Assessing EFL learners' perceptions on the use of an educational software for English learning: an analysis of pedagogic and ergonomic features

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Abstract: The present study aimed at analyzing EFL learners' perceptions on the use of an educational software for language learning. A hundred and fifty-nine learners from the Agribusiness and Computer Science courses of an Integrated Technical High School Program participated in the study and rated the pedagogic and ergonomic features of the software in light of Sociointeractional and Structural Cognitive Modifiability theories of learning. Data were collected through questionnaires before and after software use. In general, the pedagogic qualitatively analysis revealed that Agribusiness and Computer students agreed that the software represents a relevant tool for EFL learning. The ergonomic analysis, on the other hand, indicated that some human-computer interaction features of the software are deficient. In sum, findings suggest that there must be a close relationship between the pedagogic and the ergonomic characteristics of the software if the aim is to foster language learning.

Keywords: educational software; EFL teaching and learning; pedagogical characteristics; ergonomics.

Evaluación de las percepciones de estudiantes de inglés como lengua extranjera sobre el uso de un software educativo para el aprendizaje de inglés: un análisis de las características pedagógicas y ergonómicas

Resumen: El objetivo de este trabajo es analizar las percepciones de los estudiantes de inglês como lengua extranjera sobre el uso de un software educacional para el aprendizado de lenguas. Ciento y cincuenta y nueve estudiantes del curso de Agronegócio y Computación del Liceo Integrado participaron en el estudio y evaluaron las características pedagógicas y ergonómicas del software bajo la perspectiva de las teorias de aprendizado de Interacción Social y Modificación de Estructuras Cognitivas. Los datos fueron colectados a través de cuestionarios antes y después del uso del software. En general, el análisis pedagógico cualitativo revela que los estudiantes del curso de Agronegócio y Computación concuerdan con que el software representa una herramienta fundamental para el aprendizado de inglés. El análisis ergonómico, por su parte, indica que algunas características de interacciones persona-computador del software son deficientes. Finalmente, resultados sugieren que debería existir uma estrecha relación entre las características pedagógicas y ergonómicas del software si el objetivo es fomentar el aprendizado de lenguas.

Palabras clave: software educacional, enseñanza y aprendizaje de inglés como lengua extranjera, características pedagógicas, ergonomia.

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Introduction

We live in a flat world (Friedman, 2005) where our experience with technological devices is abundant both in our social and educational practices. As put forward by Lopes (2002: 01, our translation), “Information technology has acquired more relevance in the educational scenario these days. Its use as a pedagogic tool and its action on society has increased fast among us”. So as to keep pace with these advances, both quantitatively and qualitatively, it is important to critically assess the use of technology in this social and educational scenario.

From a pedagogic perspective, the major issue around the use of technology has concentrated on whether technological resources in vogue nowadays, such as educational softwares, have relevant contributions to offer in terms of effective learning. When the type of learning involves accessing information online, Finardi, Prebianca and Momm (2013) remind us that learning English and how to use technology properly (digital literacy) may function as passports to perform well in a society that circulates information mostly through clicks and in English.

However and despite lack of more robust evidence, as far as learning is concerned, it seems that actions such as offering physical access to technology in an educational context or its implementation without careful planning and design might not in themselves lead to effective learning (Warschauer, 2003). One such example can be observed in the Brazilian project One Laptop per Child - OLPC (*Um computador por aluno,* in Brazilian Portuguese) which, despite providing some physical access to technology, produced questionable results in terms of learning.

Prebianca, Cardoso and Finardi (in press) reported a study that investigated the effectiveness of the OLPC program in the south of Brazil. Results of that study showed that a great number of schools that participated in the OLPC Project in Santa Catarina had limited or no wireless access to internet. Besides this caveat, other problems related to infrastructure were observed in the participating schools ranging from lack of power switches to general precarious electrical installations. Finally, according to Prebianca, Cardoso and Finardi (in press), that study also indicated that although the OLPC project was beneficial for overall student motivation and engagement, it did not impact on students’ performance (scores), a result also observed in the American OLPC project.

As can be seen, uncritical use of technology as seen in projects like the OLPC, do not seem to guarantee quantity and quality of learning. For some psychologists such as Piaget, learning is the result of the biological maturation process of the mind. Knowledge acquisition, according to Piaget (1976), takes place through the development of cognitive structures (or mental schemes) that the individual establishes through direct contact with the environment in which he/she is inserted. Although Piaget recognizes the importance of the environment in the construction of knowledge, the individual’s biologic maturation is at the crux of his theory. Based on this view of learning it is possible to suggest that the learner’s cognitive development cannot be explained by the learning context alone, but instead represents a consequence of mental schemes being organized in a

maturational stage (Gomes, 2001).

Other theorists such as Vygotsky (1986) and Feuerstein (1997), for example, take a more interactional view of learning. Though these authors agree that mental maturation is important for learning they think it cannot explain learning in itself. These authors view interaction with the environment as having a key role in the development of mental schemes. However, for both, cognition and learning are intimately related, since one needs the other to exist. Vygotsky and Feuerstein highlight the importance of peer mediation for the individuals' biologic maturation to take place, which, in turn, functions as a trigger for the learning process (Gomes, 2001).

Another aspect worth mentioning in Vygotsky's theory is the assumption that the development of higher order cognitive functions takes place through people's interaction and mediation with the environment. According to Vygotsky (1986), mediation can take place through instruments or signs. Instruments are related to objects used to interact with the world, such as work tools, for example, whereas signs are semiotic, such as language, for example. Still according to the aforementioned author, mediation is essential for learning since knowledge is built socially and historically, taking into consideration people's experience exchanges.

Feuerstein and Feuerstein (1994) and Feuerstein (1997) advanced Vygostky's ideas for interaction, and proposed that learning takes place through peer mediation which allows aspects of novel information to be noticed by learners who, otherwise, would not be able to grasp these aspects from the environment by themselves. Thus, a mediated learning experience, as proposed by Feuerstein, may lead learners to assimilate the stimulus, modifying his/her cognitive structures in a way that he/she would not be able to do by himself/herself. In Feuerstein and Feuerstein's (1994) and Feuerstein's (1997) proposal, a mediated learning experience has three basic features. First, it has to be meaningful for learners. Second, it has to be intentional, that is, it has to present clear learning purposes and third, it must allow the transcendence or generalization of this learning to other contexts, by offering possibilities for knowledge restructuring.

Leaners who are capable of reorganizing previously learned material based on the experiences with the environment are also able to analyze their learning process in a critical way, since they make use of reasoning patterns that require comparisons, assimilation and restructuring of mental connections already established in the learner's mind. In Feuerstein and Feuerstein's (1994) and Feuerstein's (1997) views then, mediated learning experiences serve as triggers for the learners' cognitive modifiability. It is this ability to modify an already existing mental scheme through peer mediation that Feuerstein calls learning.

From a pedagogic practice point of view, there is still much to discuss regarding how we learn. The more we know about how we learn the more questions we raise, highlighting the complex role of teachers in this process. Perhaps the most basic principle or skill for learning is the development of the logic and mathematical reasoning which allows the abstraction, analysis, organization, assimilation, review, reassessment and restructuring of previously acquired knowledge. In that

sense, teachers and pedagogic materials and tools must provide learning opportunities where those skills are required so as to help learners develop.

As the demand for online and distance learning courses increase, especially in the context of undergraduate and graduate courses, an inevitable question is raised as to how the concept of mediation can be understood in this new learning scenario, given that for Vygotsky and Feuerstein mediation is human in its essence. In this perspective, a learner must interact with other people to learn. Yet, the new information and communication technologies (ICTs) provide us with new ways to understand interaction. It is possible to say that learners become more autonomous for their own learning which can take place through the mediation afforded by the interaction with educational softwares. Would this interaction be a type of mediation, as idealized by Vygotsky and Feuerstein? Is it possible to have interaction without mediation? In case there is no mediation, is there still any learning**?** And if there is mediation, how much of it is effectively equated into learning**?**

These and many other questions seem to haunt education practices nowadays. The need to better understand processes that affect learning such as mental, social and historical processes, and more recently, technological ones, is very pressing given that the modern learner is increasingly more connected in a world which offers a vast amount of information in a fast and attractive way. In this sense, it seems essential to analyze how human-computer interaction and ergonomic features of educational softwares impact on learning in general, and on language learning, in particular.

Human-computer interaction (HCI) is part of a field of knowledge known as Software Ergonomics which attempts to understand learning systems taking into consideration the user's adaptability to it (Barbosa and Silva, 2010). HCI also attempts to understand how users interpret softwares departing from the assumption that a system can be modified and improved through feedback in such a way that the designer of the software can adjust it according to the mental mode of a given user to create high-quality interfaces.

Analyzing HCI aspects is important insomuch as human natural language is very different from the complex codes that constitute machine language. Recall that language, as seen by Vygostky, is one of the most important forms of sign mediation. In this context, the software interface plays a major role in the interactions that will take place between humans and the machine.

Cybis, Betiol and Faust (2007) mention several techniques to evaluate the ergonomic aspects of a software. One of them is the heuristic assessment, which consists of the application of usability patterns to evaluate the software interface at any time of the project, either during its execution (designing of the software) or when it is already in the market. In that sense, Prebianca, Santos Junior and Finardi (2014) analyzed a software for teaching English as a foreign language already in the market (Interchange Arcade- 3rd edition) reporting (i) the interaction between the software and the learner; (ii) the cognitive/mental operations required to perform the tasks in software and (iii) the pedagogical strategies implemented by the software. The study also analyzed Human-Computer Interaction (HCI) aspects of the software so as to evaluate its degree of interactiveness and usability (Ergolist, 2011). The analyses in Prebianca, dos Santos Júnior and Finardi's study

were performed by four different raters, who were all professors at a private graduate school and did not held a degree in English or were an EFL student at the time the study was conducted. Findings of Prebianca, dos Santos Júnior and Finardi (2014) showed that Interchange Arcade – 3rd edition, in raters' view, was content-oriented. Also, the ergonomic analysis revealed that the tool met most usability criteria, requiring few modifications, especially in relation to the criteria of Minimal actions, Flexibility, User's experience and User's control. Based on these findings, Prebianca, dos Santos Júnior and Finardi (2014) suggested that the software should be evaluated by learners, who, in authors' opinions, could assess the tool from a user's perspective.

Therefore, departing from Prebianca, dos Santos Júnior and Finardi's (2014) suggestions, the present study aimed to analyze the validity of Interchange Arcade – 3rd edition from users' (learners') perspective. Taking into account the theory that sees learning as the modification of cognitive structures through mediated learning experiences (Feuerstein and Feuerstein, 1994; Feuerstein, 1997), and the need to consider ergonomic aspects that influence human-computer interaction such as users' experience with educational softwares, the present study pursued two main objectives. First, to assess the pedagogical strategies implemented by the educational software Interchange Arcade – 3rd edition from the perspective of the learners. Second, to evaluate, according to users' perceptions, Human-Computer Interaction (HCI) aspects of the same software so as to determine its degree of interactiveness and usability.

From the perspective of sociocultural theory (Feuerstein, 1994; 1997), learning takes place though the mediation of experiences allowing learners to create new mental connections, transcending their cognitive stages so as to be able to execute tasks that foster the development of autonomous and self-regulated behavior. In that sense, the mediator (teacher or the technological tool in our view), has an important role to play in the selection and modification of the stimulus that learners will receive. We assume that aspects of computer-human interaction in educational softwares can mediate the interaction between stimuli and learners, once the softwares are designed to offer users a way of applying their knowledge in the solution of problems and execution of tasks. In that sense, the present study assumes that in the case of the educational software for teaching-learning English analyzed here, the software designer must take into consideration the knowledge already acquired by learners about the language, as well as their linguistic needs and most importantly, the mental patterns needed to enable mediation and thus, cognitive modifiability, as proposed by Feuerstein and Feuerstein (1994) and Feuerstein (1997).

To assess the quality of the interface of the software investigated in this study, a set of usability criteria proposed by Ergolist (2011) was analyzed from a heuristic perspective, following Prebianca, dos Santos Júnior and Finardi (2014). Appendix 1 shows a list of the criteria used and their definitions. The criteria were adapted and 'translated' into questions in order to be easily answered by the students who used and analyzed the software investigated in the present study. In what follows, the methodological procedures used in this investigation are presented.

Method

An initial population made up of 166 freshmen students from the Agribusiness and Computer Science courses of the Integrated Technical High School in 2013 were selected for the study. These students were enrolled in the English Curricular course at the beginning of the academic year, but only 159 students (87 from Agribusiness and 72 from Computer Science) participated in all phases of the study.

The study was divided in three stages: (i) administration of initial questionnaire, (ii) use of the educational software during English classes, and (iii) administration of final questionnaire. The first questionnaire had eleven semi-structured questions that aimed to collect information regarding their experience with educational softwares and their expectations regarding this tool.

Participants used the educational software Interchange Arcade – 3rd edition in a blended approach that combined face to face classes and online sessions in the second stage of the study. The online classes were taught in a computer laboratory. The final questionnaire with 13 semi-structured questions was administered to the students in the end of the school semester and aimed at collecting data regarding (i) the pedagogic strategies implemented by the software and (ii) the software ergonomic aspects of interaction and usability. These procedures corresponded to the third phase of the study. Data originated in the questionnaires in the first and third phases were analyzed qualitatively. Tables 1 and 2 present the items available for students to select in both questionnaires and the pedagogic and ergonomic criteria they represent. The information in the following tables was translated to English for the sake of this study but were presented to students in Portuguese (see the original version in Appendices 2 and 3).

Table 1 – Pedagogic items and corresponding criteria

Items of the questionnaires	Criterion
The software makes its educational intention clear to the student	Mediation of intentionality
The software proposes meaningful and relevant activities to students	Meaning mediation
The softwares aims to develop students' comprehension of their learning process by leading them to reason about how they learn	Transcendence mediation
Knowledge is presented by the software in a formal, logic, coherent and organized way	Knowledge and content
The types of languages used by the software are varied and include numbers, symbols, schemes, verbal, visual and audiovisual language	Forms of presentation
The software proposes activities with different complexity levels, aiming to reach a balance between easy and difficult tasks	Levels of complexity and efficiency
The software helps students to observe and analyze	Observation and analysis

important characteristics of the activities since this knowledge can be used to solve other tasks	
The software allows the students to plan how to solve the activity/task	Solution planning
The software allows the student to compare different activities	Comparison

Table 2 – Ergonomic items and corresponding criterion

Items of the questionnaires	Criterion
The software leads the user (student) in all activities proposed, making it clear what to do and facilitating its use	Promptness
The icons and items of the software are logically organized	Grouping by location
The icons and symbols of the software are clear in relation to what they mean	Readability
The software indicates when some information is being processed to the users (students) by displaying specific symbols on the screen	Feedback
The software makes proper use of colors, symbols and/or audiovisual signs, displaying a balanced distribution of information in the screen	Concision, grouping by format and informational density
The software requires minimal actions from users (students) to execute commands	Minimal actions
The software allows users (students) to do any activities they want, in the sequence they want, being able to repeat them if necessary	User control and explicit actions
The software allows users (students) to personalize the screens by changing colors, letter type, among other configurations	Flexibility
The software allows users (students) to replace the use of the mouse by commands or keyboard shortcuts	User experience
The software offers opportunities for users (students) to avoid/prevent errors	Error protection
The software sends messages to users (students) regarding errors in a clear and polite way	Error message
The software allows users (students) to correct their mistakes	Error correction
The software provides users (students) a summary of the correct answers and tasks performed, showing learners which ones should be done again	Feedback
The software proposes activities that meet users' (students') expectations and needs	Compatibility

Results and Discussion

This section presents the results of the qualitative analysis of the data collected in the first and third phases of the study, through the semi-structured questionnaires. Table 3 displays the results for both learners' groups – Agribusiness and Computing, in relation to their perceptions regarding which pedagogic features any educational software for language learning should contain (before using the software) and which of them were effectively implemented by the software investigated (after using the software to learn English for an academic term).

Table 3 - Comparative analysis of the most important pedagogic features of the educational software according to learners' opinions

Pedagogic Features	AGRIBUSINESS		COMPUTING	
	1st phase	3rd phase	1st phase	3rd phase
The software makes its educational intention clear to the student	16	54	12	39
The software proposes meaningful and relevant activities to students	16	36	9	60
The software leads students to comprehend their learning process, by leading them to reason about how they learn	12	30	12	39
Knowledge is presented by the software in a formal, logic, coherent and organized way	18	40	18	84
The types of languages used by the software are varied and include numbers, symbols, schemes, verbal, visual and audiovisual language	10	25	11	22
The software proposes activities with different complexity levels so as to reach a balance between easy and difficult tasks	16	32	11	73
The software helps students to observe and analyze important characteristics of the activities that can be used to solve other tasks	2	28	5	61
The software allows students to plan how to solve the activity/task	5	25	20	52

The software allows students to compare different activities	7	21	17	69

*The figures in this table refer to the number of students who selected each item of the questionnaires in both data collection phases – before (1st phase) and after (3rd phase) the use of the software.

As can be seen in Table 3, there was a consensus among Agribusiness and Computing students in relation to the pedagogic features of software analyzed. That is, after experiencing the software for an academic semester during their English classes, learners agreed that the software met all criteria investigated. These findings, at least at first glance (see data analysis and discussion regarding Computing students' perceptions), suggest that this technological tool was able to lead learners to develop the cognitive skills needed to foster cognitive modifiability, as proposed by Feuerstein (1997).

As Table 3 shows, the three more relevant criteria related to mediated learning experiences (the crux of Feuerstein's (1997) learning theory) were positively rated by both Agribusiness and Computing learners. Insomuch as the mediation of intentionality is concerned, thirty-eight and thirty-nine[4] respondents from Agribusiness and Computing areas, respectively, agreed that software analyzed is clear about its educational intention, thus making it easy for learners to recognize that this tool aims to help them develop their foreign language skills. Also twenty Agribusiness students and fifty-one Computing students found the activities proposed by the software meaningful and relevant (Meaning mediation). Similarly, twenty-eight Agribusiness students and twenty-seven Computing students said the software helps them to comprehend their learning process by thinking about how they learn (Transcendence mediation).

Taken together, these findings indicate that, according to learners' perceptions, the software analyzed here, Interchange Arcade – 3rd edition, is a tool that can promote mediated learning experiences leading to structural cognitive modifiability in Feuerstein's (1997) terms, corroborating findings in Prebianca, dos Santos Júnior and Finardi (2014).

However, it is important to mention that, as shown by the ergonomic analysis (see discussion in what follows), the software failed to meet the criteria of Compatibility, Error message and Feedback for a relatively significant number of learners, what may have some impact on its capacity to function as a mediating tool, being able to promote meaning and transcendence types of mediation as will be argued in the discussion of data presented in Table 4. This fact might also indicate some inconsistencies in learners' understanding of the relation between the pedagogic and ergonomic features of the software.

Another interesting finding is that the Computing students' ratings for the other criteria –

4 The number of learners reported in the discussion section of this paper represent, unless otherwise stated, the difference in number of students who selected the criteria after software use, in the second questionnaire application, if compared to the number of students who selected the same criteria in the first questionnaire application, before having used the software.

Knowledge and content, Forms of presentation, Levels of complexity and efficiency, Observation and analysis, Solution planning and Comparison -, presented a relatively wider range, from eleven to sixty-six answers in the second questionnaire, whereas the ratings for the Agribusiness students regarding the same criteria ranged from fourteen to twenty-six answers after software use. This finding might suggest that, because Computing students are likely to be more tuned in relation to technology, they may have been more critical when analyzing the ergonomic aspects of the software thus, being more lenient to what concerned the pedagogical characteristics of the tool.

In sum, according to Agribusiness and Computing learners' perceptions, the software Interchange Arcade – 3rd edition seems to be a valid tool to promote mediating learning experiences that lead to structural cognitive modifiability, being able to mediate between stimuli and learners in order to foster EFL learning.

Table 4 displays the results for both learner groups – Agribusiness and Computing, regarding their perceptions about ergonomics and human-computer interaction of educational softwares. The comparative analysis performed on the data took into account students' expectations concerning the ergonomic criteria that any educational software should meet and their opinions about the criteria actually met by the software they used during their English classes for an academic term.

Table 4 - Comparative analysis regarding the educational software ergonomics according to learners' opinions

Ergonomic Features	AGRIBUSINESS		COMPUTING	
	1st phase	3rd phase	1st phase	3rd phase
The software leads the user (student) in all activities proposed, making it clear what to do and facilitating its use	56	16	30	48
The icons and items of the software are logically organized	57	15	42	40
The icons and symbols of the software are clear in relation to what they really mean	53	87	60	31
The software indicates to the users (students) when some information is being processed by displaying specific symbols on the screen	55	27	19	24
The software makes proper use of colors, symbols and/or audiovisual signs, making a good distribution of information in the screen	55	76	24	33
The software requires minimal actions from users (students) to execute commands	51	4	33	30
The software allows users (students) to do any activities they want, in the sequence they want, being able to repeat them if necessary	40	3	52	28
The software allows users (students) to personalize the screens, by changing colors, letter type, among other configurations	50	86	50	17
The software allows users (students) to replace the use of	52	77	50	15

the mouse by commands or keyboard shortcuts				
The software offers opportunities for users (students) to avoid/prevent errors	50	83	30	26
The software sends messages to users (students) regarding errors in a clear and polite way	50	74	40	28
The software allows users (students) to correct their mistakes	56	26	42	41
The software provides users (students) with a summary of the correct answers and tasks performed indicating which ones should be done again	57	58	42	28
The software proposes activities that meet users' (students') expectations and needs	56	31	47	30

*The figures in this table refer to the number of students who selected each item of the questionnaires in both data collection phases – before (1st phase) and after (3rd phase) the use of the software.

The analysis of the ergonomic features of Interchange Arcade – 3rd edition presented in Table 4 revealed that, as for as learners' expectations and further experience with the software are concerned, there seems to be some human-computer interaction characteristics that were not met by the software. According to the Agribusiness learners' evaluation, aspects such as Promptness, Grouping by location, Feedback, Minimal Actions, User Control, Explicit Actions, Error correction and Compatibility were indicated more times as being important to foster language learning before experiencing the software than after having used the tool. As can be seen in Table 4, forty students did not agree that the software used leads them during the interaction, facilitating its use (Promptness); forty-two learners thought, after using the software, that its items and icons do not clearly represent the information pieces they were supposed to, thus being perceived as not being organized in a logical way.

Regarding Feedback, twenty-eight students changed their minds in relation to the quality of the feedback provided by the software after users' actions. According to them, the software did not indicate clearly when some information was being processed. Forty-seven learners also said, after experiencing the software that it failed to require minimal actions from users to execute commands. After using the software, thirty-seven students concluded that they could not explicitly control the actions to be executed, by performing any activity in the sequence desired, including repetition of some tasks (User Control and Explicit Actions). Thirty learners agreed, after using the software that it did not offer many opportunities for error correction, as learners believed it to do before experiencing the tool. Finally, twenty-five students concluded that the activities proposed by the software did not meet users' needs and expectations regarding language learning (Compatibility).

In our view, the finding concerning the Compatibility aspect of human-computer interaction is one of the most important criteria to be considered taking into account Feuerstein's structural cognitive modifiability theory of learning, since it is closely related to meaning mediation. In Feuerstein's (1997) view, meaning is essential to learning since it boosts learners' propensity to structural

cognitive modifiability. When mediated (the learner) and mediator (the software, in our view) interact meaningfully, by building knowledge through tasks that have clear relevance and meet learners' expectations and needs, learning (the modification of reasoning structures and patterns in learners' minds) is more likely to occur (Feuerstein, 1997).

An issue as relevant as the Compatibility issue just discussed is Promptness. Recall that this human-computer interaction criterion refers to whether the software informs and leads users during interaction, making it clear what to do and facilitating its use. Although most learners agreed that the software analyzed makes its educational intention clear to the student, as already discussed elsewhere in this paper, it seems that the ergonomic analysis revealed opinions somewhat discrepant. As aforementioned, forty Agribusiness students said, after experiencing the software that the tool fails to inform users about the activities to be performed. In this case, the software would not meet the Mediation of intentionality criterion proposed by Feuerstein (1997). However, this criterion, which refers to whether the software clearly presents its educational intentions to students by establishing a communication channel with them, was positively evaluated by learners in both questionnaires.

Another interesting finding that deserves attention is the fact that a great number of Agribusiness students (57 in the first questionnaire against 58 in the second one) agreed that the software provides clear feedback regarding the amount of correct answers and which activities should be done again in case of errors. This finding does not support evidence in Prebianca, dos Santos Júnior and Finardi (2014) who found that the software lacked more detailed feedbacks in relation to the reasons for errors and details about the grammar rule learners should master to solve the activities proposed. In that study, the authors also suggested that richer feedback, containing a summary of learners' performance and tips to perform better would increase students' chances of getting a positive result when repeating the tasks they could not get right, without looking for extra help in the classbook, or asking the teacher for advice, or even just going through tentative and error trials.

With that in mind, we believe the software misses the opportunity to foster mediation of transcendence, which in Feuerstein's (1997) view represents a basic characteristic of any mediated learning experience whose goal is to promote learning. For him, transcendence mediation is responsible for helping learners to understand their learning process, by guiding them from micro to macro contexts, making them able to grasp the tiny particles in a movement towards the construction of a bigger picture – generalization. The ability to generalize to new contexts seems to be a very important cognitive skill for learning, once it is through generalization of concepts and rules that learners are able to perceive when and how to apply the knowledge previously acquired in different situations, such as when trying to communicate in a foreign language.

In Prebianca, dos Santos Júnior and Finardi (2014), raters also did not reach a consensus on the criteria of generalization. Two raters found the software provided moments for knowledge

generalization in a very good way, while another rater found it was done only reasonably. Prebianca, dos Santos Júnior and Finardi suggested that this finding might be a consequence of the content-oriented approach of the software and its self-explanatory design. Despite the software approach to content and design, as put forward by Prebianca, dos Santos Júnior and Finardi (2014), we believe that generalization and, therefore, transcendence need to be at the heart of any technological tool which aims to promote language learning, since these mental skills allow learners to build and test hypotheses about how to apply previous knowledge to novel situations – an ability that is essential to foreign language use.

After experiencing the software for an academic semester, Agribusiness students rated 6 (out of 14) ergonomic criteria positively. As far as the Readability aspect is concerned, thirty-four learners considered the icons and symbols of the software as being clearly represented. Twenty-one students also agreed in the second questionnaire that the software met the criteria of Concision, Grouping by format and Informational density, by making a good distribution of information on the screen, using colors, symbols and audiovisual signs adequately. According to 36 students, the software is flexible, allowing users to configure some screen features (Flexibility). Twenty-five learners concluded that the software takes users' experience into account, by allowing them to replace the use of the mouse by keyboard shortcuts (User experience). Concerning Error protection, thirty-three learners agreed that the software provides opportunities for users to avoid errors. Finally, twenty-four students said that the error messages to users were clear and polite (Error message).

As can also be observed in Table 4, Computing students evaluation of the Interchange Arcade – 3rd edition differs from the evaluation of the Agribusiness students in some aspects. While the latter rated 10 (out of 14) criteria negatively, the former rated only 7. Besides, some of these 10 criteria that the Computing students found negative, were rated positively by the Agribusiness students, such as Readability, Flexibility, User experience, Error protection, Error message and, Feedback. In relation to Readability, for example, twenty-nine students believed, after experiencing the Interchage Arcade – 3rd edition, that the icons and symbols do not always clearly represented what they were supposed to. As regards the criterion of Flexibility, thirty-three learners claimed that the software did not allow users to alter background color, font size, or any other type of configuration. The software also does not allow learners to use keyboard shortcuts so as to execute some commands instead of using the mouse according to other thirty-five students (User experience).

It is worth mentioning that the criteria of Error Message and Feedback were both rated negatively after learners' experience with the software. This might be due to the fact that learners associated lack of clear messages with lack of clear information about the kinds of errors produced and how to avoid them. Recall that to assess the Error Message criterion adequately, students needed to take into account aspects of meaning and politeness, whereas to evaluate the Feedback criterion properly, they needed to focus on the content of the messages related to the errors, that is, whether the content was detailed enough in terms of reasons for errors and solutions to overcome

them. Consequently, twelve students found that error messages were not clear and polite and twenty-four students said that the software failed to provide a detailed feedback with a summary of the wrong answers and extra information on what should be repeated. Again, this finding lends support to the reasoning that the software herein analyzed fails to promote the mediation of transcendence as advocated by Feuerstein (1997) since it does not lead students into the analysis of their learning process. As a result, learners are likely to face difficulties to understand the errors and to find out how to overcome them when trying to perform the same activity again or others that may require similar reasoning patterns in further learning contexts. Lack of a more detailed feedback may hinder some of the pedagogic features the software should focus on in order to foster structural cognitive modifiability (in other words, learning as proposed by Feuerstein (1997)), such as in the case of the Observation and Analysis, Solution planning and Comparison criteria (mental abilities). All of those abilities might lead to the restructuring of already internalized knowledge through the noticing of what was incorrect and what piece of knowledge needs to be mastered so as to guarantee correct answers in a similar learning activity in the future.

Two other criteria were rated negatively by the Computer students, thus matching the Agribusiness students' evaluation – User control/Explicit Actions and Compatibility. While the former criterion was mentioned by twenty-four students in the second questionnaire, the latter was selected by seventeen students. In sum, if we take the results of the Agribusiness students in relation to the Compatibility criterion, the findings indicate that, at the end of the study, after having used Interchange Arcade – 3rd edition for a whole academic semester, only 61 learners (out of 103) still believed the software proposes activities that meet students' expectations and needs. Although more than fifty percent of respondents who considered this criterion important before experiencing the software agreed that the activities offered by the tool are compatible with learners' needs and expectations, it seems clear that some features of the activities proposed do not meet a relatively significant number of students' expectations. Such aspect deserves further investigation. For now, we can only speculate that the reasons that led almost forty percent of language-learning users to dislike those activities after software use might be related to the content-oriented focus of the software coupled with the lack of opportunities for communicative practice, as suggested by Prebianca, dos Santos Júnior and Finardi (2014).

Final Remarks

The present study yielded the following conclusions. First, regarding the pedagogic features of the software, Agribusiness and Computer learners agreed that Interchange Arcade – 3rd edition meets the criteria related to mediation of intentionality, transcendence and meaning thus, suggesting the software is able to foster the structural cognitive modifiability required for learning to take place (Feuerstein, 1997). Second, as regards the human-computer interaction, learners evaluation of Interchange Arcade – 3rd edition ergonomic features suggested some inconsistencies in

Agribusiness students' understanding of the relation between pedagogic and ergonomic features of the software, as it became clear in the assessment of the Mediation criteria in relation to others such as the Compatibility, Promptness and Feedback ones.

In addition, due to their relatively greater familiarity with technology, Computer students seemed to be more critical when analyzing the ergonomic aspects of the software, which led this group of learners to rate more human-computer interaction criteria negatively in comparison to Agribusiness learners. The ergonomic analysis also revealed that about forty percent of all learners believed, after using the software, that the activities proposed by the tool were not compatible with their needs and expectations.

In sum, based on the results of this investigation and taking into account Vygotsky's socio-interactional and Feuerstein's (1997) structural cognitive modifiability theories of learning, it is possible to conclude that the quality of mediation offered by the educational software is an important factor in the use of technology to promote language learning. More importantly, the findings revealed that mediating factors such as intentionality, transcendence and meaning seem to be reflected on human-computer interaction features of the software, thus indicating a straightforward relationship among the software pedagogic characteristics and interactiveness and usability features. In other words, what the present study suggests is that there might not be propensity to structural cognitive modifiability (and thus, learning) if pedagogic and ergonomic features are not concomitantly taken into account in the design of educational softwares.

Further research should consider investigating different educational softwares aimed at language learning so as to see whether they integrate both design features (pedagogic and ergonomic ones) into the implementation of such technological tools.

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Appendix 1 - List of criteria and aspects used to analyze the ergonomic features of the educational software

Criterion	List of aspects to be observed
Promptness	Verifies that the system informs and guides the user during the interaction.
Grouping by location	Checks whether the spatial distribution of the items reflects the relationship with information
Grouping by format	Checks the format of the items as a means to convey associations and

	differences
Feedback	Evaluates the quality of the immediate feedback to user actions
Readability	Verifies legibility of information presented on the screens of the system
Conciseness	Checks the size of the codes and terms presented and introduced to the system
Minimal Actions	Checks the extension of the dialogue established for achieving the user's goals
Informational Density	Evaluates the informational density of the screens displayed by the system
Explicit Actions	Verifies that it is the user who explicitly commands the system actions
User Control	Assesses the likelihood of the user to control actions
Flexibility	Checks whether the system allows the customization of presentations and dialogues
User Experience	Assesses whether users with different levels of experience have equal opportunities to succeed in their goals
Error Prevention	Verifies that the system offers the user the opportunity to prevent errors
Error Messages	Evaluates the quality of error messages sent to users facing difficulties
Error Correction	Checks the facilities provided for the user to correct the mistakes
Consistency	Assesses whether consistency is maintained in the project code, screens and dialogs with the user
Meanings	Evaluate whether the codes and descriptions are clear and meaningful to system users
Compatibility	Checks the compatibility of the system with the expectations and needs of the user in their task

Appendix 2 – Pedagogic and ergonomic criteria analyzed by learners in the first questionnaire application

⇨ Considering didactic and pedagogical aspects, place an (X) in the characteristics of educational software for English language which you consider most important for language learning:

( ) The software makes it clear to students their educational intent;

( ) The software proposes activities that have meaning and relevance to the student;

( ) The software helps students to understand their learning process, leading him to think about how to learn;
( ) The knowledge is presented by the logical, coherent and organized way software;
( ) The forms of language used by the software are varied. For example, numbers, symbols, diagrams, verbal, visual, audiovisual;
( ) The software seeks to propose activities with varying degrees of complexity, trying to strike a balance between easy and difficult tasks;
( ) The software takes the student to observe and analyze important characteristics of activities to use that knowledge to solve other exercises;
( ) The software allows students to plan how to solve the activity;
( ) The software allows students to compare the activities.

⇨ Considering the relationship software / user indicate which characteristics of educational software for English language do you consider most important for language learning happen:

( ) The software guides the user (student) in all activities, making clear what to do and facilitating its use;
( ) The icons and software items are logically organized;
( ) The icons and symbols of the software clearly convey what they really mean;
( ) The software makes it clear when any information is being processed;
( ) The software uses appropriate colors, symbols and / or audio visual signals, making a good distribution of the information on screen;
( ) The software requires minimum user actions (student) to perform some command;
( ) The software allows the user (student) do any activity you want in the desired sequence, and may even repeat them if deemed necessary;
( ) The software enables the user (student) to customize the screens, changing colors, fonts, and other settings;
( ) The software allows the user (student) can replace the use of mouse commands and keyboard shortcuts;
( ) The software offers the user opportunities to prevent / avoid mistakes;
( ) Messages to the user of the software are clear and educated;
( ) The software allows the student to correct the mistakes;
( ) The software provides the user (student) a summary of the amount of agreed issues, making clear what should be redone;
( ) The software proposes activities that meet the expectations and needs of the user (student).

Appendix 3 – Pedagogic and ergonomic criteria analyzed by learners in the second questionnaire application

⇨ Considering the didactic and pedagogical aspects, place an (X) in the features below which apply to the educational software Interchange Arcade:

( ) The software makes it clear to students their educational intent;
( ) The software proposes activities that have meaning and relevance to the student;
( ) The software helps students to understand their learning process, leading him to think about how to learn;
( ) The knowledge is presented by the logical, coherent and organized way software;
( ) The forms of language used by the software are varied. For example, numbers, symbols, diagrams, verbal, visual, audiovisual;
( ) The software seeks to propose activities with varying degrees of complexity, trying to strike a balance between easy and difficult tasks;
( ) The software takes the student to observe and analyze important characteristics of activities so you can use that knowledge to solve other exercises;
( ) The software allows students to plan how to solve the activity;
( ) The software allows students to compare the activities;

⇨ Considering the relationship software / user (student), place an X for the features below that apply to the educational software Interchange Arcade:

( ) The software guides the user (student) in all activities, making clear what to do and facilitating its use;
( ) The icons and software items are logically organized;
( ) The icons and symbols of the software clearly convey what they really mean;
( ) The software makes it clear when any information is being processed;
( ) The software uses appropriate colors, symbols and / or audio visual signals, making a good distribution of the information on screen;
( ) The software requires minimum user actions (student) to perform some command;
( ) The software allows the user (student) do any activity you want in the desired sequence, and may even repeat them if deemed necessary;
( ) The software enables the user (student) to customize the screens, changing colors, fonts, and other settings;
( ) The software allows the user (student) can replace the use of mouse commands and keyboard shortcuts;
( ) The software offers the user opportunities to prevent / avoid mistakes;
( ) Messages to the user of the software are clear and educated;
( ) The software allows the student to correct the mistakes;

( ) The software provides the user (student) a summary of the amount of agreed issues, making clear what should be redone;

( ) The software proposes activities that meet the expectations and needs of the user (student).

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