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From ESP to CLIL using the Schema Theory

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ABSTRACT

This paper explains the use of the Schema Theory in planning and preparing a Physiology lesson in a CLIL tertiary context in a Spanish university. The adopted combination of methods used in applying the theory is transferable to any context and subject. Scaffolding for content and language learning was undertaken using schema-building through activities involving: (1) sequencing; (2) using an exercise with causality language for purposeful reading (3) outlining; and (4) commentating on a video. Since CLIL practices have often lead CLIL theory, the study is organized into two parts. The first part is described in this article, and the second part, involving feedback from the students in this study, is work in progress. The required Physiology lesson lent itself to outlining a reading, and applying top-down structuring of information and schema building, as well as to the use of causality. The video commentary activity, on the other hand, catered for a more bottom-up approach. The paper focuses on the design of materials and activities as part of the ongoing CLIL collaboration between the language and the content professors. Other than the Schema theory and top-down bottom-up information processing, the designed activities were

based on the principles of social constructivism through language scaffolding and peer collaboration.

Keywords: schema theory, top-down and bottom-up information processing, scaffolding, teaching CLIL and ESP for Physiology in Sport Sciences.

1. Introduction

The aim of this paper is to focus on the process of thought and collaboration between an ESP (English for Specific Purposes) and a Physiology teacher using schema theory in lesson planning and teaching. The title of the paper from ESP to CLIL was chosen to reflect two sides of the process, one on the learners' end and the other on the collaborators' end. Learners were first initiated into the language genres of the discipline of Sport Sciences in the ESP course before they were progressively given more credits in content subjects taught in English in the CLIL program. On the collaborators' end, facilitating language learning and motivating students to learn about their discipline in a foreign language started in the ESP class in coordination with other content teachers whose role was to highlight language-related outcomes students should be able to carry out. Some of these routine tasks included being able to take notes that involve sequencing steps in a process; identifying cause and effect and use them in expressing relations; outlining a topic from text or an audiovisual medium; and commenting on important topics. Although there are methodological differences between ESP and CLIL, there are more areas of convergence than divergence as in the necessity to scaffold students while working towards their goals. Putting the schema theory to practice in both courses, ESP and CLIL, was one of the underlying mechanisms in bridging the route from ESP to CLIL.

2. Literature Review

The review of literature will first establish the connection between ESP and CLIL then briefly clarify the models of CLIL while clarifying the role of ESP. A

review of the schema theory and its role in language and content-driven classes will then follow.

Though ESP emerged thirty years prior to the emergence of CLIL, both have been driven by common factors including the demands of world economy, the emergence of English as the international language of communication in the fields of science and business, and the attention shift to focus on responding to learner needs to communicate in specific contexts. The movement of ESP emerged in the 1960s and from there on continued to gain more merit in academic language teaching making use of the practices of the communicative approach. In parallel, in 1965, Content-Based Teaching (CBT) and the Canadian immersion model were starting to form the basis for learning content through an additional or a second language (Coyle, Hood & Marsh, 2010). Both ESP and CBT catered for occupational needs and formed a continuum with a language-driven end on one side and a content-driven end on the other. In 1994, similar learner needs led to the emergence of CLIL in the European context with the dual focus on content as well as on language. Though regarded as a stand-alone approach having developed from socioculturalism, constructivism, multiple intelligences and theories of language learning, CLIL and CBI have common features (Coyle, 2010) as both focus on integrating content and language. CLIL has also made use of findings from EFL, ESP, Task-based Instruction (TBI) and other related disciplines.

In Spain, the implementation of foreign language CLIL programs has grown rapidly as a result of proactive and reactive reasons including language policies formulated to harmonize teaching and learning across Europe. As Pérez-Vidal (2009) points out, CLIL is a natural development of communicative approaches which has been influenced by developments in autonomous learning, new technologies, and internationalization and student mobility programs. It is not surprising then for language policies to refer to CLIL as the means for internationalization and modernizing institutional profiles and for which CLIL and ESP teachers need to pool resources and experiences. Many content lecturers in tertiary education see CLIL an opportunity for providing students with a means to master specialized language competences. These competences are regarded as indispensable by those who wish to further their studies and gain an edge. ESP teachers are in some of these cases CLIL collaborators who support a number of content subjects by catering to the development of

students' communication skills in the target language, and raise students' awareness of the importance of academic study skills that facilitate their learning in the target language (Marsh, Maljers and Hartiala, 2001). CLIL as a fusion of communication, content, cognition and culture (Coyle, 1999) relies on a number of principles among which are the need to associate language needs to the learning context; to learn through the target language; and to scaffold the complex processes of learning through a foreign language without compromising cognition as one of the pillars of CLIL. Degree programs with CLIL and ESP courses are logically a good recipe for effective teaching and learning, yet it is important that teachers involved in these programs be aware of what ESP is and is not, and the CLIL-model their programs falls under. Before moving to the importance of schema building in ESP and CLIL, a synopsis of CLIL models will first be presented together with working definitions of what ESP is.

CLIL is agreed to be a generic umbrella with models that require methodological adaptations and language support depending on the language proficiency of the involved students. Pérez-Vidal (2005) lays out three CLIL models (A, B, C), distinguished by their level of focus on content and language. Model A presumes that students do not struggle with language and hence language is not the issue. Model B places more focus on English language teaching and integrates content-driven themes within the English classrooms. Model C is more sophisticated as it equally focuses on language and content as each is a vehicle conducive to the other. It involves thorough curriculum and syllabus planning, and is often found in CLIL school programs where there is a vision and policy governing the integration of content and language. Brinton, Snow and Wesche (2004) have another division for content-based instruction delivered in a second language. While this division is more alien to Spain given that English is a foreign language and not a second language, some points in their division apply to teaching content in a foreign language. These authors refer to theme-based instruction, where the EFL teacher bases materials development on content- related themes and pushes for higher-order language processing such as comparing, separating facts and opinions, and so forth; (b) adjunct instruction, where the students are enrolled in a language course that introduces or recycles the content knowledge students receive in other parallel courses; and (c) sheltered instruction, where content teachers cater to students

with language limitations by simplifying and adjusting the materials of the content (for an application of these models, refer to the methodology section).

In all the above models, content and language are continuously mixed and teachers often question where ESP stops and CLIL begins or vice versa. It is beyond the scope of this paper to answer this question in full, yet it was important for this collaboration that ESP be defined, especially when vocabulary lists are still conceived as part of the ESP-CLIL practice in some contexts.

Many ESP definitions share in common the fact that ESP is essentially based on needs analysis, but so are all subject areas. (Strevens, 1988; Hutchinson and Waters, 1987). Dudley-Evens and St. John (1998) redefined ESP after the former authors by attributing certain characteristics and features to it from which the most practical were selected for our purposes:

ESP Characteristics

1. It is mainly intended for intermediate to advanced adult students and therefore students are assumed to have basic knowledge of English. However, it can be used with beginners.
2. It uses methodologies, activities and techniques pertinent to the discipline it serves; for example, students in Sport Sciences need to be able to give instructions for exercises, so one of the activities in the ESP class has been that. The underlying methodology used by teacher and students (when they modeled) was the Total Physical Response method.
3. It should focus on the language genres (including grammar, lexis, and register) suitable for the discipline in different contexts.
4. It is divided into two main parts, one related to occupational purposes and the other to academic skills and learning to learn (Johns and Price-Machado, 2001), so study skills are part and parcel of ESP.

ESP Features

1. The use of authentic learning materials is valued whenever possible and modified by teachers when need arises which is often the case with students of lower proficiency.

2. Students are encouraged to search the internet for related materials that appeal to them for engagement, autonomy, and motivational purposes.

From the discussion of CLIL models and ESP, we are able to conclude that both are built on the principles of effective learning and not on a specific methodology where all decisions are based on the learner's needs. In our contexts, one of the magnified needs is the ability to transfer knowledge from one area to the other including transfer of language from the ESP class to the CLIL class when tackling the same topic. Carrell and Eisterhold (1983) argue that difficulties in reading comprehension in a second or a foreign language can be attributed to a deficiency in background knowledge, or to a lack in activating it. In saying so, ill-knowledge of a lexical element or a grammatical structure can be assumed to be amended if the readers have the necessary background schema. Inference is the academically acceptable term for guessing. Nevertheless, it is a classroom fact that when our students stop in the middle of an exercise if they come across a word beyond their proficiency level that was not previously elicited or pre-taught, we often ask them to 'go ahead and infer/guess the meaning from the context'. Their knowledge of the world makes the context available to them, and they are able to infer the word using their tacit schemata (Rumelhart, 1980). Without schemata or background knowledge, text would not carry meaning; it is a synergy between the text and the readers' background knowledge. Goodman (1967) described reading as a guessing game where the text is a type of graphic design that the reader learns to decode. Decoding is explained as a process of using sections from the text to predicting what follows using background knowledge, subsequently confirming or refuting formed hypothesis before further sampling, or reading. Hence, students need to be able to relate what they are taught to their schemata. ESP students often have some content knowledge (content schema) but need to fill the language gap (language schema) where this content is concerned. Schemata activating is interlinked with top-down and bottom-up processing, Krashen's comprehensible input, and Bruner's scaffolding. These points are discussed one at a time in the order they have been mentioned.

The general principle of schema theory is that received information is mapped against some existing schema and that schemata are organized from

general at the top to more specific information at the bottom. This principle has implications for information processing which are bottom-up and top-down processing. Top-down processing is more general and conceptually-driven. Bottom-up processing, on the other hand, is driven by details, the reason why it is known as data-driven processing. Students come to class each with their schema that has been formed over the years and influenced by factors including schooling and learning experiences, learner type, and culture, among many other factors. Alexander, Schallert, and Hare (1991) propose that general world knowledge, which is what forms the schemata we are referring to, can be understood as the sum of non-specific domain knowledge including metacognition and sociocultural knowledge. New information and novel concepts diffuse through processing until they are meaningfully linked to a unit or units of prior knowledge. New information is gained through bottom-up processing and the learners automatically try fitting it into their schemata. At the same time, top-down processing helps the learners recover from doubts and reinterpret possible meanings. The success of both types of processes, in part, depend on the readers' or listeners' schemata, for the data would remain incomplete or meaningless if it does not conform to the person's conceptual expectations (Rumelhart, 1980); nevertheless, teachers as "scaffolders" are expected to provide students with opportunities to activate what they know and help them link new information to what they already now. This takes us to discussing Comprehensible Input (Krashen, 1985). He believes that for input to be efficient, it should be comprehensible and that comprehensible means taking the level of talk one notch up beyond what students already know (i/knowledge + 1). As regards comprehensible input in the light of information processing, if students were presented with data beyond the level of comprehensible input, bottom-up processing would not contribute to the students' schemata given their inability to place the data in the right memory slots. Hence comes the challenging CLIL equation of balancing the provision of the 'i + 1' (comprehensible input) and not more, yet without compromising the engagement of students in tasks that promote Bloom's higher- order thinking (Nitko, 2004). Different degrees of scaffolding are then required to meet the equation.

The term "scaffolding" was first mentioned by Jerome Bruner to talk about the way young learners are assisted in learning gradually before their caregivers withdraw their support. Hammond and Gibbons (2001) note that in scaffolding,

the provider of the scaffolds plays the role of the expert; the expert closes the zone of proximal development as the expertise passes on from teacher to teacher, or teacher to student. In the paper at hand, the teachers scaffold each other, each in their area of expertise and then one of them acts as a façade to start and end the process of scaffolding the students, until they are able to show their ability to perform as expected.

3. Methodology

3.1. Program Profile

The entry language proficiency level of the students in Sport Sciences (100 students) varies from A1 to B2 on the CEFR scale. Therefore, English for Sport Sciences (referred to as Applied English) is designed to cater for a loose B1 level over 150 hours. Students start English language instruction in the first year and their exposure to English through CLIL increase from 75 hours of content instruction in English in their first semester to 450 hours in their eighth semester (3 full content subjects). The table below shows a scenario for how parts of the above CLIL models have been adapted to the needs in our context[1]. Therefore, model A was not taken into consideration at the moment, but will be in the future for 4th year students and may be expanded to include 3rd year students.

[1] University of San Jorge (Zaragoza-Spain) - The Institute of Modern Languages.

Integrating Language and Content in Sport Sciences		
Year 1	Year 2	
CLIL model focus	**Model B – Language through Content Themes** (English classroom)	**Model C – Content and Language** (Content classroom)
General Practices	Language is taught/activated through content-related themes. • Students are exposed to terminology of different themes per content subjects and to needed structures, and skills. • Students are tested to see if specific language terms, structures and skills are gained. • Language and content teachers collaborate.	Content objectives refer to language learning outcomes • Students are tested in part of the content using the target language. • Teachers are involved in peer lesson planning and peer teaching
Specific Language Teacher Role	Acknowledge important content themes and tailor grammar structures, vocabulary, speaking and writing activities around the themes. • Refer to content teachers for consultations regarding technical points. • Other than content themes, transversal objectives should be maintained in sight (study skills, academic writing, arguing a point…).	Co-weave language-related objectives within the content objectives to cover reception and production skills. • Review lesson plans for English integration • Prepare the language components related to the delivered content whether to scaffold or to assess or evaluate. • Take part in correcting and grading student sample writings. • Take part in attending student presentations, or peer teach parts of a lesson with the content professor where language is expected to be problematic. • Schedule remedial language sessions with the students when needed.

Content Teacher Role	Supply content-related themes to assist the language specialist in preparing materials. · Technically support the English language specialist when needed. · Take part in attending student presentations, or peer teach parts of a lesson with the language professor. · Create **a sheltered language environment**	Co-revise the content objectives after weaving in the language related ones and discussing their feasibility and further plans with the language specialist. · Schedule with the language specialist times to review lesson plans; means for in-class peer collaboration; language component tests and evaluation means. · Create a **sheltered language environment**

Table. Models of CLIL in Sport Sciences[2]

As noted in the table, second-year students are only exposed to English through their content (Model C). Physiology as a subject was targeted as a potential subject for CLIL. According to Sargent (1969), the content area teacher is the most adequate for teaching specialized reading text for a number of reasons, among which are the content teacher's familiarity with concepts, vocabulary and thorough background subject knowledge. The language teacher, as a CLIL collaborator, plans tasks to scaffold the teaching and learning of specialized text after anticipating possible linguistic challenges the students may have.

3.2. Objectives

One of the initial and main topics in the Physiology course is the process of muscle movement. The target learning outcome of the unit was for students to be able to do the following at the end of the unit:

– sequence the steps involved in the process of muscle movement and explain what takes place, starting with the nerve impulse and finishing with the relaxation of the muscle cell.

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[2] The models were synthesized by Nashwa Nashaat Sobhy (Co-author & ESP adjunct lecturer) for content and language integration at the University of San Jorge.

3.3. Procedures

Prior to the beginning of the Physiology course, The ESP teacher in the Applied English course focused over the course of three weeks on movement as a theme in particular, and by the end of the semester students were able to do the following at different levels:

- identify and produce correct word forms to discuss or write about a variety of topics including body movement.
- define muscles and muscle types (lexis, passive voice, prepositions).
- establish cause and effect relations when talking about injuries (cause and effect).
- outline movement-related topics from a text, among other topics.

Engaging students in controlled outline writing was done prior to starting this CLIL collaboration for three main purposes: first, to help students organize their ideas as part of the top-down and bottom-up processing practice. Luo (2012) related that after using a series of controlled outlines, students were able to organize their ideas better. The second reason was for students to reorganize text information using the outlines they made to rephrase main and sub-points in their own words as part of an introductory lesson to paraphrasing. The third reason was to give students an opportunity to freely practice the use of conjunctions and connectors which they had been introduced to in controlled exercises. By the end of the 150-hour ESP course, students had crossed the threshold of studying the content of their discipline from a language-driven angle, slightly modified for comprehensible input. Students' impression of the class atmosphere in the final course evaluations was that the ESP class provided a relaxed environment where learning how to use language was key. Students were motivated to act as the experts on content in the classroom, and to seek additional or more detailed information from the internet using web quests and scavenger-hunts which is believed to have helped them engage in learning to learn and develop essential study skills (including outlining) for future use in their courses.

These were the first steps in preparing students for their forthcoming CLIL experience in general and for the Physiology course in particular.

The ESP teacher, as the language facilitator with the Physiology teacher, planned for six activities in a sequence that would facilitate students' learning; promote peer scaffolding; involve them in the Physiology class; as well as avoid their resorting to translation tools or rote memorization. It was decided that:

– students needed to activate their content and language schemata before reading the text, hence the rationale for the first exercise: clear abundant images of muscle components from Silverthorn (2009) are adapted by highlighting the target muscle-related terms. The images are presented to students with blank labels of the terms which students are expected to know from previous classes, in addition to new labeled terms to add to their collection of knowledge. The comprehensive visuals are expected to be tacitly taken in - not "up-taken" (Ellis, Basturkmen, and Loewen, 2001) - by students to fill slots in their schemata.

– bottom-up processing, as explained before, requires follow up by top-down processing for students to clear their doubts and check the internal structuring of information their metacognition is responsible for, hence the rational for the second exercise: a video (Turney et al., 2012) explaining muscle movement is silently viewed without audio or subtitles for students to see the overall process. During the video screening, students are able to also check the names of the different muscle components and the names of the other elements in the muscle contraction process as they come up on the screen. The images in the video are not identical to the image given to students in exercise 1 which is an additional scaffolding tool that also engages them to an extent in analysis and synthesis to complete the picture, so it is not mere copying off the screen. Exercise two is followed by a question-answer-feedback pattern regarding the terms students need to master before proceeding.

  In exercise 3, continuing with the process of top-down processing, students are asked to generally deduce the number of main and sub-segments (sequences) in the process of muscle contraction. In groups of three and for ten minutes, students start sketching out a sequence of

steps based on the video which is played without audio during the activity so students do not have to rely on memory. The video is then played with the audio on and students are given a few minutes to revise their previous suppositions regarding the sequence of steps in muscle contraction. Again, the exercise is followed by feedback from the teacher and a projection of a model sequence.

– more specific data-driven details are needed for the intricacies of the muscle movement process using the language of cause and effect. The language of cause and effect (because, therefore, as a result of...) in scientific English was noted by Strevens (1972) to be essential for establishing logic and consequentiality. Bartloid (1983) designed a handout for students to explore causality which inspired the sample exercise below, put together by both teachers to be used in parallel with a text (see Exercise 4). For purposeful reading and to notice the language of causality, exercise 4 is given to students together with the target reading text. The text is divided into parts cut off at specific junctions to correspond to a three-part outline (Brain Signaling - Muscle Contraction - Muscle Relaxation) which the content teacher prepared.
– for more consolidation, exercise 5 involves sketching an outline of the reading. Students learned outlining a few months earlier in the ESP class with the English teacher.
– finally, a freer productive period where students put it all together is needed. For this part, it was decided that every three students use their enhanced outline to comment on the previous video in their own words instead of the commentator's (see model outline). It needs to be noted here that students have had an introduction to paraphrasing in the ESP class as well and have practiced paraphrasing techniques including the use of synonyms, and changing sentence structures using relative clauses, passives and connectors.

4. Conclusion

The conclusion of this part of the paper lies in the production of the activities described throughout the paper. The success of these activities, on the other hand, is still work in progress and is informally being recorded by the teachers through observations during classes. Student comments are gathered during peer work in class, and teacher perceptions regarding the level of difficulty or complexity students seem to find are being noted. At the end of the unit, which will also be at the end of the academic year, a structured questionnaire will be given to the students to gather their opinions in a more quantitative manner to be correlated with their grades on the sequencing, outlining and commentating tasks. As a general reflection on the experience so far, it is noted that one of the major challenges has been the need for close collaboration between the teachers as it would not have been possible to carry out these activities without the preparatory steps taken in the ESP class prior to the CLIL Physiology class. Also, facilitating language-based exercises or organizers (like the causality language exercise) is an added value when content and language teachers work together, as the latter is able to predict some of the linguistic challenges that could impair students' comprehensible input and pushed output in the content class.

Exercise 4: Read the text to join the causes and effects presented in the tables below using the verbal structures you see.

Effect clause	Verbal Structures	Cause
- The opening of the calcium channels. - The formation of crossbridges - Filaments of actin and myosin move past each other	is caused by is a result of results from occurs as a result of occurs due to	- The depolarization of the neuron. - Myosin binds actin active site. - The power stroke.

Cause	Verbal structure	Effect Clause
- Calcium entrance - The depolarization of T tubules - The returning of membrane potential to a basal state	leads to causes results in	- Exocytosis of acetylcholine. - Calcium release from Sarcoplasmic reticulum - Inactivation of crossbridges.
Verbal Structure	Cause	Effect
By	- Acetylcholine binding to specific muscle receptors - ATP binding to myosin head - The introduction of Calcium ions in Sarcoplasmic Reticulum.	- Muscle is depolarized - Let go of the actin. - Troponin and tropomyosin go back to the initial position.

Exercise 6 - Model Outline: in groups of three, use the outline to co-construct a commentary for the video seen in class. Your commentary should correspond to the video at all times. You can pause the video to comment when needed. All students are expected to have equal input.

Schema:

1. Signaling:
   a. Action potential in axon.
      i. Action potential arrival.
      ii. Opening of Calcium channels.
      iii. Releasing of neurotransmitter (acetylcholine).
   b. Transmission to muscle fiber.
      i. Acetylcholine binds muscle receptors.
   c. Action potential in muscle fiber
      i. Action potential in muscle.
      ii. Action potential goes to T tubules.
      iii. Calcium release.
2. Contraction
   a. Cross-bridge formation.
      i. Calcium binds troponin
      ii. Tropomyosin moves away.
      iii. Myosin binds actin.
   b. Power stroke.
      i. Phosphate, and then ADP are released.
      ii. Filaments of actin and myosin move past each other.
   c. Extension of myosin head.
      i. ATP binds myosin head.
      ii. ATP to ADP and phosphate.
      iii. Extension of the myosin head.
3. Relaxation
   a. Action potential passes.
      i. Membrane potential at basal state.
   b. Calcium is removed
      i. Activation of SERCA pump.
      ii. Calcium is introduced in SR.
   c. Inactivation of cross-bridges:
      i. Troponin and Tropomyosin go back to the initial position.
      ii. The myosin-binding sites are blocked.

References

Alexander, P.A., Schallert, D.L., & Hare, V.C. (1991). Coming to terms: How researchers in learning and literacy talk about knowledge. *Review of Educational Research*, *61*, 315-343.

Bartloid, L. (1983). Technical English: a method of teaching the cause-effect relation as applied to a diagram. Introduction to text linguistics and its application to LSP - Zagreb, Yugoslavia.

Brinton, D., Snow, M.A., & Wesche, M. (2004). *Content–based second language instruction*. Ann Arbor, MI.: University of Michigan Press.

Carrell, P.L. & Eisterhold, J.C. (1983). Schema theory and ESL reading pedagogy. In Carrell, P. L., Devine, J. & Eskey, D.E. (Eds.) (1988). *Interactive Approaches to Second Language Reading*. Cambridge: CUP.

Celce-Murcia, M. (Ed.). (2001). *Teaching English as a second or foreign language*. Boston, MA: Heinle and Heinle.

Coyle, D. (1999). Supporting students in content and language integrated contexts: planning for effective classrooms. In Mash, J. (Ed.), *Learning through a foreign language – models, methods and outcomes* (pp. 46-62). London: Centre for Information on Language Teaching and Research (CILT).

Coyle, D., Hood, P. & Marsh, D. (2010). *CLIL: Content and language integrated learning*. Cambridge: Cambridge University Press.

Dudley-Evans, A. & St. John, M.J. (1998). *Developments in English for specific purposes*. Cambridge: Cambridge University Press.

Ellis, R., Basturkmen, H., & Loewen, S. (2001). Learner uptake in communicative ESL lessons. *Language Learning*, *51*, 281-326.

Goodman, K. S. (1967). Reading: A psycholinguistic guessing game. *Journal of the Reading Specialist*, *6*, 126-135.

Hutchinson, T. & Waters, A. (1987). *English for specific purposes: A learning-centered approach*. Cambridge: Cambridge University Press.

Johns, A.M., & Price-Machado, D. (2001). English for Specific Purposes (ESP): Tailoring courses to student needs - and to the outside world. In M. Celce-Murcia (Ed.), *Teaching English as a second or foreign language* (3rd ed) (pp. 43-54). Boston: Heinle & Heinle.

Krashen, S.D. (1985). *The input hypothesis: Issues and implications*. New York: Longman.

Luo, M. (2012). Research on three-part argumentative writings for English majors in China. *English Language Teaching*, *5*(7), 140-149.

Marsh, D., Maljers, A., & Hartiala, A.K. (2001). *Profiling European CLIL classrooms*. The Netherlands: University of Jyväskylä, Finland and European Platform for Dutch Education.

Nitko, A. J. (2004). *Educational assessment of students*. 4th ed. Upper Saddle River, NJ: Pearson, Merrill, Prentice Hall.

Pérez-Vidal, C. & Grilloni, N. (2005). *Content and language integrated learning (CLIL) in Europe. Teaching Materials for Use in the Secondary School Classroom*. Barcelona: Universitat Pompeu Fabra.

Rumelhart, D. E. (1980). Schemata: The building blocks of cognition. In R. J. Spiro, B. C. Bruce & W. F. Brewer (Eds.), *Theoretical issues in reading and comprehension* (pp. 33-58). Hillsdale, NJ: Lawreence Erlbaum Associates.

Sargent, E. (1969). Integrating Reading Skills in the Content Areas. In H. Alan Robinson & Ellen Lamar Thomas (Eds.), *Fusing Reading Skills and Content* (pp. 17-20). Newark, Delaware: International Reading Association.

Silverthorn, U. D. (2009). *Human Physiology: An Integrated Approach*. San Francisco: Benjamin Cummings.

Strevens, P. (1972). Technical, Technological, and Scientific English (TTSE). *Fifth annual conference of the International Association of Teachers of English as a Foreign Language*. Retrieved from eltj.oxfordjournals.org

Turney et al. (2012). Sliding filament theory. Big Picture, Exercise, Energy and Movement. Retrieved from http://www.wellcome.ac.uk/Education-resources/Education-and-learning/Big-Picture/All-issues/Exercise-energy-and-movement/WTDV033020.htm