A multiple-intelligence approach to creativity in ESP courses

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Introduction

The manner through which a student is taught in a classroom is an influential factor on the student's achievement. Furthermore, the presence of creativity within that teaching context is of great importance. Creativity is linked to different levels of attainment in second language learning (Maley & Bolitho, 2015).

The human capability to act effectively in a novel or difficult situation constitutes the modern definition of intelligence (UNESCO, 2002) and precisely Gardner's theory of multiple intelligences (MIT). According to Gardner (1983: 2) there is more than only one intelligence an individual may rely upon when facing a novel or a difficult situation. In parallel, one of the first requirements for constructing products is creativity (Naiman & Vangundy, 2014). In order to implement a creative approach in a language classroom, we must first agree on a definition of creativity.

As language teachers and researchers, the kind of creativity that we look for in the classroom consists of the production of something new or of presenting already known material in a new fashion (Richards, 2014). An essential characteristic of creativity is the process of becoming sensitive to problems, identifying problems, searching for solutions, formulating a hypothesis and testing it, and finally communicating this procedure to others involved in the same situation (DeHaan, 2009: 172-181). This is also the common ground with the definition of modern intelligence, in particular the definition of multiple intelligences (MI). Becoming attuned to a learner's ability to think creatively provides clues about different preferences for ways of learning, the personal preferences throughout learning and the individual strategies learners employ when dealing with a learning difficulty.

According to numerous studies such as those of Tilman (1996: 1455-1477), Elton (2000) and Odum (2005), increasing diversity appears to increase creativity. In a language

class, curriculum variety maximizes chances for learners to become more creative (Pashler, 2008). When learners are exposed to a set of facts several times, in various forms and in creative contexts, their knowledge shifts from a purely theoretical construct to a more practical one. According to Gardner (2006), not all students learn the same way and, therefore, they should not be taught in one similar manner. Taking into account learners' different learning styles in a language classroom provides students with the freedom to express what they know in different creative ways. It also allows them to come up with creative strategies when facing a learning difficulty.

In this article, we will describe Gardner's theory of multiple intelligences (MIT) and its nine types of intelligences. We will also explore how becoming familiar with learners' dominant type(s) of intelligence and allowing them to experience the given topic using specific tasks might nurture creativity in the classroom. Next, we will focus on the creative characteristics of a multiple intelligence classroom. Then, we will show examples of re-designing the already existing classroom tasks and activities in a way that is both creative and MIT-based. Finally, we will discuss the current results of the pre-experimentation part of a PhD thesis in progress on the theory of multiple intelligences.

Theoretical framework

Defining creativity

There are many different scientific definitions of creativity. Some definitions are formulated in terms of a product, *i.e.* when the outcome is an invention or a discovery. Other definitions are expressed in terms of a process, a kind of person or a set of conditions. However, the production of something new to a person or to a culture is included in almost all definitions (Cutraro, 2012). There are also some traits that stand true in all the definitions of creativity, such as the fact that creative contributions must be true, generalizable, and surprising in view of what existed at the time of the discovery (Torrance, 2013). It is an interesting fact that the definition above cannot guarantee that whoever displays these features will consistently act creatively but, if one lacks these features, the chances of acting creatively decrease significantly. Creativity is a natural process that occurs when there is a problem. When tension arises and the already-existing conditions and solutions do not suffice, one attempts to come up with new ideas and that can be the start of creativity (UNESCO, 2002).

If we agree on these characteristics of creativity, we can see that the rise of an issue or a problem is the starting point of creativity. This means that one must be sensitive to problems and deficiencies and find a different way to approach and solve a potential problem (Raby, 2002). Being sensitive to existing problems and using different strategies to solve or overcome the issues at hand is also one of the definitions of intelligence or, more precisely the notion of multiple intelligences.

The multiple intelligences theory and foreign language teaching and learning

The first intelligence test was invented by the French psychologist, Binet, in 1904. This test represented intelligence with a single number, which is known as the "intelligence Quotient" (IQ). The IQ score is based on a test of mental intelligence, divided by age and multiplied by one hundred. Although Binet himself did not mention that intelligence is a fixed trait, expressing the level of intelligence with a single number often leads people to think that way and, unfortunately, gives certain educators an excuse to ignore the students who did poorly on the IQ test (Perkins, 2010). For decades, IQ tests were embedded in examinations in different countries (such as Japan, the United States, Australia, Iran, etc.) to underpin school selection procedures. Despite continued use, the prevalence of IQ tests has faded with the rise of the modern view towards intelligence (Bartholomew, 2004: 279-293).

The modern view towards intelligence holds that intelligence is learnable. A growing number of educators and psychologists believe that intelligence is carried by genes along with innumerable experiences that shape human beings (Perkins, 2010). As a result of this view, the tests of intelligence now measure different types of intelligence and no longer operate on the basis that intelligence is fixed. Educators can therefore use this information to create curricula that fit learners' needs, and help them improve their weaknesses (Shearer, 1996). We can conclude that the modern views towards intelligence hold two major beliefs: a) intelligence is not a single trait, b) intelligence is not a fixed trait.

MIT has led to the application of eight frames in the contexts of language teaching and learning. Various empirical studies (Dörnyei, 1998: 117-135; Skehan, 2001) have investigated the relationship between Binet's IQ scores and the capacity for learning foreign languages but have found only a moderate level of correlation. Therefore, Binet's traditional static concept of intelligence cannot be used as a predictor of successful language learning. Arnold & Fonseca (2004: 119-136) studied the relation of cognitive aptitudes with success in foreign language learning of over 5,000 students at American military academies and concluded that future research should involve experimentation with alternative models not narrowly dependent on a general aptitude test results.

Skehan (2001) emphasizes that in classroom language learning, MIT can provide a basis for developing more creative descriptors in the target language by helping learners to connect with the learning activities and to activate linguistic information stored in memory. However, it is not a question of addressing all the individual MI profiles of each learner in every language class but of offering a balanced approach where different windows on the same concept are incorporated (Gardner, 1993).

What are the different types of intelligences?

In 1983, Howard Gardner posited that there were at least seven different types of intelligences. Following further research, he later defined an eighth type of intelligence (Gardner, 2000). More recently (2006), he also mentioned that there is a possibility for the existence of another type of intelligence, which is different from

all the rest. Below is a brief description of these nine intelligences by Howard Gardner (1983, 2006).

1. *Musical intelligence* refers to the ability to perform, compose, but also appreciate music, ranging from the ability to keep in tune while humming or singing a song to more professionally playing a musical instrument.
2. *Bodily/kinesthetic intelligence* refers to the movement and ability of muscles in different body parts, ranging from being good with one's hands, fixing and repairing things, to being a good athlete.
3. *Logical/mathematical intelligence* refers to the ability to work and reason with numbers and figures, ranging from calculating sums in one's head to a liking for mathematics and algebra.
4. *Visual/spatial intelligence* refers to the ability to imagine the three dimensions of things, ranging from finding one's direction in a new location to being a good sculptor or a painter.
5. *Linguistic intelligence* refers to the ability to use words, ranging from having a convincing way of speaking to note-taking and being a good public speaker.
6. *Interpersonal intelligence* refers to one's ability to maintain and use social skills, ranging from having successful long-lasting friendships to understanding other peoples' moods and needs and behaviors.
7. *Intrapersonal intelligence* refers to one's ability to understand oneself, ranging from being productive when working alone to making appropriate decisions for oneself and being able to see it through.
8. *Naturalistic intelligence* refers to the ability to relate to nature and the natural environment in general, ranging from taking care of a pet to being able to categorize different breeds of animals, flowers or plants (Gardner, 2000).
9. *Existential intelligence* is defined as the ability to be sensitive to, or have the capacity for, conceptualizing or tackling fundamental questions about human existence; questions that revolve around the meaning of life, why we are born, why we die, how we got here (Gardner, 2006).

Most of the credibility of Gardner's work rests on neurological evidence of specific locations within the brain; however, the exact location of existential intelligence in the human brain has not been pinpointed (Sisk & Torrance, 2001). Accordingly, in the present study, the first eight intelligences defined by Gardner are taken into account.

Language learning can be supported by bringing into play not only the linguistic but also the musical, visual-spatial, bodily-kinesthetic, interpersonal, intrapersonal, mathematical and naturalistic abilities as they constitute distinct frames for working on the same linguistic content (Molaie, 2016). Not only does this variety allow students to learn in their own best ways, it also helps to reduce boredom as language learning requires frequent circling back over the same material, and thereby being more creative (Schumann *et al.*, 1998). In this context, the research question explored in this article is: does creative use of a multiple-intelligence approach to language teaching boost English performance among second-year undergraduate (L2) science students?

Methodology

During two semesters (2014 and 2015), the researcher/teacher randomly selected one group as the experimental group (total of 30 students) and one as the control group (total of 30 students). MIT-based activities were implemented by adapting activities found in the program's coursebook *Minimum Competence for Scientific English* (Blattes, Vans & Upjohn, 2013) in the two experimental classes. In class, the control group followed only the activities of the coursebook. The activities in the control group were not MIT-based. However, all students also had the requirement of completing common multimedia tasks during sessions in the language laboratory (*see* Hartwell, 2010a; Hartwell 2010b).

The participants in this study were all second-year science students at the University Joseph Fourier, now part of the Université Grenoble Alpes. They were all in a three-year undergraduate degree program or *Licence*, taking classes at the Service des Langues. As the field of study of all the students was science-based, and as the name of their coursebook suggests, the English course was for specific purposes (ESP), in this case, English for the sciences.

In order to answer the research question, the common work of the teacher and students in each English semester-long course was divided into five categories, and the findings on these categories will be reported accordingly. In a creative MIT-based approach to language teaching, we looked at:

- teaching materials and classroom activities,
- students' learning styles and activities,
- homework,
- testing tools,
- scoring criteria.

Creativity in teaching material and classroom activities

An important stage of MIT application to teaching is to choose and design appropriate MIT-based material to use for classroom tasks and activities. There are many different activities and tasks that are considered MIT-based, some of which many language teachers use in their classrooms without necessarily being aware of MI theory. Table 1 below shows examples of MIT activities, materials and instructional strategies, adapted and modified from Armstrong (2000). Most classroom tasks and activities used by the teacher/researcher for the experimental group were an adaptation of the activities in Table 1 and the original activities in the book *Minimum Competence in Scientific English*.

INTELLIGENCE	Teaching activities	Teaching materials	Instructional strategies
Linguistic	lectures, discussions, word games, journal writing	books, podcasts	read, write, or discuss the topic/subject
Logical-mathematical	problem-solving, science experiments, mental calculation, number games	calculators, science equipment, math games	quantify, think critically, define a logical framework, or experiment the topic/subject
Spatial	making charts and diagrams, estimating distances	maps, charts, videos, tools for measurements	see, draw, or visualize the topic/subject
Bodily-kinesthetic	drama, dance, sports	building tools, sports equipment	build, act out, or touch the topic/subject
Musical	songs that can be sung or listened to in order to practice and better understand a given lexical or grammatical point	tape recorder, tape collection, musical instruments	sing, rap, listen to the topic/subject
Interpersonal	cooperative learning, peer tutoring, social gatherings	board games, props for role plays	teach, collaborate on, interact with respect to the topic/subject
Intrapersonal	independent study, options in course of study, self-esteem building	self-checking materials, journals, materials for projects	connect the topic/subject to your personal life or make choices with regard it
Naturalist	nature study, care for animals	plants, animals, naturalists' tools	connect the topic/subject to living things and natural phenomena

Table 1 – **MIT activities for a classroom, adapted from Armstrong, 2000**

As can be seen in Table 1, there are recommended activities that can be considered creative, such as journal writing, number games, visualization, drama, cooperative learning, peer tutoring, etc. General observations of teaching at the Service des Langues suggests that MIT-based activities are encouraged, although not always labeled as such. For example, L2 students are asked to work in pairs on a poster activity called an innovation project, in which they choose an already existing machine and think of ways to improve it. During this task, students are asked to work with each other (interpersonal activity), choose a machine and make a list of its weak points (logical activity), imagine ways to improve the machine (logical and spatial activities) and, finally, make a poster expressing their ideas (spatial and linguistic activities).

An important point here is that MIT-based activities are not necessarily eccentric or completely new, but that they are creative and various. Consequently, if any course is designed in a fashion that contains a high level of variety and creativity, MIT-based activities are found among its activities. For instance, if designing posters or completing multimedia exercises are common activities that all L2 students are required to do, it means that even those students randomly chosen to serve as the control group participate in some MI activities.

Logical intelligence class activity

In the grammar and vocabulary descriptions of Unit 1 of the coursebook *Minimum Competence in Scientific English*, the focus is on using measurement vocabulary, and making grammatically correct sentences, while describing measurements in English.

The students in the control group did not work with real tools. The teacher wrote the grammar lesson on the board, and then asked the students to look up words such as *height, width, depth, diameter*, etc. in the dictionary. Then, they were asked to do another coursebook exercise for which they were asked to provide synonyms and antonyms for the measurement words. Once they had finished answering, students checked their answers in pairs. The teacher was there to answer questions about the exercise, and when there was none, the class moved on to the next exercise in the coursebook.

On the contrary, in the experimental group, the teacher provided students with various objects in different forms and shapes and a number of calipers (instruments for measuring thicknesses and internal or external diameters inaccessible to a scale), measuring tapes and a scale to calculate their weight, diameter, length, thickness, etc. This exercise triggers spatial and logical-mathematical intelligences. Next, students were asked to create charts using information on the objects and their measures. This exercise triggers spatial intelligence. The chart in Figure 1 below is one example.

Measurements→ / **Objects ↓**	***Height***	***Width***	***Length***	***Depth***	***Weight***	***Diameter***	***Span***
A carton box							
An encyclopedia							
A test tube							
A laboratory flask							
A beaker							
A crucible							
A funnel							
An evaporator dish							

Figure 1 – **A chart activity for practising measurement vocabulary**

As can be seen above, the objects chosen for this activity mostly belong to biology and chemistry labs. This material is familiar to science students as they are used in their field of academic and professional lives; therefore, learning their names in English and using them for a classroom task can be productive while working with real tools is a creative way for learners to connect their professional field to their knowledge of English. Then, students were asked to work in groups and write sentences comparing different objects and their measures. They also asked each other questions with "how' about their charts, such as "how wide" or "how deep". This exercise triggers linguistic intelligence.

Interpersonal, logical and linguistic intelligences class activity

All lessons in the *Minimum Competence for Scientific English* (*MCSE*) course book start with a self-evaluation entry test. The questions on these tests evaluate students' knowledge on lesson content before they have studied it. The aim of these entry tests is, first, to see whether students already know about the vocabulary they are going to study in the lesson and, secondly, to arouse their curiosity about the topic. After the students were asked to answer the questions on the self-evaluation entry test, the researcher/the teacher asked them to announce how many questions they were able to answer. This gives a general idea about the extent of student knowledge of content before they study each unit. Consistently, the number of questions students could answer before studying the grammar and vocabulary of each unit was very low (one or two students out of eighteen were able to successfully complete the test, and most could complete approximately two questions out of ten). The exercises at the beginning of each unit of *MCSE* is an example of a self-evaluation test. The students were asked to answer the test questions on their own and without referring to the lesson or the answer key at the end of the book. In this exercise, the teacher asks the students to do the test on their own in the classroom.

In the experimental group, after the students answered as many questions as they could in the entry test, they formed pairs to participate in a peer teaching activity. In each unit of the coursebook, the entry test is followed by a grammar lesson. The teacher divided this grammar lesson into two equal parts. Each individual in a pair is responsible for studying and then teaching his/her partner. In this way, all pairs cover the whole grammar lesson. The teacher helps them in all the steps of this peer teaching activity. This exercise is designed to trigger interpersonal, logical and linguistic intelligences.

In the control group, after the students answer as many questions as they can in the entry test, the teacher teaches the grammar lesson that follows. Learners are then asked to go back to the entry test to see if they are able to answer the questions they could not before the lesson. This activity ends with students checking their answers together.

Students' learning styles and activities

In an exercise in the *Minimum Competence for Scientific English* coursebook (page 43), students are asked to follow a certain grammatical pattern to compare and contrast two objects. The coursebook provides them with a number of suggestions such as a rat, a diamond, a village, and Mars. As an example, Figure 2 shows an actual classroom activity that occurred in one of the classes. Most of the students came up with factual and true statements. However, a student whom we will call student C, came up with a more creative example.

Definitions – defining by comparison
Use the following pattern:
"X is similar to Y but much … + er."
Example: "A tiger is similar to a cat but much larger."
Define the following words: a rat, diamond, a village, Mars
Student A: Mars is similar to Earth, but much smaller.
Student B: Mars is similar to Earth, but much dryer.
Student C: Mars is similar to Snickers, but much more delicious.

Figure 2 – **Students' answers for an activity from the coursebook *Minimum Competence in Scientific English (p. 43)***

As can be seen in this real classroom situation in Figure 2, student C compared the famous Mars candy bar to another famous candy bar, Snickers. The vocabulary and the grammar student C used fulfilled the goal of this exercise, although what was originally requested by this exercise was to compare planet Mars to another planet. As far as the goal is achieved, in this case using the correct grammatical formula for comparison in English, more freedom can be given to students to come up with their own strategies for learning and production and therefore, open up to their creative potential. In this regard, MIT is a method that welcomes and appreciates learners' individuality and creative ways of production.

Creativity in homework

Learning is not limited only to the classroom. Each individual is influenced by an immediate and a proximal environment. That proximal environment includes outside-of-the classroom environments such as the students' homes. Consequently, learning is extended to students' homes and homework can play a key role in learning (Carbone, 2009: 1). In the semesters through which MIT was integrated into teaching English to science students, we tried to increase the level of creative homework as much as possible.

As homework, learners were assigned to work on a three-minute presentation on the thirtieth week of pregnancy and on the main causes of death between the ages fifteen and thirty. The students in the experimental group were asked to be creative with their visual supplies, whether displayed in a chart, a drawing or a graph. For example, a student presented his own drawing of the embryo in the thirtieth week of pregnancy and the changes it goes through. Another student had prepared an illustration of the main causes of death in the age range of fifteen to thirty, namely

road accidents and suicides. It was followed by a quotation from Woody Allen that says "I'm not afraid of death, I just don't want to be there when it happens." This exercise can trigger student's logical, linguistic and spatial intelligences.

Another task the experimental students were assigned to do for homework entailed practicing the grammar elements of Unit 5 in their coursebook which focuses on linking words. Students were asked to find English songs with the linking words *besides, moreover, as, since, in other words, for instance, in fact* and *actually* present in the lyrics, then to make a selection of those parts of the songs with these linking words, and finally mix and record them on their cellphones to be played during the next classroom session. This was a creative listening exercise designed to aid students to become familiar with the usage of these linking words in contexts outside their coursebook. In the next session, students played their playlist in the classroom and their peers were asked to record as many of the phrases or sentences they heard on a piece of paper. They compared their answer sheets in a group including the student who created the playlist. Finally, they were asked to use the same linguistic units and phrases to link two scientific ideas, beliefs, or concepts in order to use the creative exercise and reproduce scientific ideas. This exercise can trigger students' logical, musical and interpersonal intelligences.

Creativity in testing tools

Midas test

Another stage of integrating MI into teaching is to determine the strongest type of intelligence of each individual. In order to do this, the standardized test of intelligence named Multiple intelligences developmental assessment scales (Midas), designed by Dr. Branton Shearer in 1996, and modified by the teacher/researcher was used. Midas represents the first effort to measure the multiple intelligences and has been developed according to standard psychometric procedures (Gardner, 2006). There are approximately twelve questions for each type of intelligence and a total of 100 questions in the Midas test (See Appendix 1 for sample questions). There are five options for each question enabling test takers to choose the option best fitting their personal experiences. For example, the first question in the test is: "As a child, did you have a strong liking for music or take music lessons?" and is followed by six options: a) Always or almost always, b) Often c) Sometimes, d) A few times, e) Almost never, f) I do not know/I do not remember. The options have the following scores: a = 5, b = 4, c = 3, d = 2, e = 1 and f = 0. For each type of intelligence, the scores are totalled and then multiplied by 100. By comparing the percentages accumulated for different types of intelligences for each test taker, the strongest type of intelligence is identified. Figure 3 below shows results of one of the students who took the Midas test. After a thorough analysis of their answers is completed, a detailed report is also given to them (*cf.* Appendix 2).

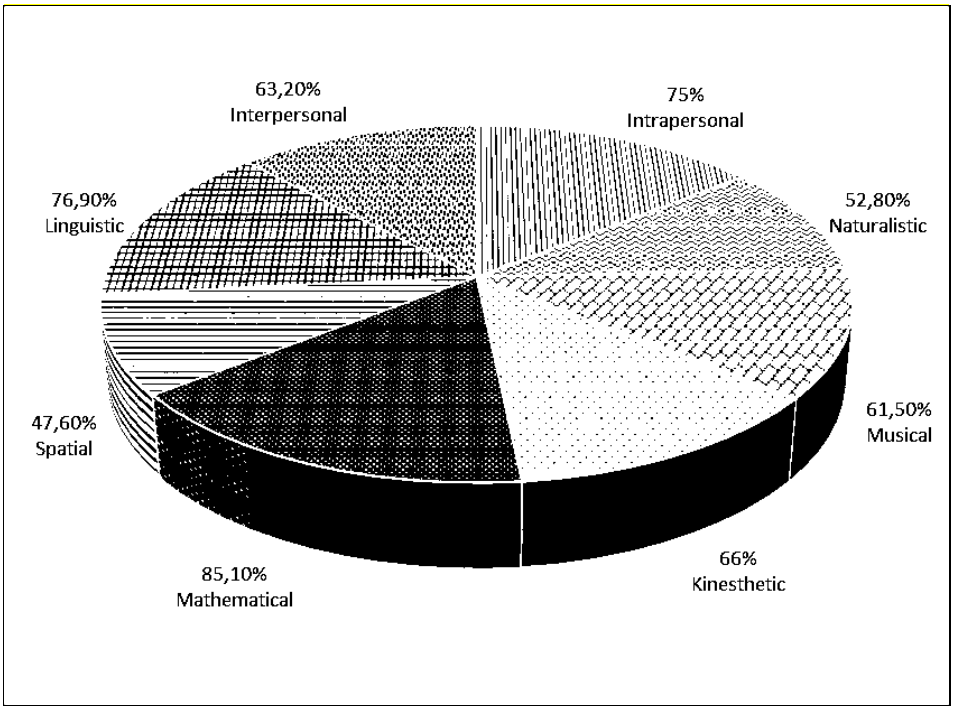

Figure 3 – **Sample Midas result of a random student**

Continuous assessment

In the testing system used at the Service des Langues, continuous assessment marks are valued and compose 60% of a student's final mark. The continuous assessment mark consists of classroom activities, homework, and oral presentations. These marks are notified to the English learners gradually over the course by their English teacher. Consequently, continuous assessment can also be conceived as a type of evaluation that allows the teacher to be more creative and gives learners more freedom to express themselves in creative fashions.

One of the testing ways encouraged by MIT is peer teaching and peer testing. During one session, students were divided into two different groups, and a "teacher" was chosen randomly for each group. While the students were busy answering the questions on the self-evaluation entry test that begins each unit of the coursebook and checking their answers together, the student who was chosen to be the teacher had time to study two pages of grammar and prepare a lesson plan to teach his/her fellow students. Then, each "teacher" was provided with a few markers and a board, and students were asked to move the chairs and sit in front of the board. The session was very successful as the students helped each other in all the steps of this teaching-learning process. Also, there were many other sessions through which students were asked to reflect on each other's answers and even give scores to one another. Other criteria for continuous assessment are those shared with other colleagues and teachers, such as the use of correct grammatical forms in speaking, use of lexis, avoiding certain frequent mistakes, level of cooperation in pair and group work, avoiding unjustified absences, and completing lab work.

Observation and process folios

According to Gardner (2006), fill-in-the-blank tasks have a limited ability to encompass the wide range of learners' abilities and potentials. To the contrary, MIT-based teaching requires gradual and thorough observation and taking continuous notes of likes, dislikes, preferences, strategies and weak and strong traits of the learners. In order to achieve that goal, teachers are encouraged to keep a process-folio of learners. "Process-folio", a term coined by Gardner, refers to the need of learners to know continuously about their progress. Keeping a process-folio can help learners remain positive about the process of learning and at the same time help them to be better aware of the areas in which progress and improvement is needed. A sample process-folio is demonstrated in Figure 4.

	Week	**3**	**5**	**7**	**9**	**11**
Classroom tasks and activities *5 points*	Pair-work participation					
	Group-work participation					
	Volunteer individual work					
	Creativity					
Writing *5 points*	Grammar					
	Use of lexis					
	Not repeating previously corrected errors & mistakes					
	Creativity					
Homework *5 points*	Homework completed					
	Bringing supplies: maps, graphs, charts, etc.					
	Creativity					
Speaking & oral presentations *5 points*	Grammar					
	Lexis					
	Accent & pronunciation					
	Gesture, tone, expression					
	Self-correction					
	Creativity					

Figure 4 – **A sample process-folio of the student's progress**

Students were asked to have the process-folios with them in all sessions. In Figure 4, the first report starts from week three of the course, when sufficient time has passed from the start, course participants are fixed, learners have had enough time to become acquainted with the pace of the course and they are ready to display their work. The process-folios are updated every two weeks so that students regularly know how they have been doing.

There are four main categories in the process-folios: classroom activities, writing activities, homework, and speaking and oral presentations. Detailed marks are allocated to each of the categories based on regular observation. Progress and

improvement is taken into account. For each category, a certain mark is given for creativity, originality of the ideas, and novelty. A benefit of using process-folios worth mentioning is that students will be aware of their end of the course continuous assessment mark evaluated by the teacher.

Another testing tool used in all courses is the final written exam which is common to all L2 students, irrespective of the many teachers participating in L2 teaching.

Pre-experimental procedure

In order to answer the research question "Does creative use of a multiple-intelligence approach to language teaching boost performance among L2 English learners?", we analyzed the marks for both continuous assessment (Figure 5) and final exams (Figure 6), both of which were scored between 0 and 20. We found a correlation between creative class tasks based on an MI approach and performance as expressed through marks.

First, we examined all the individual student scores concerning creativity of the experimental group, notably the continuous assessment marks, the process-folio marks, and the MIDAS scores pertaining to creativity. Each student often had similar marks for the continuous assessment and process folio marks. Students with high MIDAS creativity scores tended to also have higher continuous assessment and process-folio marks. Inversely, those who scored low on the MIDAS creativity questions, also had lower continuous assessment and process-folio marks.

Secondly, we looked at the possible differences between the continuous assessment marks of the experimental group and the continuous assessment marks of the control group. Figure 5 shows that the experimental group had a higher overall mean (13.783) and standard deviation (1.617) than the control group (mean 12.633, SD 1.351). A *t-test* produced a *P*-value of less than 0.0001, indicating that the difference is not simply produced by chance, but by a difference of marks between the two groups. However, because there were different activities for the experimental and control group, we then examined final exam results.

Groups	Experimental	Control
Continuous assessment mean	13.783	12.633
Continuous assessment standard deviation	1.617	1.351
Number of students	30	30

Figure 5 – **Comparison of continuous assessment mean and standard deviation between the experimental and control groups**

Both the experimental and the control groups took a final exam that was prepared by the English Department for all of the students in the given program. This means that the results are highly objective and were not designed to evaluate the impact of MIT-teaching. Figure 6 shows that the experimental group also had a higher mean for the final exam (13.733) than the control Group (12.266) as well as higher means of standard deviation (2.756 compared to 2.016). As for the

continuous assessment scores shown in Figure 5, we used a paired *t*-test to compare the final exam marks of the experimental group with those of the control group. The two-tailed *P*-value was 0.0042. Once again, this value would indicate that the higher final exam means for the experimental group is not due to chance, but to an actual significant difference of results between the two groups.

Groups	Experimental	Control
Final exam mean	13.733	12.266
Final exam standard deviation	2.756	2.016
Number of students	30	30

Figure 6 – **Comparison of final exam score mean and standard deviation between the experimental and control groups**

To summarize, the statistical tests performed to evaluate the differences between the experimental and the control group results showed an apparent statistically significant difference between the groups.

Analysis of the results

Statistical procedures in this study showed that teaching English for the sciences based on a creative use of the theory of multiple intelligences has a significant effect on the performance level of students during the course. Students who showed a higher level of creativity on the Midas test and participated in classroom tasks based on MIT, demonstrated a higher level of creativity in their continuous assessment scores, and also exhibited a higher level of creativity during each semester through observation. These students also performed better on the standard L2 final exam which is shared by all other L2 classes taught by other teachers. It is of importance to mention that the final exam papers were anonymous and were randomly corrected by all L2 teachers. As a result, the teacher/researcher had no access or influence on the final exam marks of the students.

Based on this data and statistics, results suggest that teaching English for sciences based on a creative use of the theory of multiple intelligences can boost performance level in learners.

Conclusion

Based on the procedures undertaken in this research, it seems that using an MIT-based approach to teaching English can boost creativity among science students in their leaning styles, how they do their homework, how they perform their oral presentations and writing exercises. Also, learners' scores on creativity had a high correlation with their scores of continuous assessment as well as a high correlation with their scores on process-folios and observations. Using regular and planned observation can be a useful tool to measure learners' creative potential in a more detailed and fair manner.

Furthermore, using a creative MIT-based approach to teaching ESP proved to have a positive effect on the learners' performance on the standard L2 final examinations. Learners in the experimental group who participated in creative MIT-

based activities and were assigned more creative homework, performed better on the standard course final exam common with other L2 students.

Another interesting point is that creativity does not only blossom in arts, music and literature, but it can also manifest itself in science. In fact, observations in this study showed that there are many ways to be creative in teaching and learning English for the sciences, and that science students are able to manifest creativity in different tasks and activities during the course of an English semester.

One of the characteristics mentioned in the adopted definition of creativity was an element of novelty and surprise when the tested-and-true does not seem to work anymore. To be fully capable of investigating the relationship between creativity and MI, the testing tools should also be MIT-based. This does not mean that the only tool for measuring MIT-based experiments is MIT-based assessment. However, in order to be able to measure the true results of teaching based on MIT, we need a testing tool that allows learners to manifest their knowledge in different ways. As such testing tools do not fit into the limited time of many courses, the use of process-folios throughout the semester might be of great help for a more detailed and fair judgement of learners' progress. Further research will include analyzing process testing methods, targeting specific intelligences or the impact on different populations from other disciplines and a survey of the evolution of students' motivation.

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Appendix 1 **– Sample questions in each type of intelligence on the Midas test**

Musical: Do you ever make up songs or write music?
Kinesthetic: Do you enjoy working with your hands on projects such as mechanics, building things, preparing fancy food or sculpture?
Logical: How are you at inventing "systems" for solving long or complicated problems?
Spatial: Are you creative and like to invent projects, or often draw or sketch to explain an idea?
Linguistic: Have you ever written a story, poetry, or words to songs?
Interpersonal: Are you able to come up with unique or imaginative ways to solve problems between people or settle arguments?
Intrapersonal: Have you ever been able to find unique or unusual ways to solve personal problems or achieve your goals?
Natural: Have you taken photographs of nature or written stories or done artwork with/about nature?

Appendix 2 **– Sample report on a random student's Midas results**

"As you see, mathematical/logical intelligence is your strongest trait. Generally, it means that you are good at solving problems, finding solutions, and that you are good with figures and numbers. In an English classroom, that can mean that activities which involve numbers, or tasks that require you to experiment or think critically about a topic can aid your learning.

According to Howard Gardner, the scientist who proposed the theory of multiple intelligences, we are not born with a fixed degree of intelligence and die with it, *i.e.* intelligences can improve! We can all become smarter or more intelligent through the right practices and being exposed to the right kind of material. Also, all of us are intelligent in many different fields and domains, as you can see yourself in your results above.

Please note that no test of intelligence has yet been designed that can really estimate one's true intelligence. Therefore, this is mainly to help you know your own strengths, know yourself better, and be able to pick the best strategies for your own learning in different subjects and in different fields.

There is also a link provided on MIT in case you are interested to know more, or another link of a brief interview with Howard Gardner explaining MIT in short, simple words:

http://www.learning-theories.com/gardners-multiple-intelligences-theory.html.

Or simply watch this video on his interview explaining what the theory of multiple intelligences is about:

https://www.youtube.com/ watch?v=l2QtSbP4FRg.

Best of luck to you and to your learning, [Teacher's name]