAHQMT should not be the goal of machine translation researchers. The actual progress of MT applications began with the Automatic Language Processing Advisory Committee's (ALPAC, 1966) report, which contained an evaluation of ten years of research, pointing to the feasibility of high-quality machine translation. The first MT research in the 1960 and 1970s depended on linguistic theories of translation, and the research was conducted using empirical trial-and-error methods, adopting statistical analysis of grammatical and lexical regularities among different languages. Thus, the first MT generation applied word-for-word translation method, translating only 250 words, six grammar rules and 49 sentences. However, US government funded large-scale projects to develop MT systems.

The second MT generation systems (from mid-1960s until 1980s) used a large lexicon and a small syntax. The number of MT installed systems increased, including mainframe technology, SYSTRAN, LOGOS, ARIANE-G5, METAL, and METEO. The ALPS (Automatic Language Processing System) was developed, using multilingual terminological data manipulation systems. SYSTRAN was widely used, and the METEO system was in operation in Canada from 1982 to 2001. Pan American Health Organization built two mainframe systems: from Spanish into English (SPANAM); and from English into Spanish (ENGSPAN). According to Guerra (2000, p. 74), these systems were successful for translating conference documents, scientific papers, training materials and technical brief reports. Gouadec (2007) noted that the spread of the Internet activities and the increase of personal computers changed communication practices beyond paper files to enhance the use of electronic emails, word processing, translation memory tools, and terminology management systems. Thus, the progress that MT made resulted in increasing the number of professional and non-professional translators, and localizations.

Moreover, the advent of the millennium witnessed the invention of new technologies, and the birth of the third generation with focus on statistical, example-based MT, corpus-based, and hybrid systems. MT was used for interpretation, speech translation, speech recognition, and speech translation for deaf people. Many projects such as TC-STAR, in Europe, and STR-DUST and US-DARPA-GALE, in the United States, focused on automatically translating political speeches and broadcast news whereas the French –German project QUAERO examined the application of machine translations for a multi-lingual Internet to translate webpages, audio and videos files. Thus, the development of MT has played an important role in enhancing media interactions, and cross culture communication. While MT researchers and engineers have not developed a perfect fully automatic high quality translation (FAHQT), yet, there are many systems which provide advanced machine translation services.

2.2 Systems of Machine Translation

MT systems are based on translation memory systems. According to EAGLES (1996), translation memory is a multilingual text archive which contains segmented, aligned, parsed and classified multilingual texts, and it allows the storage and the retrieval of multilingual text segments against various search conditions. Segmentation is the process of breaking a text up into units consisting of a word or a string of words that is linguistically acceptable; and this process is needed for the translation memory to perform fuzzy or perfect matching processing. Alignment is the process of binding a source-language segment to its corresponding target-language segment for creating a new translation memory database or to add to an existing one. According to Bononno (2000), terminology management system is a systematic arrangement of concepts within a special language, and since this system is based on concepts not terms; therefore it is not alphabetical. In such a system, each concept has a label, called a term which is a single word or a string of words used to represent it into the language of the specialized field.

According to Hutchins (2000), a machine translation system can be classified as operating on one of three levels: *basic, standard*, or *advanced*, depending on the size of the dictionaries and the syntactic analysis used. The *basic level* contains less than 50,000 entries in its largest dictionary, with restricted dictionary expansion, and restricted to single-clause translations, therefore, it is suitable for home use. The *standard level* has more than 50,000 entries in its largest dictionary, allowing dictionary expansion, and permitting more than single-clause translations; and it is suitable for home and office. The *advanced level* has more than 75,000 entries in its smallest dictionary, and it allows dictionary expansion, and is capable of more than single-clause translations; hence, it is suitable for offices with network facilities.

MT systems include linguistic and computational architectures. The linguistic architecture consists of the direct approach, the transfer-based approach, and the interlingua approach. The computational architecture includes the rule-based approach, the corpus-based approach, and the hybrid approach. Quah (2006) observed that the rule-based system is deductive because it is based on linguistic rules built in the system by the designers. The corpus-based system is inductive because the rules are derived from the translation examples and modification

can be made by adding new translation examples. Furthermore, in new MT systems, workbench or workstation systems were developed as a single integrated system which is made up of a number of translation tools and resources such as a translation memory, an alignment tool, a tag filter, electronic dictionaries terminology databases, a terminology management system and spelling and grammar-checkers. The database model has a component that stores all previously translated material in one database. In the reference model, the translation database is empty until relevant source and target-language texts are loaded into it. The new MT systems also have a *concordancer*, which is an electronic tool used in language learning, literary analysis, corpus linguistics, terminography and lexicography. The *concordancer* allows the user to select a phrase and displays the uses of that word or phrase in a selected corpus in order to show where and how often it occurs, and in what linguistic contexts it appears. Localization tools have also been added to the new systems. Localization covers three issues: language, culture, and technicalities. The localization process involves three stages: the project, the preparation, and the translation with quality assurance.

2.3 The Concept of Hybridization and Quality of Translation Technology

Hybridization refers to the strategies of combining two or more MT systems together to improve the translation process. For example, Costa-jussà and Fonollosa (2015) argued that a hybrid system could incorporate corpus-based rules or combine various corpus-based approaches. This combination can be effected in two main ways: using rules at pre/post-processing, or integrating dictionaries/rules into the core model. The applications of MT with hybrid components include retrieval of cross-lingual information, computer-aided translation, and speech translation.

In this respect, Hunsicker, Yu, and Federmann (2012) introduced the *substitution-based*, *hybrid MT system* after examining a number of MT systems, including the Open Source Machine Translation System Combination (Barrault. 2010), Lucy RBMT system, as described in Hunsicker, Yu, and Federmann (2012), Moses, Open Source Toolkit for Statistical Machine Translation (Koehn et al., 2007), and Joshua, Open Source Toolkit for Parsing-Based Machine Translation (Li et al., 2009). Hunsicker, Yu, and Federmann argued that while statistical MT (SMT) systems suffered from a lack of grammatical structure, resulting in ungrammatical sentences, RBMT systems had problems with a lack of lexical coverage. Hybrid architectures intend to combine the advantages of the individual paradigms to achieve an overall better translation. Federmann et al. (2010) and Federmann and Hunsicker (2011) believed that using a substitution based approach could improve the translation quality of a baseline RBMT system. Therefore, the output of an RBMT engine serves as the translation backbone. In other words, Hunsicker, Yu, and Federmann's proposal of the hybrid system architecture combines translation output from the Lucy RBMT system (Alonso & Thurmair, 2003); the Linguatec RBMT system (Aleksic &Thurmair, 2011); Moses (Koehn et al., 2007); and Joshua (Li et al., 2009).

2.4 Project Based Teaching Methodology

According to Schunk (2011), project-based techniques are connected with cognitive learning theories that require a shift in learning objectives so as to stress higher order thinking skills and performance-based assessments. Cognitive learning theories emphasize that instruction should be as meaningful as possible to the learner, and that information should be introduced in an authentic context, and in collaborative interactions. Research (Duch, Groh, & Allen, 2001; Gredler, 2005) indicated that project-based teaching, which is based on brain research, can stimulate learners' cognitive abilities and help students improve their performance. Project-based teaching approach is founded on inquiry-based learning, emphasizing questioning and critical thinking. Project-based teaching techniques urge students to determine their own learning goals, expectations, and achievement standards. Learning, thus, becomes experiential, meaningful, and valuable. In this light, Dewey (1916) defined education as "reorganization and reconstruction of experience which adds to the meaning of experience, and which increases the ability to direct the course of subsequent experience" (p. 76).

Hence, the primary difference between project-based teaching strategies and traditional teaching methods is that the traditional approach is basically teacher-centered, which depends on direct instruction to explain, or describe knowledge in a sequential order whereas the project-based method is student-centered, which implements collaborative activities to analyze, criticize, evaluate, and create new knowledge in a non-linear way. Furthermore, project-based teaching approach can be integrated into problem and inquiry-based techniques because the three approaches are related to the information processing strategies, which can be applied through using technology as a learning tool. Using technology creates open-ended learning opportunities for students. Watson (2005) argued that project-based learning focuses on developing creativity whereas problem-based learning relies on the process of solving problems. Some of the benefits of project-based techniques include the enhancement of cooperative learning, and critical and creative thinking.

2.5 Educational Technology

Research **(**Beldarrain, 2006; Dudeney & Hockly, 2007; Ellison & Wu, 2008; Glass & Spiegelman, 2007; Juniu, 2006) indicated that the application of educational technology such as Web 2.0 and Web 3.0 changed teaching and learning significantly. Using educational technology in conjunction with machine translation is of utmost importance in implementing a project-based methodology as students can use various technological tools to carry out their projects. For example, multimedia packages, such as video applications, can be used by teamwork for sharing information. Film making engages students in the processes of exploration, construction, and reflection on a subject while the finished film is the *visualization of the process of learning.* Juniu argued that educational technology facilitated "alternative pedagogical models of guided and reflective inquiry through extended projects that generate complex products and results in the assimilation of information" (p.71). Incorporating technology into project-based strategies can increase motivation. Technology can foster the inquisitive process that students need to become inventors and innovators. Moreover, Zhang (2010) asserted that using computers, and multimedia-network technology helped in changing the lecture-based teaching process into interactive models of involving students in active learning. The Internet has become a pedagogical approach to stimulate inquiry-based learning when students formulate investigative questions, analyze information, and construct new knowledge.

3. Research Method

3.1 Participant Characteristics

This quantitative-qualitative, analytical research aimed at examining the impact of integrating a project-based problem into teaching machine translation on students' performance. The participants were selected from the graduate students who studied machine translation for the first time, at the College of Languages and Translation at Imam Mohammed bin Saud Islamic University, Riyadh, Saudi Arabia. The sample contained 100 participants, who voluntarily agreed to complete the research questionnaire. However, cultural constraints affected the scope of this research since the research sample was selected from *only* feamle graduate students. The participants' age profile ranged between 21-25 with the percentage of 74% , and 19-20 with the percentage of 26%. The participants' social status indicated that 74% were married , and 26% were single. Regarding the participants' language profiles, and based on their GPA, the percentage of students with advanced language level reached 85%. The advanced level refers to language scores between 85-99 out of 100. The intermediate language level reached 71%. The intermediate level points to language scores between 70-84 out of 100. Furthermore, qualitative data was gathered using two groups, of 20 students each, from the same research population, to explore the effectiveness of project-based teaching methodology.

3.2 Measures

A 5-point Likert- scale questionnaire, ranging from strongly agree to strongly disagree was used to collect this research quantitative data. The first part of the questionnaire provided the participants' demographic information. The second part of the questionnaire included 29 items regarding the problems of machine translation and the integration process of project-based strategies into teaching methodologies. Qualitative data was gathered using two groups, of 20 students each, from the same research population to explore the effectiveness of project-based teaching methodology. The first group of participants was taught for one semester using traditional teaching methods that depended on direct instruction and memorization of information while the second group of participants was involved in creative projects about various topics on machine translation. Quantitative data was coded and analyzed using the Statistical Package for the Social Sciences (SPSS) while qualitative data was coded and analyzed using and Nvivo 9 software. The questionnaire reliability was calculated using Cronbach's alpha. Table 1 displays the results.

Table 1. Descriptive statistics of data predictors and reliabilities

Question	Cronbach's Alpha	Question	Cronbach's Alpha	Question	Cronbach's Alpha
Q01	.995	Q11	.995	Q21	.995
Q02	.995	Q12	.995	Q22	.995
Q03	.995	Q13	.995	Q23	.995
Q04	.995	Q14	.995	Q24	.995
Q05	.995	Q15	.995	Q25	.995
Q06	.995	Q16	.995	Q26	.995
Q07	.995	Q17	.995	Q27	.995
Q08	.995	Q18	.995	Q28	.995
Q09	.995	Q19	.995	Q29	.995
Q10	.995	Q20	.995		

As shown in Table 1, the results are within the acceptable limit reflecting that the questionnaire is reliable. The overall Cronbach's Alpha is 0.995.

3.3 Procedures

Before applying the integration process of project-based strategies into teaching machine translation, this research participants responded to the questionnaire questions to identify and document the students' problems. Students' exam results and assignments were also analyzed statistically. The second step was using two groups, of 20 students each, from the same population of the present research to explore the effectiveness of project-based teaching methodology. The first group of participants was taught for one semester using traditional teaching methods that depended on direct instruction and memorization of information while the second group of participants was involved in creative projects about various topics on machine translation. The third step was conducting content analysis to evaluate the participants' projects. A comparison of the two groups' final exam results and assignments was made to provide statistical evidence regarding the impact of project-based teaching approach on students' performance.

Regarding the projects apparatus procedures, the first procedure was to create the participant's profiles. The profiles operated like a database for the whole project of this research. The profiles were designed to record each participant's cognitive and affective abilities, including performance level, motivation, learning style, competence, technology skills, and collaborative skills to determine how the projects would be designed and implemented. The second procedure was creating a workstation in the lab. Figure 1 shows an image of the workstation.

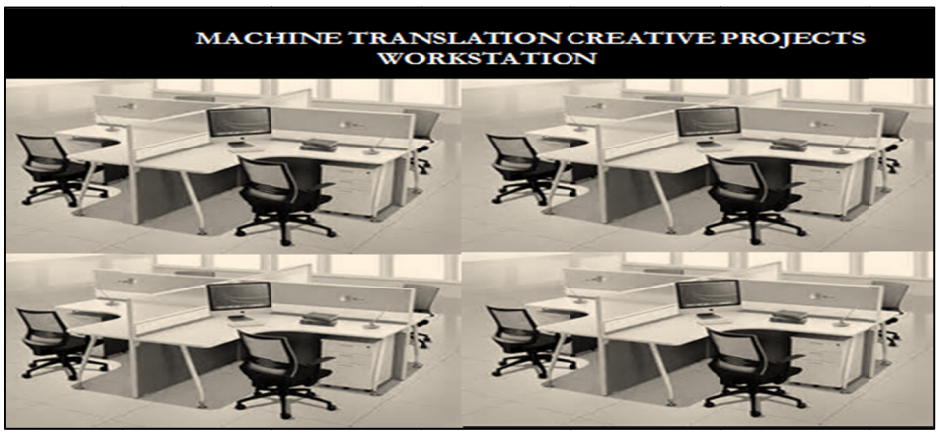

Figure 1. Participants' Workstation

As shown in Figure 1, the workstation is designed so that students learn the concept of MT workstation as it exists in real life. The third procedure was dividing the participants into smaller groups of 2, 3, 4, 5, and 6 students. The fourth procedure was discussing the concept of project-based learning/teaching methodology, the project's requirements, and technological tools such as Web 2.0, Web 3.0, and Web 4.0, teamwork charter, and the project's evaluation rubric. For example, some participants used Web 2.0 online collaboration tools such as YouTube, VoiceThread, MovieMaker, Xtranormal, Diigo, Prezi, and Podcast, among others.

3.4 Data Analysis

The correlations among the items of the questionnaire were calculated and found to be significant at the level of 0.01. The results were within the acceptable limit, as the overall Cronbach's Alpha was 0.995. To validate H_1, *there is a statistical relationship between project-based teaching methodology and students' performance in machine translation*, the researcher used the independent sample *t*-test to explore if there was any statistical significant difference between the two groups. The results showed a statistical significant difference between group A and group B at the level of 0.1 as the 2-tailed significance was less than 0.1 and the *t* values of items exceeded that of df (99) which was 2.6264. Thus, the *null* hypothesis, *there is no statistical relationship between project-based teaching methodology and students' performance in machine translation* is rejected.

4. Results

Data analysis results include the following two reports:

4.1 Results of Quantitative Data Analysis

Data analysis revealed that the questionnaire had a 91% return rate. The majority of the respondents (88%) *strongly agreed* that teaching methods affected their' performance negatively, 80% *strongly agreed* that classroom learning activities aggravated their problems, 78% *agreed* that teaching methods affected their motivation, and 76% *strongly agreed* that lack of lab equipment prevented them from putting MT theory into practice. Data analysis also revealed that the percentage of participants who had problems with MT reached 76% which reflected their low performance. Only 22% of the participants were performing within the advanced level. The results of students' skills in using technology are displayed in Figure 2.

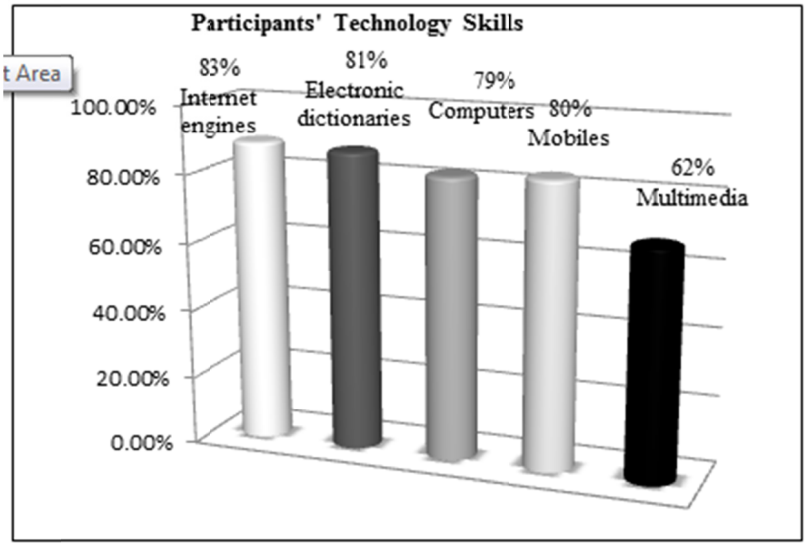

Figure 2. Participants' Technology Skills

Figure 2 shows that the participants' highest skills are the Internet, reaching 83% while the percentage of their skills in using mobile phones is 80%, and the percentage of their skills in using electronic dictionaries is 81%. The percentage of the participants' computers skills reached 79% whereas the percentage of their skills in using multimedia is only 62%. Furthermore, data analysis revealed the frequency of students' responses to the questionnaire items regarding the problems that hindered them from achieving high grades. Figure 2 shows the results.

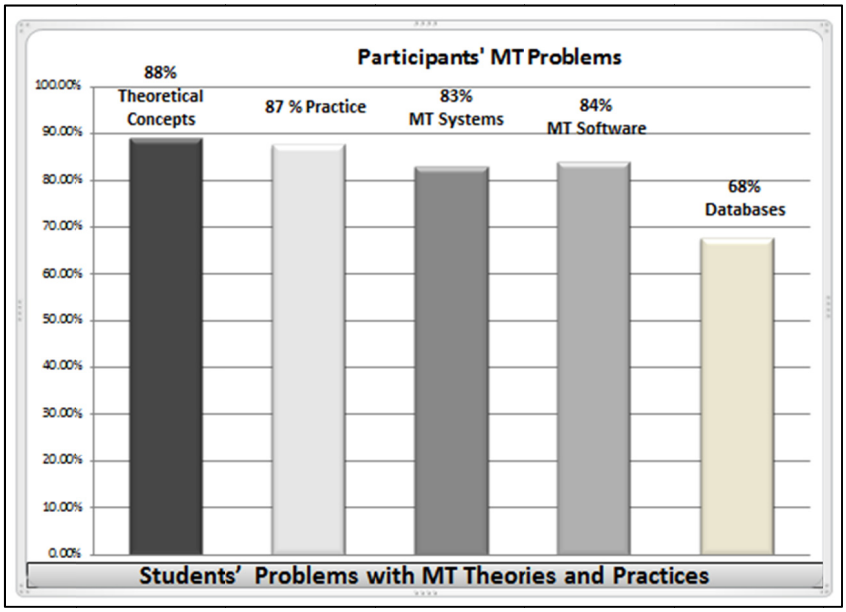

Figure 3. Participants' MT problems

Figure 3 displays the participants' MT problems indicating that 88% of the participants had problems understanding the theories and the conceptual bases of MT, and 87% of the participants had problems applying theories into practice. The percentage of participants who had problems with understanding MT systems reached 83% while 84% did not understand the MT software features, and 68% did not know the impact of MT database on translation quality. These results revealed that the participants' primary problem was inability to perceive the relationship between translation, linguistics, computational science, and MT. Students did not understand their roles as interveners to pre-edit and post-edit the source and target texts. Such results also reflected students' lack of understanding of the analytical and evaluative tasks involved in MT. Furthermore, data analysis showed the cumulative percentage of participants' understanding of the relationship between gaining experience through practice and the level of translation performance. Table 2 displays the results.

Table 2 . Participants' perception of the relationship between MT theory and practice

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	3	3.0	3.1	3.1
	Rarely	3	3.0	3.1	6.1
	Sometimes	27	27.0	27.6	33.7
	Frequently	27	27.0	27.6	61.2
	Always	38	38.0	38.8	100.0
	Total	98	98.0	100.0	
Missing	9	2	2.0		
Total		100	100.0		

As displayed in Table 2, only 38% of the participants were *always* aware of the impact of MT practice on their performance while 27% of the participants were *frequently* aware of such a relationship. The cumulative percentage of participants who were *sometimes* aware of the effect of MT practice on their performance reached 33.7%. Such results showed that students did not use MT to identify and solve translation problems. Table 3 shows the results.

Table 3. Frequency of identifying and solving MT problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	3	3.0	3.1	3.1
	Rarely	12	12.0	12.2	15.3
	Sometimes	44	44.0	44.9	60.2
	Frequently	26	26.0	26.5	86.7
	Always	13	13.0	13.3	100.0
	Total	98	98.0	100.0	
Missing	9	2	2.0		
Total		100	100.0		

Table 3 shows that only 13 % of the participants *always* identified and solved MT problems when they were involved in translating various texts while 26% *frequently* identified and solved MT problems. The frequency tables revealed students' problems in studying MT, which were clearly due to a gap between theory and practice. Moreover, the researcher calculated the internal consistency of the questionnaire, and results indicated that all the statements in the questionnaire were statistically significant at the level of 0.01, as they all exceeded the level of 0.8, reflecting their consistency.

4.2 Qualitative Data Analysis: Students' Creative Projects

The project topics focused on MT concepts and their applications, which included workstation , workflow, MT systems and architectures, database model, database –reference model, coding, encoding, direct system, rule-based MT, corpus-based MT, hybrid MT, translation memory systems, terminology management systems, segmentation, filter, alignment, concordances, localization tools, among others.

A rubric was created to assess the projects. The evaluation rubric included 5 categories: project content, language level, application of theories, technology level, and translation skills. Each category carried 20 points in the rubric scale. The scores from 95-100 refer to the high advanced level A+. The scores from 90-94 refer to low advanced level A. The scores from 85-89 refer to the high intermediate level B+ while the scores from 80-84 refer to B, which is low intermediate. The scores from 75-79 refer to C which is the average level while the scores from 70-74 refer to below average level C-. The scores from 65-69 are the weak level whereas the scores from 60-64 refer to passing unsatisfactorily. The scores below 60 refer to a very weak performance that requires repeating the experience of project-based environment.

Table 4. The emergent themes for integrating project-based strategies into teaching MT

Emergent Themes	Number of Participants
Integration of Project-based into MT is Effective	97
Project-based Methodologies Facilitate Learning	95
Project-based Strategies Enhance students' Motivation	98
Integration of Project-based strategies into MT Fosters Creative Thinking	92
Incorporation of Project-based strategies into MT Enhances Critical Thinking	89
Project-based Teaching Engages Students in the Assessment Process	86
Integration of Project-based strategies into MT Strengthens Active Learning	90
Integration of Project-based strategies into MT Enhances Independent Learning	87
Project-based Methodologies Narrow the Gap between MT Theory and Practice	94

Table 4 shows that nine themes emerged from the analyses of the qualitative data, which include project-based strategies enhance students' motivation (98 out of 100 participants), project-based methodologies facilitate learning (95 out of 100 participants), project-based methodologies narrow the gap between MT theory and practice (94 out of 100 participants), the integration of project-based methodologies into MT fosters creative

thinking (92 of 100 participants), the integration of project-based into MT strengthens active learning (90 out of 100 participants), the incorporation of project-based into MT enhances critical thinking (89 out of 100 participants), the integration of project-based methodologies into MT strengthens independent learning (87 out of 100 participants), project-based teaching engages students in the assessment process (86 out of 100 participants). The number of participants who confirmed the effectiveness of integrating project-based methodologies into MT reached 97 out of 100 participants. Such results indicate that teachers need to integrate project-based teaching methodologies into teaching machine translation. Some samples of the participants' projects and the content analysis report on each one are presented herein (see references for projects web links). Figure 4 represents a snapshot of the first project on automatic bookmarking and web translation (Project #1, Video file, 2015).

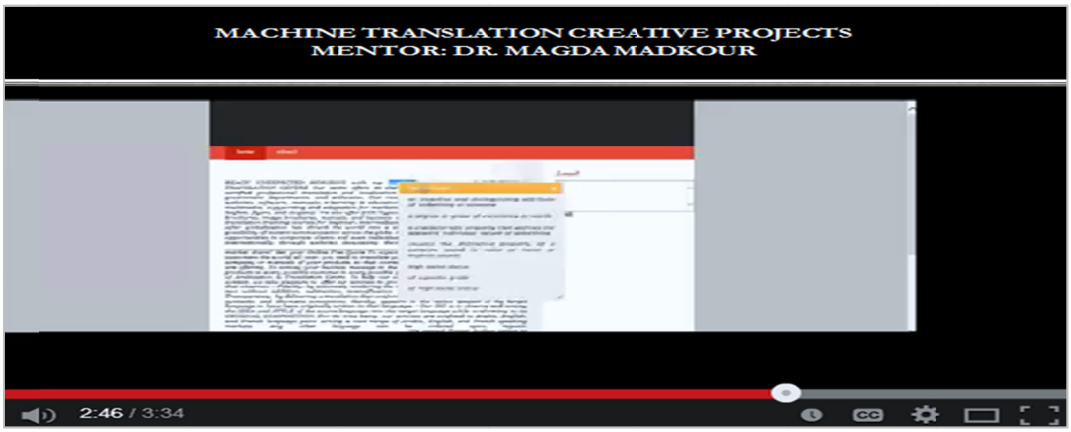

Figure 4. Project # 1: MT for automatic bookmarking and web translation

As shown in Figure 4, in project # 1, students focused on using online bilingual and multilingual dictionaries, and thesauruses to bookmark and translate automatically important information on the web. The participants used the color palette tool to highlight the information that web users may need to review at any time. Bookmarking, looking up difficult words, highlighting information using different colors, all were done through MT automatic systems. This project was completed by collaborating with an expert in information technology. Therefore, students were involved in new learning opportunities that helped them to understand machine translation as a multidiscipline subject. Figure 5 shows a snapshot of project # 2 (Project #2, Video file, 2015).

Figure 5. Project # 2: improving omega T

Figure 5 displays project # 2 which was oriented towards OmegaT. This project aimed at helping students learn

about the functions of terminology management systems in practice, the characteristics of translation memory, and MT terminology concepts. In this project, the participants downloaded OmegaT, and practiced maintaining a database, establishing terminological resources for dictionaries and glossaries, and manipulate terminology resources. MT corpus systems were also discussed. The participants experienced using online corpus. In this project, the participants provided some suggestions to improve OmegaT by including the Arabic online corpus from the official website of *Arabicorpus* (2015). Adding such online corpus can be helpful as it can operate as a monolingual concordancer to allow users select a phrase and display the uses of that word or phrase in a selected corpus. The Arabic online corpus can also help in using the correct terminology. Because OmegaT is written in Java, students discussed language programming and the computational theories that are implemented in MT. Statistical MT systems were analyzed, together with such concepts as fuzzy matching, matching propagation, simultaneous processing of multiple-file projects, simultaneous use of multiple translation memories, the use of Microsoft Word, Excel, Power Point files (.docx, .xlsx, .pptx), and XHTML and HTML applications, which are OmegaT features. Figure 6 displays a snapshot of Project # 3 about using the concordancer tools (Project #3, Video file, 2015).

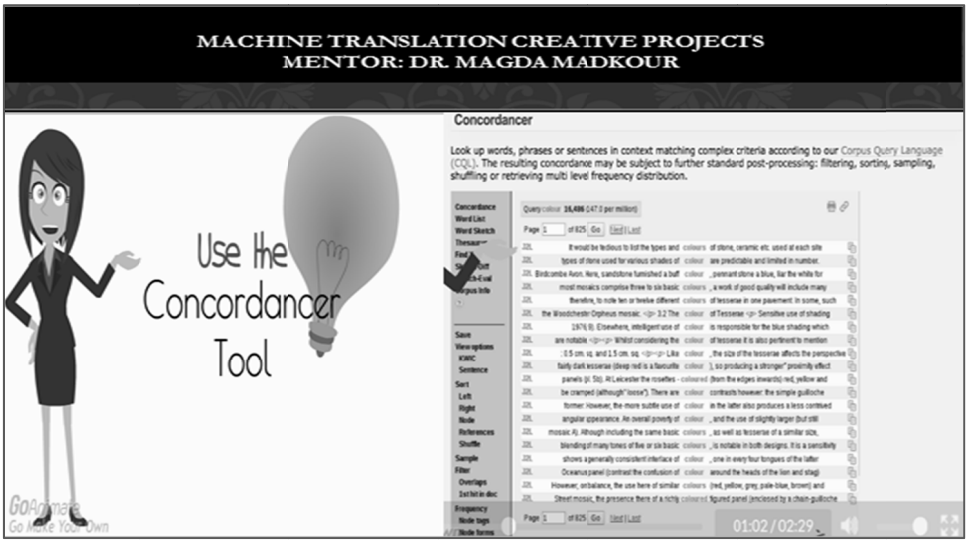

Figure 6. Project # 3: Using concordancer tools

As displayed in Figure 6, **i**n project # 3, the participants worked on a video to define the concordancer as an electronic tool which they used in language learning, literary analysis, corpus linguistics, terminography and lexicography. The participants selected some phrase and displayed the uses of the word or phrase in the selected corpus in order to show where and how often it occurred, and in what linguistic contexts it appeared. Figure 7 shows a snapshot of project # 4 (Project # 4, Video file, 2015).

Figure7. Project # 4: Barcodes for creating a medical guide

As shown in Figure 7, project # 4 focused on using Barcreate software, which helps in creating personified barcodes. The participants used pictures to create barcodes. The participants created a medical guide that contained medical information for daily healthcare. The medical guide contained a specialized medical dictionary, videos about medical issues, websites to provide medical news, a bookshelf to link web users to online libraries and bookstores. Connecting this medical guide to some social networks such as Twitter and Facebook, the participants aimed at assimilating their guide medial information. The participants used their medical guide to discuss MT translation databases, and some of MT purposes such as dissimilation, assimilation, and information exchange. Figure 8 displays a snapshot of project # 5 (Project #5, Video file, 2015).

Figure8. Project # 5: Using prototyper mobile application for disabled people

Figure 8 shows that in project # 5, the participants developed a mobile application prototype and uploaded it into a website to demonstrate how it operated. The participants used Just In Mind Prototyper software, operating on iOS and Android platforms, to help blind people use MT in performing daily tasks. The prototyper, they developed allowed volunteers to connect with the disabled's mobile phone to provide any help. The application was used smoothly by selecting either the word blind or the word volunteer. The participants exported the prototype into HTML files to be able to upload it into the web server. By clicking View Prototype, in the website, audience can review the application. In this project, the participants discussed the characteristics of mind

prototyper software, and features of HTML. Figure 9 represents a snapshot of project # 6 (Project #6, Video file, 2015).

Figure 9. Project # 6: A desperate call: MT for culture learning

In project # 6, the participants created their own story from their own culture about the relationship between parents and children. Then, they created a cartoon movie to display their story using MT applications for English- Arabic translation. In this project, the participants put into practice the integration if multimedia with MT systems. They discussed general translation theories, and the role of linguistic and computational theories in developing MT architectures.

5. Discussion

Comparing the results of Group A (taught using project-based methodology), and Group B (taught using traditional method) revealed that the participants' performance in Group A was higher. Table 5 shows the results statistically.

Table 5. Results of traditional teaching methods vs. project-based methods

Evaluation Category	Group A % Project-based Methods	Group B% Traditional methods	Differences %
Final Exam	98	60	38
Research Paper	97	62	35
Semester Project	98	30	38
Classroom Discussion and Presentation	98	33	65
Overall Performance	97.75	39.5	58.25

As shown in Table 5, the final exam results of the participants in Group A who taught using project-based methodology is 98 % while Group B participants' percentage is 60% with a difference of 38%. The results of research paper is 97% for group A , and 62% for group B with a difference of 35%. The semester project results point to 98% for Group A and 30% for Group B with a difference of 38%. The results of the classroom discussions and presentations for Group A refer to a difference of 65%. The overall performance of Group A is 97.75 while Group B score is 39.5%, with a difference of 58.25 between the two groups. Such results revealed the positive impact of integrating project-based teaching methodology into machine translation on students' performance. Furthermore, the two group participants were asked to respond again to the 29 items of the Likert scale questionnaire to examine the frequency and standard deviation *after* implementing the project-based teaching approach. A rubric for evaluating students' collaborative skills was created to evaluate students'

teamwork skills. The rubric includes five categories: preparation of the project research; participation; interpersonal skills; attendance; and communication skills.

The current research quantitative and qualitative data analysis indicated that adopting project-based teaching methodology, which aims at enhancing students' higher order cognitive and metacognitive thinking, affects students' motivation, cooperative learning, competence, and performance. Watson (2005) discussed the advantages of project-based and problem-based learning including acquiring knowledge of the subject content, using appropriate learning resources, and gaining real life skills. Watson argued that the significance of project-based learning arose from putting learning into action, developing critical thinking, and making the learning experiences meaningful. Moreover, the multimedia applications that students employ while creating their projects intensify student's perception of the abstract ideas of the course they study. Furthermore, Chauncey and Azevedo (2010) argued that the motivational force in integrating computer-based instruction strengthened students' independence and self-management. Computer-based instruction is relevant to MT due to the application of technology in learning. Ryan and Deci (2000) asserted that technology enhanced intrinsic motivation, and that intrinsic motivation was derived from the students' themselves when they were experiencing deep-level of learning and satisfying their curiosity and explorative thinking. In harmony with this argument, Katuk, Kim, and Ryu (2013) asserted that those learners' best experiences occurred when creating stimulating environments, and raising the challenges to gain knowledge, and acquire refined skills.

The aim of this research study was solving the problems of students who study machine translation for the first time. Based on the assertion that problem-based teaching techniques are effective in helping students use their cognitive abilities, integrating project-based teaching methodologies into teaching machine translation could be an avenue for providing appropriate solutions. Angelo and Shreve (2010) emphasized that understanding the cognitive processes involved in translation elucidated the complexity of translation tasks. Project-based teaching approaches, which are based on higher order thinking, are relevant to teaching machine translation. Students need to understand the concepts of machine translation theories in order to comprehend their applications in practice. Students should be engaged in projects that help them perceive such a relationship. Therefore, in the light of the results of the current research, the researcher presents herein the following recommendations. First, integrating project-based teaching methods into machine translation instruction is important for helping students be involved in learning activities that require developing their cognitive abilities. Figure 4 displays the integration process.

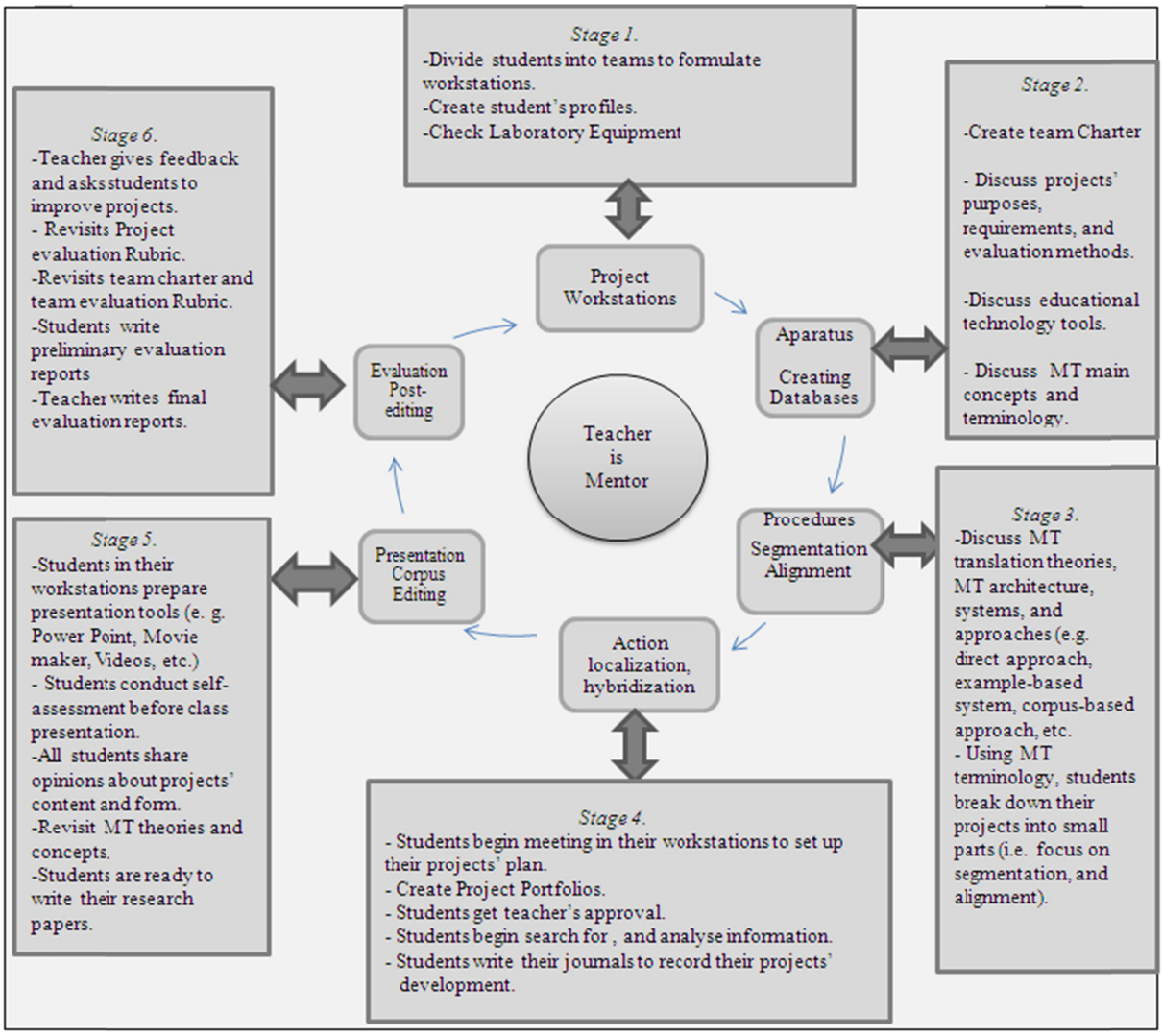

Figure 10. The process of project-based MT teaching method: An integrative model

As seen in Figure 10, the integration of project-based teaching methodology into machine translation classroom consists of six stages. Using MT concepts and terms, teachers engage students in creating projects about various topics that link MT theories and practices. The first stage of the project is designing the workstations. Workstations are the team settings where students are divided into groups to work cooperatively. The second is the apparatus phase, which is the stage of creating the project databases. Using MT terminology, the third step is the procedures phase, which refers to the segmentation and alignment stage. In this stage, students breakdown their projects into small components and select the educational technology appropriate for each project's purpose. The fourth stage is the action phase, when students put theory into practice and set up their plans to work on their creative projects. Using MT terminology, the fifth stage is the phase of localization, and hybridization stage. Students customize their projects according to their goals. The sixth stage is the presentation stage when students use media tools. The sixth stage is the evaluation stage which begins with post editing, when all teams make use of feedback to improve their projects. In this stage, evaluation takes place through self-assessment, peer evaluation, and teacher's final reports. In project-based teaching methodology, the teacher is the mentor who guides the students at every step of their creating their projects. In the workstation integrative model, presented herein, students work in small or large groups of different ability levels and backgrounds. The teacher becomes facilitator, guide, and co-learner. The teacher selects the theme of inquiry, designs the assessment tools which include rubrics and portfolios.

The second recommendation is that encouraging students to assimilate their creative projects in machine translation through holding seminars, organizing technology exhibitions, or publishing online via visual media,

would motivate students to develop advanced skills in using machine translation in their daily lives. Developing some of the students' creative projects in machine translation into further research would help higher institutions to advance in the field of machine translation.

The third recommendation is to provide professional developments programs for teachers to train them to use educational technology since technology is an essential component of teaching machine translation.

Fourthly, equipping the translation laboratories with the most sophisticated technology is indispensable in order to provide adequate training for students. As such, bridging the gap between theory and practice in machine translation becomes real.

In conclusion, the focus of this quantitative–qualitative research was on the problems and solutions for machine translation as an academic course at higher education institutions. Data analysis results pointed to the positive impact of integrating project-based teaching methods into teaching machine translation on students' performance. Engaging students in creative projects would not only help them to improve their academic achievements, but would also play an effective role in developing new tools for automated translation. The discussions on the research data analysis include content analysis of students' projects and how they can put machine translation theories into practice. The review of the literature contains a thorough analysis of previous research on machine translation and project-based teaching and learning approaches, and the application of educational technology in the classroom. The contribution of this research is derived from three specific areas: integrating education research into teaching machine translation to motivate students to improve their performance; employing educational technology to bridge the gap between theories and practice of machine translation; and providing an implementation of creative teaching in machine translation through presenting students' creative projects. Student's creative projects presented in this research provide numerous ideas for classroom instruction that is founded on cognition and constructive knowledge. The integrative teaching model, presented in this research, is a new approach for solving students' problems in machine translation.

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