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Executive functions intervention program for academic learning for young people/undergraduate students: Development and evidence of content validity

Programa de intervenção em funções executivas pró-aprendizagem acadêmica para jovens/universitários: Desenvolvimento e evidências de validade de conteúdo

Programa de intervención en funciones ejecutivas para el aprendizaje académico de jóvenes/estudiantes universitarios: desarrollo y evidencia de validez de contenido

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***Abstract*:** Despite the current emphasis on intervention programs for executive functions (EF), those for children and older adult predominate, with a gap in programs aimed at young people/undergraduate students. The present study presents the process of developing an EF intervention program to support academic learning for young people/undergraduate students. The development followed 5 stages: 1) Internal organization, 2) Construction, 3) Judges' Analysis, 4) Review and finalization, 5) Pilot Study. Participants were 8 judges (step 3) and 3 classes of students (n = 102) enrolled in Higher Education (step 5). There was high agreement among the judges regarding the demands and the general quality of the activities. Review and integration of the judges' quantitative and qualitative assessments gave rise to the current version of the πFex-Academics, with 7 activities structured in 3 modules, with a focus on learning and academic demands. The pilot study revealed good applicability. The πFex-Academics is a promising tool for stimulating EF in a university context.

***Keywords*:** executive functions; reading; learning; undergraduate students; cognition.

Resumo: Apesar de atual destaque para programas de intervenção das funções executivas (FE), predominam aqueles para crianças e idosos, com uma lacuna de programas destinados ao público jovem/universitário. O presente estudo apresenta o processo de desenvolvimento de um programa de intervenção em FE em prol da aprendizagem acadêmica para jovens/universitários. O desenvolvimento seguiu 5 etapas: 1) Interna de organização, 2) Construção, 3) Análise de Juízes, 4) Revisão e fechamento, 5) Estudo Piloto. Participaram 8 juízes (etapa 3) e 3 turmas (n = 102) ingressantes no Ensino Superior (etapa 5). Houve elevada concordância entre juízes em relação às demandas e qualidade geral das atividades. Revisão e integração das avaliações quanti e qualitativas dos juízes originou a versão atual do πFex-Academics, com sete atividades estruturadas em três módulos, com foco na aprendizagem e demandas acadêmicas. Estudo piloto revelou boa aplicabilidade. O πFex-Academics constitui-se como ferramenta promissora para estimulação de FE em contexto universitário.

Palavras-chave*:* funções executivas; leitura; aprendizagem; universitários; cognição.

Resumen: A pesar del énfasis actual en los programas de intervención para funciones ejecutivas (FE), predominan los de niños y ancianos, con una brecha en los programas dirigidos a jóvenes/universitarias. El presente estudio presenta el proceso de desarrollo de un programa de intervención en FE a favor del aprendizaje académico para jóvenes/universitarios. El desarrollo siguió 5 etapas: 1) organización interna, 2) construcción, 3) análisis de expertos, 4) revisión y cierre, 5) estudio piloto. Participaron 8 expertos (etapa 3) y 3 clases (n = 102) matriculados en Educación Superior (etapa 5). Hubo un alto acuerdo entre los jueces con respecto a las demandas y la calidad general de las actividades. La revisión e integración de las evaluaciones cuantitativas y cualitativas de los expertos dieron lugar a la versión actual de πFex-Academics, con siete actividades estructuradas en tres módulos, centradas en el aprendizaje y las demandas académicas. El estudio piloto reveló una buena aplicabilidad. πFex-Academics es una herramienta prometedora para estimular la FE en contexto universitario.

Palabras clave: funciones ejecutivas; lectura; aprendizaje; estudiantes universitarios; cognición.

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The role of executive functions (EF) in enhancing different outcomes throughout life is well documented in the literature. This includes learning and academic/school performance, functionality and independence in activities of daily living, such as the level of occupational adjustment, avoidance of academic procrastination, better coping strategies, physical and mental health, and even reduced involvement in crime (Barkley & Murphy, 2010; Diamond & Ling, 2016; Gareau, Chamandy, Kljajic & Gaudreau, 2018; Moffitt et al., 2011; Rabin, Fogel & Nutter-Upham, 2011; Seabra et al., 2014; Villegas & Cruz, 2015). This evidence adds importance to the assessment of EF and initiatives aimed at improving these skills, which could, for example, have an impact on the various outcomes associated with them, with emphasis on learning in all phases of the life cycle.

Executive functions are a set of cognitive processes, which include, for example, working memory, inhibition, flexibility and other more complex skills such as organization/planning and metacognition. These skills allow the management of behavior (including cognitions and emotions), adaptation to changing environments, engagement and targeting of actions toward goals, decision making and risk assessment, among others. That is, they enable self-regulation (Snyder, Miyake & Hankin, 2015).

In the previous decade, different strategies and procedures for the stimulation of EF have been developed for various age groups, with a predominance of childhood. Studies with these programs have shown their effects on the EF themselves, in addition to measures of behavior and learning – internal or distal transfer (Cardoso, Seabra, Gomes & Fonseca, 2019; Diamond & Ling, 2016; Dias & Seabra, 2017). At the national level, programs have already been published for preschool children and those entering Elementary Education (Dias & Seabra, 2013), as well as for students throughout Elementary Education I (Cardoso & Fonseca, 2016). These were developed based on theoretical assumptions of neuropsychology and have been cognitively and empirically tested.

With the progression of school levels, however, there is an increase in environmental demands and demands on the individual's EF (Dawson & Guare, 2010; Meltzer, 2010). In Higher Education, planning, organization and time management skills are increasingly required and at more complex levels, with their underdevelopment possibly being at the base of adaptation and performance difficulties in university learning. With the advancement of education and increasing demands, many students may have difficulties in understanding longer, dense and complex texts, in writing papers, in meeting deadlines and in setting goals, ending up facing problems in organizing their studies (Best, Miller & Naglieri, 2011; Georgiou & Das, 2014). One of the main differences between Higher Education and Fundamental Education is an environment that requires greater autonomy and self-directed learning efforts.

In this context, some skills seem relevant to the university performance. For example, alongside a measure of self-efficacy, a measure of 'Organization and attention to study' was a significant predictor of the mean score of the first-semester of freshman undergraduate students; this, in turn, was the main predictor of the mean score at the end of the school year. The measure of 'Stress and time management', associated with how students deal with time pressure and academic demands, was a predictor of 'Satisfaction with life' also during the first year at university (Krumrei, Newton, Kim & Wilcox, 2013). In the study by Van Herpen, Meeuwisse, Hofman, Severiens and Arends (2017), it was also identified that a pre-entry effort measure (degree of involvement in tasks and ability to pay attention and show

persistence when faced with a challenging activity) was the only predictor of permanence on the course during the first year of undergraduate study, and not 'reasons to attend university' and 'academic self-efficacy'. For the authors, students who drop out of their course may not have sufficient control over their level of effort, with repercussions in their performance. They emphasize that these skills could be the target of stimulation prior to entering university. All these skills are interrelated and are part of the wide range of EF.

More specific findings regarding EF illustrate that skills such as initiation, inhibition, planning/organization, self-monitoring, working memory, and organization of materials have proven to be significant predictors of academic procrastination (Rabin et al., 2011). For these authors, such results should support intervention proposals in an attempt to minimize the difficulties that procrastination can cause in university life. Another study also showed that self-control measures and the use of strategies to achieve academic goals, measured at the beginning of a 12-week course, could predict the performance of undergraduate students at the end of the course (Zhu, Au & Yates, 2016).

Additionally, Baars, NijeBijavank, Tonnaer and Jolles (2015) demonstrated that attention, planning, self-regulation and self-monitoring were predictors of better performance in the first year of university. Researchers suggest that many first-year students lack sufficient planning and self-monitoring skills and, therefore, become more prone to dropping out, presenting slower performance, and slower progress. They suggest that targeted interventions can help alleviate these difficulties, as well as help students with basic study skills. In addition, difficulties in reading comprehension and learning at university have been increasingly reported (Giang, 2017; Pirttimaa, Takala & Ladonlahti, 2015).

The amount of evidence described suggests that EF should be skills taught and systematically encouraged in the educational context. Even students who attend Higher Education could benefit from this stimulation. Surprisingly, with regard to EF stimulation programs for adults, one can observe a predominance of investment in older adults, especially regarding working memory (Borella, Carbone, Pastore, De Beni & Carretti, 2017; Zimmermann, Netto, Amodeo, Ska & Fonseca, 2014), as well as cognitive flexibility (Buitenweg, Van de Ven, Prinssen, Murre & Ridderinkhof, 2017) and inhibitory control (Wilkinson & Yang, 2016). Regarding EF interventions for young adults, the main target is still clinical populations such as those with brain damage (Tornås et al., 2016). There is a large gap in EF stimulation for healthy young adults, with only two studies found: one with a working memory intervention (Clark, Lawlor-Savage & Goghari, 2017), without positive outcomes, and one intervention with inhibitory control (Maraver, Bajo & Gomez-Ariza, 2016).

For difficulties in learning or potentialization of reading comprehension at academic levels, the gap remains, with incipient initiatives when compared to investment in children's literacy. Our review identified only one study of stimulating reading comprehension strategies for adults (Hock & Mellard, 2005), and one for adults with reduced literacy (Sabatini, Shore, Holtzman & Scarborough, 2012). Therefore, this real and urgent demand for EF stimulation and academic learning skills in healthy adults motivated the development of an EF intervention program focused on undergraduate students – the πFex-Academics. This program is intended to be an intervention complementary to the curriculum, and can preferably be implemented within the scope of general disciplines or those with a common core, preferably when the student enters Higher Education. The aim of this study is to present

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the development process of the πFex-Academics intervention program, including evidence of its content validity and a pilot study to assess its applicability.

Method

Participants

From the total sample of 111 participants, 8 professionals participated in the judges' analysis stage. They had graduated in psychology (n = 5) and pedagogy (n = 3); and were holders of Master's (n = 4) or Doctoral (n = 4) degrees in Psychology or in an interdisciplinary area. All had experience in neuropsychology (practice and research; min = 3 years; max = 13 years) and teaching in Higher Education (min = 2 years; max = 10 years). Each module of the program (the alpha version had 2 modules) was evaluated by 5 judges, with 2 judges analyzing both modules.

One university professor, who was a Portuguese language teacher and doctoral candidate in Educational Psychology, participated in the pilot study, as well as three classes from a private HEI in the city of São Paulo. The selected activities were applied on different occasions, so that different groups participated (n total = 102) in the application: Application 1 - 30 students of the 2nd semester of the Psychology course, morning; Application 2 - 40 students of the 2nd semester of the Pedagogy course, night; Application 3 - 32 students of the 2nd semester of the Psychology course, night.

Procedures and Instruments

The study was approved by the Research Ethics Committee of Universidade Federal de Santa Catarina. The development of the program was based on 4 stages delimited by Cardoso, Dias, Seabra and Fonseca (2017); plus a 5th stage, with a pilot application.

Stage 1 - Internal stage: A brainstorming session was carried out focused on reviewing existing activities and investigating: 1) activities used in the literature of the area, based on published studies on interventions in EF and related constructs, with analysis of existing activities and programs; and 2) activities that already exist and are used, for example, in the teaching practice, in which an attempt was made to map activities that were already known and that could have require EF skills.

Stage 2 - Construction: During this stage, the following took place: 1) Selection of activities investigated; 2) Adaptation of activities to the program under development; 3) Creation of new activities; and 4) Systematic description of the activities. Next, the stage was completed with: 5) Allocation into modules based on the general aim of the activities; and 6) Finalizing the initial – alpha – version of the program, here already called the πFex-Academics.

Stage 3 – Judges' Analysis: The judges' analysis was carried out using the Program Evaluation Protocol, developed for this study, based on protocols used in previous studies (e.g. Cardoso & Fonseca, 2016; Dias & Seabra, 2013), to systematize and make the process of evaluating the activities more objective.

In this protocol, the judges were instructed to evaluate each activity developed, firstly identifying the construct (or constructs) represented in the item/activity. In the second part, they evaluated each activity according to the criteria: a) suitability for the target public; b) plausibility of application in the context; c) clarity of instruction for the application; d) accessibility to materials; e) activity-goal coherence; f) involvement of EF in the activity; and g) existence/previous performance of the activity (familiarity index). These criteria were answered on a four-point Likert-type scale from 1 (*No, I completely disagree*) to 4 (*Yes, I completely agree*). The last criterion to be considered in the evaluation of each activity was answered on a Likert-type scale from 1 (*very easy*) to 4 (*very difficult*) and refers to the analysis of the difficulty of the application (difficulty index). The protocol also has three open questions: 1) suggestions for changing or re-structuring activities in the modules developed; 2) the judge's position on the exclusion of any activity; and finally 3) general suggestions and comments. The judges were told that they could also mark their observations in the activity booklet.

Stage 4 - Review and finalize the program: After the judges' analysis, each activity and its quantitative and qualitative assessment were analyzed by the authors. Therefore, this stage included the review of the entire program considering the judges' analysis, the reformulation of the initial version and the finalization of the 'beta' version of the πFex-Academics.

Stage 5 - Pilot Study: A pilot application was carried out with the revised version of the program (Beta), in order to identify its feasibility and any implementation difficulties. Considering the focus on verifying the applicability of the activities and the fact that the activities of each module share the same structure, it was understood that, for the pilot study, the application of one activity per module would be sufficient. Accordingly, 3 activities were randomly selected, one from each of the three modules of the beta version of the program.
The selected activities were applied in classes of the partner HEI by the professor of the Portuguese Language discipline. One activity was applied to each of the three classes; two activities being used for just one day; while the third activity, due to its character, continued in use for four consecutive weeks. The Portuguese language classes were weekly double classes, each with 50 minutes; totaling 100 minutes/week. The pilot application was carried out from November 7 to 28, 2019, as follows:

- Application 1 (on November 14) - Activity drawn from Module 1; applied in one class (double class; 100 minutes duration) with a group of 30 students from the 2nd semester of the Psychology course, morning;
- Application 2 (on November 22) - Activity drawn from Module 2; applied in one class (double class; 100 minutes duration) with a group of 40 students from the 2nd semester of the Pedagogy course, night;
- Application 3 (on November 7, 14, 21 and 28) - Activity drawn from Module 3; applied over 4 classes (each a double class, with 100 minutes duration), one per week, with a group of 32 students of the 2nd semester of the Psychology course, night.

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To collect information about applicability, the professor used the Pilot Study Protocol, developed specifically for this study, based on previous experiences in the application of programs (e.g. Cardoso & Fonseca, 2016; Dias & Seabra, 2013).

The pilot study protocol was developed to systematize the assessment of the applicability of the activities. The professor who applied the activities filled it in at the end of each day of application covering each selected activity. The criteria evaluated were: Ease of understanding the activity for the professor; Ease of providing instructions for the activity to the students; Students' understanding of the activity (from the professor's perspective); Ease of use of the strategy by the students (from the professor's perspective); Ease of implementation of the strategy within the students' content area; and Engagement of the students in the proposed activity. These criteria were answered on a five-point Likert-type scale from 1 (*Poor applicability or comprehension*) to 5 (*Very good applicability or comprehension*). Qualitative observations were carried out.

Data analysis

The content analysis of the activities was synthesized from the agreement of the judges regarding the predominant component or components (i.e. those identified with 1 meaning the main or primary demand of the activity). The mean of the judges' responses to each EF scored for each activity was also provided (means closer to 1 indicate greater agreement among the judges in relation to the greater demand for that skill; means more distant from 1 indicate lower demands for the skill in the activity).

The degree of agreement between the judges in the criteria 'a' to 'f' of the Program Evaluation Protocol was measured using the Content Validity Index (CVI), with values from .80 being considered satisfactory. The formula used was:

$$CVI = \frac{number\ of\ item\ ratings\ with\ a\ score\ of\ 3\ or\ 4}{number\ of\ item\ evaluations}\ (5)$$

The familiarity (criterion g) and difficulty indices were obtained from the arithmetic mean of the scores assigned by the judges to each item. For the pilot study, the scores assigned by the participant-professor to each item of the Pilot Study Protocol, as well as their qualitative observations, are presented.

Results

Results of Stage 1 - Internal Stage

This step allowed for a better outline of the programs, activities and strategies that could be used or adapted for the πFex-Academics. Although our review was not systematic, we mapped the EF promotion programs available in the national context (Piafex, PENcE, CENA and Glia; computerized programs/cognitive training were not included) which, despite focusing on a younger age group than our program, offered general ideas regarding principles and structure. Proposals were also identified (e.g. Dawson & Guare, 2010; Meltzer, 2010) for teaching strategies with reasonable applicability in the university context, with adaptations. Neuropsychological rehabilitation strategies (Sohlberg & Mateer, 2009) that could eventually be considered and adapted to the target context were also consulted.

This stage made it possible to investigate activities already known and used, although without a deliberate intention to promote EF. In this process, the dialogue with university professors who were part of the team was useful, allowing the identification of activities/tasks already carried out and considering their demands and possible use as a tool to promote EF. From the exchanges among the team, the demands that guided the structuring of the modules also emerged: Activity planning, Reading Comprehension and Writing Production, with the initial focus (reported in this article) on the first two.

Results of Stage 2 - Construction

This stage culminated with the alpha version of the πFex-Academics (Dias, Costa, Cardoso, Colling & Fonseca, in press). The activities of the πFex-Academics are focused on stimulating the development of EF within academic activities, encouraging students to use and apply strategies that will help them focus attention, mentally manipulate information, consider different alternatives, and organize and plan for the achievement of goals. All activities are systematically described in order to ensure consistency in their implementation. The program's activities are structured in modules and all of them are permeated and include demands for 1) Attention/inhibition; 2) Working Memory; 3) Flexibility and 4) Planning/Organization.

In this alpha version, initially, the modules included were: 1) Reading comprehension and study strategies (initially with 5 activities); 2) Planning of work and projects (initially with 2 activities), with the continuing development of Module 3 - Written production. The πFex-Academics is composed of an activity notebook and implemented by the professor in their academic routine throughout the semester (Modules 1 and 2 as described earlier in this topic) or academic year (Modules 1, 2 and 3 described earlier in this topic). A semester application calendar was created as a guide for carrying out the program's modules already developed. The alpha version of the program was revised and submitted for analysis by the expert judges.

Results of Stage 3 – Judges' Analysis

Table 1 illustrates the content analysis performed by the judges in relation to each activity of the program. Given the complexity of the tasks and the difficulty of isolating a single executive component, a more comprehensive analysis of the judges was chosen, so that they could identify the various executive demands of the proposed activities, listing them from the highest to the lowest (primary = 1; secondary = 2; and successive demands). The table shows both the identified predominant components (those identified as the primary demand, therefore 1) and the mean of these responses to each skill.

With regard to the predominant components, there was a high agreement among the judges and between these and the previous analysis of the authors regarding the main demand(s) of each activity. For example, in activity 1 of module 1, 5 out of 5 judges identified 'Planning/Organizing' as the primary demand. In some cases, more than one main demand was identified, as in activities 2 and 3, also from module 1, in which two or three executive skills were identified as equally predominant by the n of judges illustrated in the table. Complementarily, the mean responses to each skill, by item, also allow for a glimpse of the different degrees and demands of EF involvement. Other demands were also scored by the judges, however, for parsimony, it was decided to consider only those that were reported by

at least 3 of the 5 judges. In this case, only metacognition emerged as a coherent demand associated with item 2 of module 2.

Table 2 presents the results of the analysis of activities in relation to criteria 'a' to 'f' of the Program Evaluation Protocol. All items were satisfactorily evaluated in terms of suitability for the target public, clarity of instruction for the application; accessibility of materials, activity-objective coherence, and involvement of EF in the activity. Six out of seven activities were satisfactorily assessed for plausibility of application in the university context. In this criterion, the exception was the activity 'Stay focused!', which in fact was based on tasks used in (re)habilitation contexts, distancing itself slightly from the format of typical classroom activities. The activity was considered, as will be described in the next section.

The last two aspects evaluated were the 'familiarity index' and 'difficulty index'. These are merely informative indices that can give hints about the unusualness and complexity of the tasks for application in the context of the university classroom and, therefore, provide information about the adherence of professors and students to the program. The familiarity indices (scale from 1 to 4) were relatively medium and suggest that the activities, although not common or routine in the context, are not foreign to these professionals. The exception seems to have been the 'Stay focused!' activity, for the same reason outlined above. Regarding the difficulty of implementation (scale from 1 to 4), the indices did not suggest activities with such complexity that could indicate their unfeasibility for use in the context.

The judges also made comments and suggested some changes in order to make some activities clearer for the professor-applicator and students. These included: adding information and details to instructions and replacing very technical or neuropsychological terms. Another relevant suggestion was the restructuring of the seven activities in the modules initially proposed. This suggestion led to the division into three modules, rather than two. All suggestions were analyzed and most were incorporated into the new beta version of the program.

Table 1.
Analysis of the content demands of the activities of the initial version of the program

Modules (alpha version)	Activities	Skills engaged - provided by the authors (descending order of demand)	Predominant component in the activity (freq. of judges)*				Mean of judges' responses**				Other skills identified by judges***
			IC/At	Flex	WM	Plan/Org	IC/At	Flex	WM	Plan/Org	
M 1 - activity 1	Prioritizing the ideas of the text: Strategy of underlining	Plan/Org + IC/At, Flex and WM				5/5	1.60	2.75	2.20	1.00	
M 1 - activity 2	Organization of ideas: Mental schemata	Plan/Org, WM			2/5	5/5	2.50	2.75	1.60	1.00	
M 1 - activity 3	How do you take notes?	Plan/Org, WM		2/5	3/5	2/5	2.75	1.80	1.60	1.50	
M 1 - activity 4	Be Flexible!	Flex		5/5			2.00	1.00	1.50	2.34	
M 1 - activity 5	Stay focused!	IC/At	5/5			2/5	1.00	2.66	1.67	2.00	
M 2 - activity 1	Organization: Use of Calendar/Schedule	Plan/Org				5/5	2.75	2.75	2.50	1.00	
M 2 - activity 2	Project and activity planning	Plan/Org				5/5	3.50	2.75	2.00	1.00	Metacognition

Notes: * Predominant components were considered those marked with a value of 1 (main demand) by the judges. The complexity of the activities and our protocol allowed more than one skill to be marked as the 'main demand'.
** The judges were asked to mark, for each activity, which skills were involved in descending order of demand. Scores closer to 1 indicate greater demand for that skill.
*** Considered only the skills marked (in agreement) by at least 3 out of the 5 judges.
Legend: IC/At = Inhibitory Control and Attention; Flex = Cognitive Flexibility; WM = Working Memory; Plan/Org = Planning and Organization.

Table 2.
Global analysis of program activities

	CVI						Means	
	Relevance	Plausibility	Clarity - description	Materials	Coherence with aim	EF engagement	Familiarity index*	Difficulty index**
Prioritizing the ideas of the text: Strategy of underlining	1	0.8	1	1	1	1	3	1.5
Organization of ideas: Mental schemata	1	1	1	1	1	1	3	1.8
How do you take notes?	1	1	1	1	1	1	3	1.6
Be Flexible!	1	1	1	1	1	1	3.4	2.4
Stay focused!	0.8	0.6	1	1	1	1	1.4	1.8
Organization: Use of calendar/schedule	1	0.8	1	1	1	1	3.2	2.2
Project and activity planning	0.8	0.8	1	1	1	1	2.4	1.75

Notes: * Values range from 1 to 4 - values close to 1 indicate less known/usual activities; values closer to 4 indicate activities already known/performed in the academic context (although with other objectives).
** Values range from 1 to 4 - values close to 1 indicate activities that are easier to apply by the professor; values close to 4 indicate more activities that are difficult or complex for the professor to apply.

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Results of Stage 4 - Review and finalization of the program

The integration of the quantitative and qualitative evaluations of the judges gave rise to the current, beta version of the πFex-Academics. One specific activity received further revision, the 'Stay focused!'[1] activity of Module 1. It was decided to maintain the activity, however: its objectives were clarified, outlining the purpose of the activity with greater clarity; it was removed from its original module (Reading Comprehension and Study Strategies) and placed in an initial module of 'Basic Study Skills'. With the creation of this new module, another activity (Be flexible!) that was also identified by the authors as decontextualized within its original module, was relocated.

The final program maintained the seven original activities, revised, however, was restructured into three modules. Table 3 presents the final structure of the program; note that the names of the modules were also revised, and the executive skills worked on in each one were added to them.

Table 3.
Final structure - beta version - of the πFex-Academics

Restructured modules	Composition	Activities
Module 1 - Basic Study Skills: Flexibility, inhibition and attention	2 activities	Activity 1 - Be flexible Activity 2 - Stay focused!
Module 2 - Reading comprehension and study strategies: Organization of ideas and working memory	3 activities	Activity 1 - Prioritizing the ideas of the text: Strategy of underlining Activity 2 - Organizing ideas: Mental schemata Activity 3 - How do you take notes?
Module 3 - Work and projects: organization and planning	2 activities	Activity 1 - Organization: Use of calendar/schedule Activity 2 - Project and activity planning

Results of Stage 5 - Pilot Study

For the pilot study, an activity of each module was drawn for application, and the following were obtained: Module 1 - Stay focused!; Module 2 - How do you take notes?; and Module 3 - Project and activity planning.

Immediately after the application, the professor-applicator filled out the pilot study protocol. The results are shown in Table 4. In general, the strategies were positively evaluated by the professor in all criteria. The activity in Module 3 was marked as medium in the

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[1] In this activity, the professor conducts an exercise in which they will use a timer app and a record sheet. While performing an activity that requires concentration (e.g., reading) the application is programmed to periodically beep. At each beep, the student will assess their attention and record on the sheet whether they assess themselves as 'inattentive'. With repeated practice, it is expected to improve self-monitoring and reduce the number of records of 'inattentive' on the sheet.

criterion 'Ease of use of the strategy by the students'. In fact, the activity introduces the use of strategies such as organizers and planning sheets that may be unfamiliar to students, hence the greater difficulty in using them. However, it should be noted that this evaluation was based on a single application and that the repeated use of the strategy throughout the semester should consolidate its use. However, a review was carried out in the description of the activity, in order to strengthen the professor's action as a mediator in the first stages of implementation.

Table 4.
Evaluation of the activities - beta version - in pilot application*

	Selected Activities		
	M1 -Stay focused!	**M2 – How do you take notes?**	**M3 - Project and activity planning**
Ease for you, the professor, to comprehend the activity	5	5	5
Ease of instructing the activity to students	5	5	4
Students' understanding of the activity	5	5	4
Ease of use of the strategy by the students	5	5	3
Ease of implementation of the strategy within the students' content area	5	5	4
Student engagement in the proposed activity	4	5	4

Note: *Scale ranges from 1 (*Poor applicability or comprehension*) to 5 (*Very good applicability or comprehension*).

Some comments made by the professor-applicator:

Module 1 -Stay focused!
- Performed while reading an article in the classroom;
- In total, 10 interruptions/beeps were performed, for the self-assessment of attention, at 5-minute intervals;
- Most of the class completed the activity: 2 students finished reading after 6 beeps; 2 students finished reading after 8 beeps; 4 students finished reading after 9 beeps; most ended with 10 beeps. A few could not finish the full reading of the article in the allotted time; 6 students interrupted the activity (to go to the bathroom, drink water) and then resumed.
- An activity that is easy to understand and apply, one must only consider the variation in the time each student may require for the reading.

Module 2 - How do you take notes?
- Activity performed by introducing the semester content on how to write a dissertation paragraph;
- Activity was productive and important to access students' prior knowledge.

Module 3 - Project and activity planning

- The activity was carried out to manage the semester content: "How do you conduct an interview?";
- For this, a project was carried out during the month of November, divided into the following stages, which were organized with the support of this activity in Module 3:
  - Reading an article on the topic that each student chose at the beginning of the semester (individual);
  - Highlight the main ideas of the article (individual);
  - Choose a classmate to send the article to read and underlined (pair);
  - Make a conceptual map of the underlined ideas of the colleague's article (individual);
  - From the conceptual map, prepare at least 10 questions to interview the colleague about the topic of the article (individual);
  - Interviewing and being interviewed in the classroom by a colleague (pair);
  - Organize the interview responses (individual);
  - And, finally, post on the virtual platform the questions that were prepared with the answers of the interviewed colleague (individual).
- According to the professor: "Faced with so many individual and group actions, without a proposed systematization, most would not be able to carry out all the stages of the activity".

Discussion

In this study, we sought to describe the development and map evidence of content validity of an EF intervention program focused on undergraduate students - the πFex-Academics. The program was designed to be a preventive intervention, implemented in Higher Education, preferably with freshmen, to stimulate EF components, enhancing academic learning and reducing the risk of difficulties in reading comprehension, text production and acquisition and consolidation of study habits. It was constructed considering the authors' experience with intervention programs related to EF in academic and clinical contexts (e.g. Cardoso & Fonseca, 2016; Dias & Seabra, 2013).

University students can experience academic difficulties for a variety of reasons: failure to fully engage in academic learning, difficulty properly setting goals, inability to plan and use strategies, or procrastination. The learning strategies or planning that students employ to perform various academic tasks directly influence their learning and academic performance (Baars et al., 2015; Krumrei et al., 2013; Petersen, Lavelle & Guarino, 2006; Zhu et al., 2016). Therefore, EF are skills that are also widely employed in the university environment.

As there is an increase in environmental demands and demands on EF with the progression of school levels (Dawson & Guare, 2010; Meltzer, 2010), which is also consolidated in Higher Education, it was found that it would not be possible only to adapt

activities from existing programs for application to Higher Education. It was necessary to develop a program that could be ecological and stimulate executive skills using tasks and activities that are required throughout Higher Education, such as comprehension tasks, project planning and text production. Accordingly, one of the main characteristics of the intervention is that it was organized in modules in order to stimulate EF through activities that involve academic skills typical of the university environment, that is, sufficiently complex and innovative, with an inherently greater use of EF.

To construct an intervention, it is necessary to follow several steps before arriving at the final product. In the area of assessment, the stages of construction of a psychological instrument are well consolidated (e.g. Fonseca, Salles & Parente, 2008). For the construction of neuropsychological interventions, however, there is a scarcity of studies describing the procedures that should be adopted. Accordingly, the procedure described here was based on the systematization suggested by Cardoso et al. (2017), with four essential stages: (1) Internal phase of organization of the program; (2) Construction of the program; (3) Analysis by expert judges; and (4) Finalization of the program. To these, step (5) Pilot Study was added in the construction of the πFex-Academics.

Each step was followed with rigor and care until reaching the final version. One of the main measures of the content validity of an intervention is the agreement between expert judges. This step is relevant as it provides the judgment and contribution of professionals of the area, allowing the program to be modified and improved to stimulate what it proposes to do, aligning it with its theoretical model. This stage was successfully reached, as there was high agreement among the judges, confirming that the πFex-Academics is a valid tool in terms of content. This is a fundamental step before verifying the effectiveness of an intervention.

Another important step that was applied was the pilot study, with the application of three program activities with higher education classes. This moment is necessary to verify whether the intervention that was developed is understandable and easy to apply in the target context, as well as to analyze the ease and difficulties for the professor and the understanding of the activities by the students. In this way, adjustments can be made before concluding the final version. The results obtained were considered satisfactory in terms of confirming the applicability of the program.

All these procedures led to the final version, with 3 modules and 7 revised activities. The execution of the πFex-Academics lasts approximately 4 months (one semester - modules 1 to 3) or 8 months (if module 4 is included, Written Production, under development). However, there is flexibility in this structure (the modules are independent of each other). One of the program's foundations is the systematic and explicit teaching of strategies. Meltzer (2010) reinforces that the culture of using strategies in the classroom and in school systems ensures that students actively apply EF strategies in other daily tasks, which reinforces the persistence in the use of the strategies and greater academic success for life. In addition to the explicit instruction, another premise is to offer students the opportunity, through activities, to practice the strategies, initially with feedback and support from the professor, and gradually in a more autonomous way. Following these premises, all intervention tasks include a description, direct explanation, modeling, guided practice, autonomous practice, reflection/metacognition, application/discussion and guidelines about the application, specifying the frequency and how to organize it throughout the semester.

This study includes some limitations, such as the absence of an observer during the application sections of the program's activities, which could have provided information about the implementation itself, the attitude of the professor-applicator and the engagement of the participating class, adding to the information obtained from the Pilot Study Protocol. Another possible limitation is the fact that the program was not applied in its entirety in the Pilot Study stage, however it is understood that the selection and application of activities per module would be sufficient considering the aims of verifying whether the modules are understandable and applicable in the context of the classroom with undergraduate students, as well as analyzing the ease and difficulties for the professor and its understanding by the students. Finally, no instrument was used to access or measure the participating students' perceptions, which can also be highlighted as a limitation and should be addressed in future studies.

The πFex-Academics is a promising tool to boost executive skills for academic learning in undergraduate students. Its format and organization allows its inclusion in the curriculum or as a university extension activity. The next step is to carry out effectiveness studies, which are currently underway. Future studies also include possibilities for adapting the program for high school adolescents, both for groups of individuals with typical development and for clinical groups of adolescents or young adults with potential executive dysfunctions, such as attention deficit hyperactivity disorder (ADHD), in addition to specific reading and/or writing and/or math learning disorders.

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