
RESEARCH ARTICLE

Foreign Language Learning in Light of Cognitive Learning Theory

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ABSTRACT

Language, with a capital initial, indicates the human system of verbal communication, which has a lot of variations represented by various languages spoken in the world. All languages involve the same mechanisms that govern their patterning because all humans have the same architecture of the cognitive system and follow the same cognitive learning principles in acquiring knowledge. While the cognitive processing mechanisms are unconscious and automatic in first language acquisition, they are effortful and can impose load on the cognitive system of the EFL learners due to factors internal to the texture of languages and some other external factors related to the cultures of individuals; which commits the learner to process multiple resources of information simultaneously before being able to schematize the new knowledge related to the target language. Accordingly, this paper discusses foreign language learning in light of cognitive learning theory with the aim of explaining why it can be hard on the EFL learners' part to acquire the target language perfectly.

KEYWORDS

Cognitive load, categories of Cognitive load, mental knowledge, foreign language, working memory, long-term memory

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1. Introduction

Human memory is the base of the learning process without which no learning takes place. The ability to learn and collect information indicates a good ability to retrieve knowledge from memory (Ashman and Conway: 2002). Humans are involved in a long life process of learning where they acquire some particular knowledge about the endless details of their world. Actually, individuals learn only things that are part of their interactive world, as their minds cannot store knowledge of things out of their world of experience (Whorff, 1965). Moreover, they are limited in terms of the amount of information they can process at every point in time.

This limitedness is due to the mechanisms of information processing and the architecture of the mental processing system itself. Individuals direct their attention to details that fit their interactive needs in their environment and selectively receive the required information by their senses and hold it in their sensory storage system for a while till the working memory judges that the information is meaningful (i.e., it has a sort of reference) in the long term memory (Brown et al., 2014) or associations of some kind with the knowledge that has already been part of that memory and consequently approves receiving it. Otherwise, the information will disappear and fade out.

The working memory is the central region of the mind where information coming from the outside is organized and combined with the mental storage already available in long-term memory. It depends on active processing. Selecting an information element from the interactive world, representing it mentally, linking it to one's prior knowledge, inferring its associations with every single detail in long-term memory, etc., are all considered by Ericsson and Kintsch (1995) as mental states of working memory. Accordingly, this memory is involved in the online processing of both the temporary sensory information and the permanent knowledge in the long-term memory, allocating the kind of knowledge to be processed from the sensory memory and the one to be stored in and gotten back from the long-term memory.

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The long term memory is permanent mental storage for an unlimited range of organized information (Newell and Simon, 1972) approved by the working memory. It can be regarded as a mental record of individuals' past experiences organized in blocks of knowledge. The level of cooperation between this memory and the working memory is the determinant of the efficiency of learning and knowledge acquisition.

Since working memory can hold seven (minus or plus two) items or chunks of knowledge at a point in time (Miller 1956), process only two to three elements of data simultaneously (Kirschner et al. 2006), and hold the completely new information for only 15 to 30 seconds (Driscoll,2005), it is restricted in capacity and duration of the processing; which can load the individuals' working memory because of the competing demands of the cognitive processes (Ginns and Leppink, 2019). When the newly perceived information is either irrelevant or contrary to the conventional knowledge in long-term memory, learners have to set upon a series of cognitive processes to build a mental frame of knowledge that projects meanings on details of the received new information; which requires mental scanning of all possible relevant domains of individuals' experiential world and inferring all possible associations within and among details of these domains.

Actually, the relation between human cognitive architecture and the information to be acquired is instructional by nature, even outside teaching classes, as the information prompts the human cognition to act along universal cognitive learning principles yet in line with the interactive and communicative requirements of humans across time and place of their lives. Drawing on this perception, the present paper proposes that human languages are by nature instructional in that they call the thinking of their native and nonnative speakers to achieve communicative and interactional tasks in the wide real world (as opposed to the restricted and narrow language classes) and that a target language acquisition follows the same five cognitive learning principles (see Sweller and Sweller,2006, Sweller 2011) that natural information processing system works on. Accordingly, Language can be explored in terms of cognitive load theory to highlight some reasons that make learning a foreign language a hard long term experience for some learners.

2. Research questions

This paper is intended to foreground a number of issues related to foreign language acquisition by answering the following questions:

1. What is the relation between language, cognition, and culture?
2. Why can foreign language learning be a source of cognitive load?
3. In light of the nature of human language, how can a foreign language be categorized in terms of cognitive load theory?

3. Methodology

This paper adopts a theoretical account that involves dealing with the foreign language (inside the class and outside it) as instructional material that calls learners to perform the task of thinking and communicating in the target language accurately and correctly. The principles of cognitive load theory are projected on Language as a cognitive system whose high level of elements' interactivity is explored and linked to the category of intrinsic cognitive load, while Language as a cultural system is thought to be relevant to the category of extraneous cognitive load. A qualitative analysis method is adopted to clarify more relevant information that can answer the paper's questions.

4. Language, Foreign Languages, and Cognitive Principles of Learning

Knowledge falls into two kinds: primary and secondary. The former is the knowledge that humans evolve to get across time. Humans get and use Primary knowledge unconsciously and effortlessly just as a consequence of their membership in the human social organization (Sweller et al. (2011), Geary(2012) Sweller (2016)). Humans' cognitive skills, social skills, and the use of native language are examples of Primary knowledge. Secondary knowledge, however, is acquired through deliberate mental effort and conscious work; learning a foreign language can be an example of this category. Based on this classification, it can be said that cognitive load is potentially possible only with secondary knowledge acquired within the teaching environment and through instructional designs. However, the two kinds of knowledge are governed by five cognitive learning principles, which work naturally when input information is processed in human cognition.

Sweller et al. (2011) summarized the way these principles work as the following: while we are interacting with entities in the world, we observe, acquire and store knowledge in mental cognition ("Long term memory and information store principle"). Knowledge in long term memory is a mimic of individuals' interactive world, and it is adapted to their needs and automated as schemas that guide their behaviors along their course of life ("Schema Theory and the Borrowing and Reorganizing Principle"). However, in situations where the information to be learned is completely new and has no reference base in long term memory, human cognition tests, which among a set of random options, can best instantiate the relevant need (whether interactive, communicative needs or any other kind of need) and selects the effective option to be stored in long term memory ("Problem solving and Genesis

principle"). Building new storage in long term memory must be slow and incremental in order to keep the storage safe ("Narrow Limits of Change Principle"). Humans have the ability to transfer huge amounts of organized blocks of knowledge from long term memory to working memory to guide their actions in various situations by associating the new experience with some relevant details from past experiences to respond appropriately ("Working Memory and the Environment Organizing and Linking Principle").

Being natural components of the information processing system, these principles are applicable to all learning experiences. In the case of foreign language acquisition, learners' working memory can be overloaded due to deviation from these principles or inability to utilize them accurately. This will be discussed in light of the relationship between the nature of Language, some categories of cognitive load, and cognitive learning principles.

5. Nature of Language and categories of Cognitive Load of

The comprehensive view of language indicates that language is a reflection of its speakers' thinking (Langacker, 1987, 2012) and that culture is the filter that ordains the ways of their thinking (Sharifian 2003, 2017). On the one hand, to learn a language effectively means to process the new language input information in line with the five learning principles mentioned earlier. On the other hand, it demands modelling these principles (which are universal for all humans and in any kind of experience) in light of the cultural cognition of the natives of the target language; which means developing a cognitive view of the world just as that adopted by the natives of the target language. Cognitive principles, including all cognitive processes underlying them, and the natives' culture are the two pillars that pattern human Language in all its varieties and give it its defining characteristics as:

- A reflective system that mirrors modes of thinking in terms of both the universal mechanisms underlying its patterning and the particular modes of thinking of its speakers.
- An interactive system that responds to the interactive needs of its speakers in their cultural environment; the latter covers all aspects of the physical, emotional, mental, psychological, spiritual lives, etc., of individuals who share some particular view of the world.
- A dynamic system that involves online universal cognitive processes such as information encoding, organization, association, schema construction and re-construction, problem solving techniques, etc.; a property that makes the content of a language far from being canned in some relevant linguistic elements or structures that externalize it. Rather, Language is being updated all the time to meet the developed communicative and interactional needs of its users at every point in time.

These general characteristics of Language as a unique human property are present in all languages spoken by humans all over the world. They imply a high level of interactivity between all of the elements that can contribute to the shaping of any language and the online encyclopedic associations between those elements, which can be a source of cognitive load on learners of foreign languages. The cognitive processes involved in languages' constructions are universal, automatic for all humans, and unconscious for the natives of languages as they become part of permanent knowledge stored in their long term memory. However, cultural cognition sets languages differently, gives each of them its unique structures, and makes foreign language acquisition demand more conscious cognitive effort from the non-natives to acquire that target language. Moreover, the difference between cultural cognition (mental conventional knowledge in the long term memory as determined by cultural schematization, categorization, and conceptualization) of the learners and that of natives of the target language may cause a sort of extraneous load because the target language can be classified by learners' cognition as a kind of knowledge that is unrelated to or different from the conventional frame reference in their long term memory on which they base their cognitive processing of information. Thus, learners under the influence of their cultural cognition may require more time to acquire the target language due to the germane load effect, where they try to test various element options and associations before they finally get to understand and learn the new piece of knowledge; which can be a justification of the inevitable construction of interlanguage system by the learners of foreign languages.

5.1. Foreign Language Learning and Intrinsic Cognitive Load

Intrinsic load occurs as an outcome of the interactivity of multiple elements that need to be processed in working memory at one time (Sweller and Chandler, 1994). Learning a word in a target language for beginners, for example, does not impose that much load on working memory when it is learned as a unit independent of any contextual effect. However, cognitive load arises at more advanced levels when learners have to understand the meaning extension of that word and the context of its usage. Understanding is "the ability to process all elements that necessarily interact simultaneously in working memory" Sweller (2003:216). In such a situation, a learner has to be aware of the relation between the physical referent of a word and the conceptual content that it provokes in different mental domains of all relevant knowledge stored in the cognition of its speakers. The production and recognition of the accurate meaning of a word demand working memory to consider all these elements, which puts that memory

under the pressure of manipulating a number of intrinsically interactive entities every time learners face a new word in the target language.

Hadi (2017a) stated that some Iraqi EFL Learners failed to recognize the metaphoric extension of the word 'sight' by projecting incorrect interpretations of that word. 'Sight' as a sense has its mental domain in English cognition, and another domain encompasses the mental knowledge that things to be seen are either close or far, so we either can see them or can't. Accordingly, the metaphoric meaning extension of 'sight' in "The end is in sight" (ibid.: 801) involves the mental mapping of the closeness concept from the physical domain of the distance within which we can see things to the mental domain which makes things close to or far from our awareness. Learners may fail to understand the long list of interconnected senses of a word due to the high level of interactivity between the mental domains related to every sense of that word, which puts them under cognitive pressure.

Interactivity on the syntactic level can be another source of intrinsic cognitive load on foreign language learners. Langacker (2008) implied that there is an interrelation between the conceptual element underlying a particular structure and the syntactic arrangement of constituents of that structure. Drawing on this proposition, Hadi (2017 b) concluded that the pre-position of the English adjective in relation to the modified head is a reflection of the interaction between the conceptual and the linguistic levels of Language. An English adjective is conceptualized as an entry that allows an individual's awareness to identify the modified noun. The temporal sequence of mental awareness involving the conceptualization of the physical experience "To go inside some place you must step the entrance first" (ibid: 2108) determines the position of an adjective in relation to its head noun. Actually, languages encompass mapping from a source domain represented by individuals' mental images of details of their experiences to a target domain represented by the linguistic codes that externalize these images (Langacker: 1987, 2008, 2012). Learners' working memory can be overloaded when the mental concepts in their long term memory contradict or do not fit the concepts in the cognition of the natives of the target language.

Learners, then, have to deal with a couple of elements at the same time while they are trying to learn and use the various levels of a language; a situation which frequently puts them under mental pressure, especially when they have to scan their minds for a lot of interrelated details of learning material and to solve problems of understanding arisen due to the information unfamiliarity or its contradiction with the learners' own mental storage (the one related to their native language). They have to discover the fabric of the target language and engage in online comparisons and analogies by applying the cognitive learning rules mentioned earlier to acquire the target language accurately.

5.1.2 Foreign Language and Extraneous Cognitive Load

Extraneous cognitive load occurs when working memory is loaded by poor instructional material. It occurs when the class instructions involve either directing the learners' mental activities to unnecessarily integrate heterogeneous elements of information to understand and learn the material or neglecting the necessity of such integration when the material to be learned is organized in such a manner that it cannot be understood as an independent unit (Chandler and Sweller:1991). For instance, presenting some visible images of the referents whose English names are intended to be learned by EFL learners will be an effective instruction as the learners will directly connect the word 'fire', for example, with the physical entity of its referent and store the new linguistic code for that referent in their cognition according to the first cognitive learning principle. However, this instruction won't be enough to teach the extended meanings of this word because cultural values, rituals, habits, etc., contribute to the meaning extension of that word. In such a case, part of the difficulty in learning comes from cultural elements which formulate languages at different levels and which act as external factors that affect Language system patterning. Culture can be a source of extraneous cognitive load when the learners fail to connect the linguistic entities with the cultural schemas or categories underlying their structure and use. The real communicative and interactive life situations that a learner may be involved in are actually parallel to the instructional material they have to respond to in their classes in that, in the two cases, they have to perform verbally in response to the various prompts in various contexts.

Being involved in a situation where learners have to interact and communicate via the target language, they automatically turn to internal knowledge in their cognition, as the latter is the executive mental unit that normally guides their behaviour. At this point, a couple of scenarios are possible. The information in the target language has an equivalent conceptual content in learners' cultural cognition, and hence they respond simultaneously. Otherwise, the mismatch between cultural conceptualizations in learners' native language and the target language will cause a sort of cognitive conflict, the result of which is either misuse of linguistic constituents (on production or recognition levels or both) or a block of communication altogether. The former occurs as the learners apply some of their cultural conceptualization (principle of borrowing and reorganizing) into the wrong context in the target language, while the latter is due to their inability to find some mental knowledge base reference on which they built their linguistic response as the long term memory does not work due to change of environment (Sweller: 2004) represented by the target culture.

Cultural integration into language systems is actually projected on various levels of language systems. For example, English natives belong to an individualistic culture where males and females are equal in duties and rights. While Arab natives belong to a collective

culture where males and females are unequal. The kinds of their jobs are culturally classified as man-related jobs and woman-related jobs. Accordingly, the role schema (a term used by Nishada (1999) to indicate the role played by individuals or assigned to them by members of their cultural group) assigned to each gender is different. This distinction has been projected on the grammatical verb form in the two languages, where an English verb has a neutral form regardless of the gender of its subject, while an Arabic verb has a female and masculine form. Some cultures differentiate between actions depending on the doer of these actions. Littlemore (2009) mentioned that German natives use two verbs (essen) and (fressen) to indicate the act of eating depending on whether the doer of the action is a human or an animal. English natives, however, use the word 'eat' without such distinction. The learners of the German language have to learn to split verb categories according to the cultural categorization process of speakers of the target language.

Moreover, the semantic content of an item depends on the way its speakers schematize the relevant aspects of their experiences, which involves the mental representation of generic information about a particular experience and associations between its attributes both within that experience and outside it (i.e., in relation to other experiences). Hadi (2022) concluded that although English and Arabic languages meet in putting some occupants of official positions in the leadership category, the cultural schemas associated with those occupants differ in the culture relevant to each language. Consequently, in Iraq, there are (رئيس قسم) (literal translation: president of the department) and (رئيس وزراء) (literal translation: president of ministers), while the English have a head of the department and a prime minister. Different role schemas built two different concepts for the members of one category. The Head of the department is a leader of a group in the two cultures, but English natives view him as a member of the group, while Arab views a leader as being in a higher position than other group members. The decision maker can be the role schema underlying the title 'prime minister', yet English view the occupant of such a position as the first, among other ministers, to perform his duties in government by naming other ministers. In Arab culture, however, this person is seen as a leader of others due to the power that allows him to determine others' positions. Those cultural idiosyncrasies come from the cultural settings, values, and rituals relevant to the official organizations in these cultures. Ignorance of these matters makes learners unaware of the importance of its integration into their linguistic repertoire of the relevant expressions, which may inhibit communication repeatedly and put a load on their working memory due to the poor knowledge of how to associate the attributes of cultural values and rituals to the semantic structure of the target language.

Interactivity between cultural conventions and language is also observable on the pragmatic level. In a study comparing some English speech acts to their counterparts in Polish, Wierzbicka (1985) stated that the English cultural convention prefers indirect speech acts when they are intended to bring an action from the hearer. While the Polish ways of speaking are more direct, which is reflected in the linguistic realization of speech acts in the two languages. For example, the act of exclaiming involves the use of an interrogative form in English. However, Interrogative in Polish would always be used as genuine questions; a notion that may cause misinterpretation or misuse of the relevant utterances due to learners' failure to observe the interrelation between cultural conventions of the target language and the linguistic realization of relevant speech acts; which may result in a load on non-natives when their conventional knowledge contradicts the one embedded in Polish cultural cognition. Actually, the coding and encoding processes of any language system reside in the experiences shared between interlocutors, and being a foreigner to these experiences can load Learners' mentality as they have to be involved in a discovery learning process to figure out the schemas that can facilitate the acquisition of the new knowledge.

5.1.3. Language and Germane Cognitive Load

Germane cognitive load refers to the effort put into building knowledge that constitutes part of the individuals' cognition and enhances their learning. It involves converting a new piece of information into a learning experience integrated into long term memory (Pass et al., 2003). The interlanguage system, which is known as a transitional system of language that has some characteristics of the learners' native language and some characteristics of the target language (Yule, 1985), can be a reflection of this kind of load. According to the cognitive learning principles, learners first try to internalize the new knowledge on the basis of knowledge they have already acquired as natives of some particular language (first cognitive principle of learning). As long as they don't master the target language, they are trying to fit the conceptual scaffolding of their cultural cognition on the target language (second cognitive principle of learning) through engaging in an unescapable solving problem task in the communicative context they are involved in (third principle of cognitive learning). Throughout the learning time, they discover the optimum piece of knowledge that fits the target language conceptual structure (fourth cognitive principle of learning), then they store it and put it into the schematic frame to be automated for use (fifth cognitive principle of learning).

Interlanguage, as a portrait of Germane cognitive load, can be perceived as the EFL learners' constant mental effort exerted in discovering the target language by referring either to their cultural cognition rather than the cognition underlying the target language or any other kind of base reference. Actually, literal transfer, generalization, substitution, and all other communicative strategies employed by EFL learners in their interlanguage system are attempts to get the accurate piece of knowledge that fits the target language and helps in constructing the relevant schemas.

According to all mentioned earlier, acquiring a foreign language goes beyond memorizing the list of vocabularies and structures of the target language. It involves learners' engaging in a sensitive process of modifying their cognitive mechanisms in line with both the universal architecture of the cognitive system, the universal cognitive principles of learning, and the specific cultural fabric through which a target language and its underlying conceptual content are filtered.

6. Conclusion

This paper highlights the fact that any language system is a mirror of the cognitive thinking of its speakers and that languages are patterned by the cultural values of their natives, which answers the paper's first question, 'What is the relation between language, cognition, and culture?'. The high level of interactivity both within syntactic, semantic, and pragmatic levels of languages and between those levels and the conceptual and cultural base on which they are formulated can impose a cognitive load on learners when their conventional knowledge completely differs from or contradicts the conventional knowledge of the natives of the target language. In such a case, learners' long term memory does not work, and the learners lack the guide that directs them to the correct response which can serve their communicative needs in the target language; this answers the second question 'why is foreign language learning a source of cognitive load?'. Finally, foreign language learning can be a source of an intrinsic load on learners due to the high level of interactivity between all elements that constitute the texture of a language. It can also be a generator of external cognitive load due to the patterning role played on the internal fabric of a language by external factors represented by cultural conceptualizations and its relevant components. The interlanguage system, which is an unavoidable stage of the foreign language acquisition process, is, in fact, a reflection of a positive load that signals the learners' engagement in a schema building activity during their journey of language learning. Accordingly, learning a foreign language can exert both an intrinsic and an external cognitive load at the same time, and it can also be a germane load which is essential for successful learning outcomes.

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References

- [1] Ashman, A., and Conway, R. (2002). *An introduction to Cognitive Education: Theory and Applications*. Routledge.
- [2] Brown, P., Roediger, H. and McDaniel, M. (2014) *Make It Stick: The Science of Successful Learning*. Harvard University Press.
- [3] Chandler, P., and Sweller, J. (1991). Cognitive Load Theory and the Format of Instruction. *Cognition and Instruction*, 8(4), 293-332.
- [4] Driscoll, M. P. (2005). *Psychology of Learning for Instruction* (3rd ed.). Boston: Pearson.
- [5] Ericsson, K. A., and Kintsch, W. (1995). Long-term Working Memory. *Psychological Review*, 102(2), 211.
- [6] Geary, D. (2012). Evolutionary Educational Psychology. In K. Harris, S. Graham, and T. Urdan (Eds.), Vol. 1. *APA Educational Psychology Handbook* (pp. 597-621 Washington, D.C.: American Psychological Association.
- [7] Ginns, P., and Leppink, J. (2019). Special Issue on Cognitive Load Theory. *Educational Psychology Review*, 31(2), 255-259.
- [8] Hadi, S. A. K. (2017a). Investigating Iraqi EFL Learners' Comprehension of Some Senses of the Word 'Sight'. *Basic Education College Magazine For Educational and Humanities Sciences*, (33).
- [9] Hadi, S. A. K. (2017b). An analysis of the Post-Nominal Modifiers in English and Arabic in light of Cognitive Grammar Theory. *Journal of the University of Babylon*, 25(5).
- [10] -Hadi, S. A. K. (2022). *Foreign Language Learning in Light of Cognitive Learning Theory*. Unpublished Manuscript.
- [11] Kirschner, P. A., Sweller, J., and Clark, R.E. (2006). Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching. *Educational Psychologist*, 41, 75-86.
- [12] Langacker-Ronald W. (2008). *Cognitive Grammar: A Basic Introduction*. Oxford: OUP.
- [13] Langacker, R. W. (1987). *Foundations of Cognitive Grammar: Descriptive Application*. Volume 2.
- [14] Langacker, R. W. (2012). *Essentials of Cognitive Grammar*. Oxford University Press.
- [15] Littlemore, J. (2009). *Applying Cognitive Linguistics to Second Language Learning and Teaching*. Springer.
- [16] Miller, G. A. (1956). The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information. *Psychological Review*, 63, 81-97.
- [17] Newell, A., and Simon, H. A. (1972). *Human Problem Solving* (Vol. 104, No. 9). Englewood Cliffs, NJ: Prentice-hall.
- [18] Nishida, H. (1999). Cultural Schema Theory. In W. B. Gudykunst (Ed.). *Theorizing About Intercultural Communication* (pp. 401-418). Thousand Oaks, C.A.: Sage Publications, Inc.
- [19] Pass, F., Tuovinen, J. E., Tabbers, H., and van Gerven, P. W. M. (2003). *Cognitive Load Measurement as a Means to Advance Cognitive Load Theory*: *Educational Psychologist*, 38,(1), pp.63-71.
- [20] Sharifian, F. (2003). On Cultural Conceptualisations. *Journal of Cognition and Culture*, 3(3), 187-207.
- [21] Sharifian, F. (2017). *Cultural Linguistics: Cultural Conceptualisations and language* (Vol. 8). John Benjamins Publishing Company.

-
- [22] Sweller, J., and Chandler, P. (1994). Why Some Material is Difficult to Learn. *Cognition and Instruction*, 12(3), 185-233.
- [23] Sweller, J. (2003). Evolution of Human Cognitive Architecture. *Psychology of Learning and Motivation*, 43, 216-266.
- [24] Sweller, J. (2004). Instructional Design Consequences of an Analogy Between Evolution by Natural Selection and Human Cognitive Architecture. *Instructional Science*, 32(1), 9-31.
- [25] Sweller, J., and Sweller, S. (2006). Natural Information Processing Systems. *Evolutionary Psychology*, 4(1).
- [26] Sweller, J. P., Ayres, P., and Kalyuga, S. (2011). Explorations in the Learning Sciences, Instructional Systems and Performance Technologies, and Cognitive Load Theory. Springer Science+ Business Media, LLC.
- [27] Sweller, J. (2016). Cognitive Load Theory, Evolutionary Educational Psychology, and Instructional Design. In D. Geary, and D. Berch (Eds.), *Evolutionary Perspectives on Child Development and Education* (pp. 291e306). Switzerland: Springer
- [28] Whorf, B.L. (1956). *Language, Thought and Reality: Selected Writings*. Technology Press of Massachusetts Institute of Technology: Cambridge Press.
- [29] Wierzbicka, A. (1985). Different Cultures, Different Languages, Different Speech Acts: Polish vs. English. *Journal of pragmatics*, 9(2-3), 145-178.
- [30] Yule, G. (1985). *The Study of Language* (6th ed.). Cambridge: Cambridge University Press.