Motivation scale for learning with the use of DICT (EMA – TDIC)

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Abstract
The motivation to learn, as a socio-affective component, has been investigated as a facilitating phenomenon for the permanence of young people in formal education. The aim of this study was to seek evidence of content and the internal structure of the items that make up an instrument to identify the motivational quality for learning with the use of DICT (EMA – TDIC), with its scope being students in high school and higher education. Participants in this study were 822 students, who responded collectively to the scale. Descriptive and exploratory (EFA) and confirmatory (CFA) analysis of the items were performed. The CFA results corroborated the structural model established in the EFA, that is, the three-dimensional structure was confirmed: Controlled Motivation, Autonomous Motivation and Demotivation. New studies are underway, aiming to expand the psychometric evidence of the instrument, increasing the possibilities of making this questionnaire useful in educational contexts.
Keywords: Motivation to learn; Information and communication technology; High school; Higher education.

Escala de Motivação para Aprender com o Uso das TDIC (EMA – TDIC)

Resumo
A motivação para aprender, como componente socioafetivo, tem sido investigada como um fenômeno facilitador para a permanência dos jovens na educação formal. O objetivo deste estudo foi buscar evidências de conteúdo e da estrutura interna dos itens integrantes de um instrumento para identificar a qualidade motivacional para aprender com o uso das TDIC (EMA – TDIC), sendo seu âmbito de aplicação os estudantes dos ensinos médio e superior. Participaram neste estudo 822 estudantes que responderam coletivamente à escala. Realizou-se análises descritivas e fatoriais exploratória (AFE) e confirmatória (AFC) dos itens. Os resultados da AFC corroboraram o modelo estrutural instituído na AFE, isto é, confirmou-se a estrutura de três dimensões: Motivação Controlada, Motivação Autônoma e Desmotivação. Novos estudos estão em andamento, visando ampliar as evidências psicométricas do instrumento, aumentando as possibilidades de rentabilização desse questionário nos contextos educativos.
Palavras-chave: motivação para aprender; tecnologia da informação e comunicação; ensino médio; ensino superior

Escala de motivación para aprender con el uso de las TICs (EMA - TDIC)

Resumen
La motivación para aprender, como componente socio-afectivo, ha sido investigada como un fenómeno facilitador para la permanencia de los jóvenes en la educación formal. El objetivo de este estudio fue buscar evidencias de contenido y de estructura interna de los ítems que conforman un instrumento para identificar la calidad motivacional para aprender con el uso de las TICs (EMA - TDIC), para los estudiantes de secundaria y preparatoria. En este estudio participaron 822 estudiantes que respondieron colectivamente a la escala. Se realizaron análisis descriptivos y exploratorios (AFE) y confirmatorios (AFC) de los ítems. Los resultados del AFC corroboraron el modelo estructural establecido en el AFE, es decir, se confirmó la estructura tridimensional: Motivación Controlada, Motivación Autónoma y Desmotivación. Se están realizando nuevos estudios, con el objetivo de ampliar la evidencia psicométrica del instrumento, aumentando las posibilidades de rentabilizar este cuestionario en contextos educativos.
Palabras clave:Motivación para aprender, Tecnologías de la información y la comunicación, Educación secundaria, Bachillerato.

Since the beginning of this 21st century, the world has experienced social, economic and cultural transformations driven by Digital Information and Communication Technologies (DICT). The advent of a historically unique evolutionary process, due to the speed with which they emerged in this contemporary society, these DICT revolutionized communication processes (Castells, 2013). Although actively present in the cultural and social history of humanity, technology is conditioned and not a determinant of society, that is,

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society submits technology to its interests, values and needs (Castells, 2013). However, Calvo et al. (2016) and Peters et al. (2018) emphasized that the use of technologies, notably those that make communication processes viable, have the potential to, deliberately or inadvertently, influence the psychological well-being of their users.

The scientific literature shows that the nomenclature Generation Z or Zed (Mccrindle & Wolfinger, 2014) has been widely used to differentiate those born after 1995 from previous generations, these being: Baby Boomer (1946 to 1964), Generation X (1965 to 1979) and Generation Y or millennials (1980 to 1994) (Twenge, 2018). Recently, Twenge (2018) suggested the term iGen (the use of the letter "i referring to the internet) or centennials, to characterize this current generation (since 1995).

McCrindle and Wolfinger (2014) portrayed Generation Z as the technologically saturated generation, globally connected, with the greatest material conditions, albeit in uncertain economic times, and the one with the largest number of individuals attending formal education. According to the authors, the sooner a subject makes use of a certain technology, the more it becomes incorporated into their lifestyle. Generation Z has integrated DICT from childhood into virtually every area of their lives, which gives this generation its characteristic of "digital integrators". To illustrate, McCrindle and Wolfinger (2014) announced that these young people have grown up in a world where there are more than 5.1 billion Google searches a day, more than 4 billion daily YouTube views, and more than a billion users connected to the Facebook social network.

The iGen generation or centennials differ from previous generations in terms of the ways they experience and understand religion/spirituality, sexuality, politics, tolerance of inequality and formal education. According to Twenge (2018), today's young people socialize more through internet-connected devices than face-to-face, start adulthood at an older age than their predecessors, and are less happy, with a large part of this generation being less motivated to study.

Authors highlight that many students are extremely interested in using these technological resources (Flaning & Kiewra, 2018; Yot-Domínguéz & Marcelo, 2017), however, the motivation to use DICT is not always related to their social, emotional or cognitive development, as is, for example, carrying out their school/academic tasks. Despite demonstrating that they identify the potential of online technologies for many activities in their daily lives, some students sometimes seem to be unaware of or disregard the use of these tools, specifically, to favor their own learning.

Drain et al. (2012), when investigating the differences between groups of students who made use of technological resources and those who did not adopt DICT in their studies, showed that the use of these technologies has positive correlations with academic performance. The researchers emphasized that it is necessary to invest in actions that lead students to envision the "smart use" of DICT, that is, in activities that help them improve their motivation for learning and, consequently, increase the chances of school/academic success.

The studies developed by Arlia and Sumiati (2015), and Montes and Vallejo (2016), followed the same direction when investigating students that used resources/applications/software to study. The results obtained in these studies converge to indicate that when students use technologies to support the performance of their school tasks, they are more motivated to learn the proposed contents.

Due to the communicational conditions and the properties of access, production and transmission of information, these technologies, when used to enable teaching and learning processes, can contribute to the quality of the motivation for learning. They can also lead to significant results in student school/academic engagement (Arlia & Sumiati, 2015; Heafner, 2004; Sayadchi, 2016).

The studies of Heafner (2004), and Arlia and Sumiati (2015) show that DICT have a great potential to motivate the learning of content, however, they are sometimes underused. Although the presence of DICT is a reality for most students, especially among those who attend high school and university, the scientific literature demonstrates that the number of studies investigating the motivation of students for learning with the use of these resources is limited (Stevens et al., 2018; Yot -Domínguéz & Marcelo, 2017).

According to investigations carried out by Lee et al. (2005), young people are intrinsically motivated to use the internet in activities of everyday living and insist on using this resource, even when they perceive some difficulty in using it. However, research suggests that the student's commitment to using DICT in study activities is inferior to that applied to using them in entertainment situations and/or, when this use is directed toward educational purposes, it sometimes occurs inappropriately (Flaning & Kiewra, 2018;

Livingstone, 2019; Yot-Dominguéz & Marcelo, 2017). Flaning and Kiewra (2018) reported that it is common to find students distracted by using the internet, accessed through smartphones, tablets or computers, both when carrying out tasks developed outside the school/university space and even during the teaching of content in the classroom.

Given this scenario, there is an incipient growth of research aimed at investigating the implications that the use of DICT has for the student's motivation for learning (Guo & Stevens, 2012; Koh, 2016). Among these studies, which considered a diversity of contexts and variables, there is a certain divergence in the results achieved regarding the significant contributions of these technologies to motivate students to study (Arlia & Sumiatti, 2015; Fukuzawa & Cahn, 2019). However, it is also observed that when it comes to the need for more research to deepen knowledge on this topic, there is a common concern among researchers in the area (Heafner, 2004; Fukuzawa & Cahn, 2019; Kinde, 2007; Stevens et al., 2018).

Regarding the investigations that addressed the negative implications of using DICT in the study context, the studies by Fukuzawa and Cahn (2019) and Stevens et al. (2018) can be highlighted. In these studies, some resources were perceived as obstacles, discouraging students to invest or persist in the proposed school/academic task. Regarding these results, Stevens et al. (2018) estimate that the student's commitment to adopt DICT in their studies is possibly related to the preference for use and type of device and to the student's own knowledge and perceptions about the effectiveness of these technologies for their learning. The authors also observed that despite the students being intensely connected and having technical knowledge about the functionalities of digital technologies, many showed a restricted view on the properties of using DICT for study activities, that is, they saw their use only to extend or strengthen traditional teaching practices.

At the same time, several studies have evidenced significant contributions to the motivation of students who use DICT for their study activities (Arlia & Sumiatti, 2015; Fathali & Okada, 2017; Heafner, 2004; Kinde, 2007; Sergis et al., 2018; among others). In these investigations, researchers found that, when properly used, digital technologies positively influenced student motivation, contributing to strengthen their perceptions of self-efficacy and interest in deepening the learning of the proposed content. According to the results achieved by Heafner (2004), the use of DICT changes the nature of the task, as by adopting technologies with which they feel familiar, students feel confident and are involved even when faced with tasks that are initially considered uninteresting or difficult to carry out.

The number of studies investigating the motivation of students to use DICT to study is still low. Nikou and Economides (2017) also highlighted that most studies focused their investigations on specific resources or contexts, such as fulfilling psychological needs with the use of games (Calvo et al., 2016; Proulx et al., 2017), the motivation of students in courses subsidized by virtual learning environments (Beluce & Oliveira, 2019; Calvo et al., 2016; Durksen et al., 2016) and/or acceptance for the use of technology (Nikou & Economides, 2017).

Given this situation, Bzuneck (2010) and Peters et al. (2018) reported that motivating students to learn has been one of the great concerns and challenges of contemporary teachers. Therefore, comprehending the different aspects that involve motivation also implies looking into the theories that support it. A theory used to understand this construct is the Self Determination Theory (SDT) which considers that all human behavior is intentional and directed to fulfill some objective. These behaviors are susceptible to the level of autonomy and self-determination identified by the individual, as well as to socio-environmental influences that can both hinder and favor them (Deci & Ryan, 2000; Ryan & Deci, 2017; Ryan et al., 2019).

The SDT is a macro-theory, which integrates the Organismic Integration Theory (OIT) among its assumptions, which explains that people present different motivational types and orientations and, therefore, this theory seeks to understand the reason for these actions, considering the nature and the focus of motivation analyzed (Ryan & Deci, 2000). Traditionally, motivation is established in two distinct categories, namely: intrinsic and extrinsic motivation. Intrinsic motivation, highly desired in educational settings, is characterized as a natural source of learning and achievement. In turn, the classical motivational literature understood extrinsic motivation as inferior or impoverished when compared to the high quality of intrinsic motivation.

By breaking with this concept, the SDT highlights that even extrinsically motivated behaviors can be self-determined to some degree, and it is possible to be directed towards more autonomous types of motivation. Therefore, this theory proposes a continuum of internalization of behavioral regulations that run gradually from demotivation (lack of motivation) and the

different types of regulation of extrinsic motivation to the type identified as more autonomous and self-determined, that is, intrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2000, 2017; Rufini et al., 2012). Regarding the types of regulation of extrinsic motivation, the SDT categorizes four types, namely: external, introjected, identified and integrated.

External regulation illustrates a classic type of extrinsic motivation by external controllers (for example, rewards, castigation, punishments), while introjected regulation expresses actions are guided by internal controllers, that is, originated and managed by the person (issues related to self-esteem, pride, and shame, among others). The behaviors driven by identified regulation are those in which the individual has more deeply internalized their regulation, as they recognize and accept the value or attribute importance to the action performed. The behaviors driven by integrated regulation are those that the subject believes to be consistent with their values and identity, incorporating these actions into the self as valuable or relevant (Beluce & Oliveira, 2019; Deci & Ryan, 2000; Ryan & Deci, 2000, 2017).

Faced with theoretical refinements, supported by diverse and rigorous empirical investigations based on the SDT, it was found that behaviors driven by different motivational regulations can be grouped into two large groups: autonomous motivation and controlled motivation. From this perspective, the SDT demonstrated that people can be guided in their study activities by autonomous motivation (consisting of those actions that are directed by intrinsic or altruistic benefits, represented by intrinsic motivation and by identified and integrated extrinsic regulations) or by controlled motivation (consisting of those behaviors driven by external or introjected regulations, such as fear of punishment, rewards, and guilt) (Beluce & Oliveira, 2019; Ryan & Deci, 2017; Rufini et al., 2012).

To establish an overview of the students' motivation to study with the use of DICT, a survey was carried out in different databases available online, namely: Capes Platform, Dimensions, ScienceDirect and SciELO, as well as the search service for scientific articles, Google Scholar, using the following descriptors: "self-determination theory and digital technologies"; "motivation to learn and digital technologies"; "self-determined motivation and internet"; "motivation to study and internet". Keywords were also consulted in the Portuguese and Spanish languages, namely: *"motivação para aprender e tecnologias digitais"; "teoria da autodeterminação e tecnologias digitais"; "motivação autodeterminada e internet"; "motivação para estudar e internet"; "motivación para aprender y tecnologías digitales"; "teoría de la autodeterminación y tecnologías digitales"; "motivación para estudiar e internet"*.

The search with the aforementioned descriptors, which considered titles and keywords, returned 35 (thirty-five) articles. After, the analysis of the studies retrieved, publications in which the description of the investigation did not correspond to the title presented and/or did not address the theme investigated in this study were excluded. In the end, the result was the selection of 9 (28%) articles, of which three of these papers (33%) based their studies on the Self-Determination Theory (Akbari, Pilot & Simons, 2015; Fathali & Okada, 2017; Sergis et al., 2018). The following publications were considered: Arlia and Sumiati (2015), Montes and Vallejo (2016), Fathali and Okada (2017), Sergis et al. (2018), Stevens et al. (2018), and Fukuzawa and Cahn (2019), among others.

The analysis of the studies made it possible to observe a slow growth in investigations related to the motivation of students for learning using digital technologies, however, the number is still very low, especially when considering studies based on the Self-Determination Theory. It was also found that, although the studies by Akbari et al. (2015), Fathali and Okada (2017) and Sergis et al. (2018) investigated motivation in the context permeated by DICT and also used SDT, the authors opted for the adaptation and association of different instruments to assess the construct investigated.

The studies by Akbari et al. (2015) and Fathali and Okada (2017) investigated the quality of student motivation to learn different languages with the use of digital technologies and used the Intrinsic Motivation Inventory (Ryan, 1982; Mcauley et al., 1989) to perform the data collection. This instrument, developed by Ryan (1982), was examined and its psychometric properties were validated in the study by Mcauley et al. (1989). The study carried out by Sergis et al. (2018), followed classes with the Flipped Classroom teaching method and investigated the motivation to study of students who used different DICT in their activities. For this investigation, the authors applied the Instructional Materials Motivation Survey – IMMS instrument (Keller, 2009). Both instruments present items based on SDT, however, these questions do not represent motivational situations/phenomena foreseen in the mini-theory of Organismic Integration, since the questions referred to another constituent theory of SDT, the Basic Psychological Needs Theory - BPNT (Ryan & Deci, 2000).

The prevalence of international productions is also noteworthy, since no national publications that fulfilled the search criteria proposed for the investigation of studies were found. It should be mentioned that researchers such as Guimarães (2008) and Scacchetti et al. (2014) also found a scarcity of scales to assess the motivation for learning of students in these educational stages in the Brazilian context, regardless of the use of DICT.

Given the above, this study sought evidence of the validity of the internal structure of the items that compose an instrument to identify the motivational quality for learning of high school and higher education students when using DICT to study content and/or perform the school/academic tasks requested in the academic activities. It should be reported that the proposed instrument favored the Organismic Integration Theory (Ryan, 2009), which is part of the SDT, for the elaboration of its items.

Method

Participants

This study collected data from different samples of students for the different moments of the research: content validation, pilot study and application of the instrument. The instrument designed to measure motivation was initially submitted for the evaluation by linguist judges for the correction of the Portuguese (these were two PhD candidates in Linguistics, who performed a syntactic and semantic analysis of the items); then it was submitted to judges with extensive knowledge on this subject, namely: a PhD holder in the area of Education, three PhD holders in Psychology and an MSc holder in the area of Education specializing in motivation for learning with the use of DICT. The judges were aged between 35 and 55 years and were all female.

A total of 88 students participated in the collection carried out to seek semantic evidence, of whom 29.5% (n=26) were high school students and 70.4% (n=62) university students. The mean age of the students was 19.61 (SD=2.76) years, with a minimum age of 15 years and a maximum of 29 years, 70.1% of whom were female. The pilot study had the participation of 48 students from public institutions, with a mean age of 18.13 (SD=2.45) years, and a minimum of 15 years and a maximum of 22 years. Among these students, enrolled in schools/institutions in the state of Paraná, 56.2% were from high school and 43.7% from higher education, with 66.7% being female.

The instruments were applied with a convenience sample composed of 822 participants, composed of 64.3% high school students and 35.6% university students, having a mean age of 19.67 (SD=6.45) years, with a minimum of 14 years and a maximum of 52 years, 34.4% being male students. The students from schools and institutions from the states of Paraná (52.7%), São Paulo (35.8%) and Mato Grosso do Sul (11.3%) participated.

Instrument

In order to assess the students' motivation for learning with the use of Digital Information and Communication Technologies (DICT), the Motivation scale for learning with the use of DICT (*Escala de Motivação para Aprender com o uso das TDIC* - EMA – TDIC) was developed. The proposed instrument contained 30 items and presented 11 questions (1 to 11) relevant to Controlled Motivation, 11 items (12 to 22) that composed the Autonomous Motivation and 8 propositions (23 to 30) directed toward Demotivation. Examples of the questions constituting this instrument include: "For me, it is a pleasure to use internet research resources to study" and "I see no reason to use the internet to study or do school/academic work". It should be clarified that the instrument was constructed for the purpose of this study.

The questionnaire used a three-point Likert-type scale, established as "always", "sometimes" and "never", attributing a value of 2 for the option "always", a value of 1 for the alternatives marked with the option "sometimes" and the value 0 for the "never" option. For the construction of the items, the Self-Determination Theory was considered as the theoretical framework, focusing on the assumptions of the Organismic Integration Theory (Ryan, 2009). Considering that this study examined the motivation of students when using DICT for learning, researchers who investigated this theme, such as Beluce and Oliveira (2016, 2019), Fathali and Okada (2017), Heafner (2004), Peters et al. (2018) and Sergis et al. (2018) were also considered as guides in the construction of the items.

To measure evidence of content validity, high school and university students analyzed the semantics of the propositions and the adequacy of the information presented by checking one of the options: "I didn't understand", "I understood more or less" or "I understood everything". Similarly, two additional columns were made available in the questionnaire sent to the judges to indicate whether they agreed (A) or disagreed

(DA) that the item presented was adequate to represent the dimension investigated. The contributions of the students were accepted for the final structuring of the questionnaire (at least 80% agreement, Pasquali, 2017).

Procedures

Data collection - The judges received the questionnaire via e-mail, asking them to assess the intelligibility/understanding of the proposed items (semantic validity) and also the representativeness for measuring the investigated construct (content validity). The data collection with the students was carried out by the researchers in person.

It should be clarified that the two collections carried out, for the pilot study and for the one developed with the application of the questionnaire, took place after the express approval of the Research Ethics Committee, in compliance with the precepts of Resolution No. 510/2016 and the complements of the National Health Council, under Authorization No. 2.364.852. Prior to completing the instrument, the students were required to read and confirm their agreement with the terms described in the consent form. For students under the age of 18, a copy of the consent form was given, requesting the permission of the parents/guardians to participate in the research.

Before the application of the pilot study, the students were instructed that, in case of doubts or not understanding something, they should inform the researchers so that they could be individually assisted. The final stage of collection occurred with the effective application of the instruments. In addition, the third stage already had the correct items in accordance with the results arising from the analyses that sought evidence of content and semantic validation. The final collection took place in early 2018 and was completed in the second half of 2019.

Data analysis

To carry out the quantitative analyses, the collected data were arranged in spreadsheets and submitted to descriptive (means, standard deviation and percentage indices) and inferential (exploratory and confirmatory factor analysis, Pearson's correlation) statistical analysis. Exploratory and confirmatory factor analyses were developed using the MPlus software (version 7) (Muthén & Muthén, 2012), while the software - SPSS (Statistical Package for the Social Sciences) for Windows version 23 was used for the descriptive and correlational analyses. Measurement methods were also performed to examine the adequacy of the factor analyses for the investigated sample. Accordingly, the Kaiser-Meyer-Olkin (KMO) criterion and Bartlett's Test of Sphericity were applied. The three comparative fit indices: the Comparative Fit Index (CFI), the Tucker Lewis Index (TLI) and the Root Mean Square Error of Approximation (RMSEA) (90% confidence interval), were also calculated. It should be emphasized that although the verification of the CFI, TLI and RMSEA indicators is commonly adopted in confirmatory factor analysis (CFA), these indices were also considered in the exploratory factor analysis (EFA), using the MPlus program.

Results

For elucidation purposes, we chose to describe the results obtained in stages, the first two referring to the evidence of content validity. The first stage dealt with the results achieved with the analysis of semantic validity and the second stage consisted of the description of the indices revealed by the pilot study. The finale stage considered the results arising from the collection carried out with the largest sample of students that was investigated in the analysis of the instrument's structural validity. In this the students' motivation to use the DICT in school/academic study situations was measured and the relationship between the dimensions emerging from the analysis verified.

Regarding the content validity, the judges consulted returned with approval ratings above 80% (Pasquali, 2017), highlighting that the content covered in the items proved to be adequate to represent the construct investigated. The recommendations issued for adjustments/complements in the textual structure of some items of the EMA-TDIC instruments (which did not exceed 80% for exclusion) were promptly implemented.

Although the students did not demonstrate difficulties in comprehending the questions, situations concerning the formatting of the text were highlighted. These adjustments contributed to the structural refinement of the items, both in aspects related to the content and those aimed at the semantics and configuration of the instrument, considering that the agreement was not below the 80% limit for any item. This analysis of the items helped in the format used for the application in the total sample, considering that instruments that fulfilled the objectives set for this study were not found in the literature.

After these adjustments, the second stage was performed, that is, the pilot study that sought to reproduce the methods planned for the application of the questionnaire, aiming to anticipate the need for any changes/complements that could arise in the final collection (Zaccaron & Xhafaj, 2018). Regarding the results relevant to the intelligibility of the items, arising from the analysis of the data collected in the pilot study, it was possible to identify that the students did not show apparent difficulties in comprehending the questions presented. However, some changes were made in the structure of the questionnaire regarding minor corrections in the text, as suggested by the linguist judges.

The results from the first analyses of the third stage revealed information about the internal structure of the Motivation scale for learning with the use of DICT. The initial results, achieved with the Exploratory Factor Analysis (EFA), considered data from 403 high school and university students. This number of participants was obtained after randomly dividing the total sample of subjects (N = 822).

The measures that assessed the adequacy for the EFA application revealed a statistically significant coefficient in Bartlett's test of sphericity (χ^2 [435; N = 403] =16964.474; $p < .000$) and a homogeneity index higher than required (KMO = .824), highlighting that the sample was considered adequate for the EFA application. The chi-square (χ^2), computed to verify whether the proposed covariance matrix (hypothetical factorial model) fit the sample matrix, indicated a coefficient of 1.73, resulting from the ratio between the chi-square indices (χ^2 = 604.617) and degrees of freedom (*df* = 348), corroborating the good fit of the model.

In turn, the comparative fit values indicated CFI = .997 and TLI = .996, and the RMSEA coefficient was obtained with a value of .037. In view of the adequacy of these indices, the study continued with the performance of the EFA with extraction using the adjusted least squares estimation method (Weighted Least Square Mean and Variance Adjusted – WLSMV) and oblique geomin rotation, aiming to simplify the structure of the factor loadings. The geomin rotation was adopted considering the notes of Hattori et al. (2017), who recommended this type of rotation to produce factor loadings and factor correlations similar to those of confirmatory factor analysis.

The indices obtained presented saturation values with loads above .30 and composed the three-dimensional structural model proposed for testing with the Mplus software. The following dimensions were established: Dimension 1 – Controlled Motivation, with 5 items (1, 2, 4, 7 and 10); Dimension 2 – Autonomous Motivation, composed of 6 items (12, 17, 18, 19, 20 and 22); Dimension 3 – Demotivation, with 8 items (23, 24, 25, 26, 27, 28, 29 and 30). In view of these results, the EMA-TDIC Scale, which was initially composed of 30 items (theoretically constructed), was reduced to a 19 item-structure. The lowest factor loading score achieved was .313 and the highest .972. The results that show the distribution of items by dimension and their respective reliability indices are presented in Table 1.

The exclusion of 11 questions (03, 05, 06, 08, 09, 11, 13, 14, 15, 16 and 21) from the originally elaborated scale (30 items) occurred because these items did not obtain a significant factor loading index ($\alpha < .30$). It should be highlighted that questions from Dimensions 1 and 2 were discarded, with Dimension 3 retaining the same number of items (8 items). The distribution of discarded items and their corresponding factor loadings are presented in Table 2.

After discarding the aforementioned items, the questions were redistributed and integrated the dimensions of the EMA - TDIC scale with the following structure: Dimension 1 - Controlled (1 to 5), Dimension 2 - Autonomous (6 to 11) and Dimension 3 - Demotivation (12 to 19). As mentioned, analyses were also performed to confirm the hypothetical factorial model found with the EFA. Confirmatory factor analysis was used to investigate the factorial model of the EMA scale. For the CFA, data collected from the second half of the sample (n = 419) were used and the WLSMV estimation method was applied with delta parameterization and the following criteria were adopted: maximum number of interactions (1000), convergence criteria (.500D-04), maximum number of iterations for Steepest Descent (20) and for H1 (2000) and the convergent criteria for H1 (.100D-03). The evaluation of the factorial model also considered the chi-square, RMSEA, CFI and TLI fit indices. The chi-square index of 2.05 indicated the suitability of the proposed matrix and the comparative fit values also demonstrated the good adaptation of the investigated model, indicating an RMSEA index of .043; CFI = .948 and TLI = .940.

The CFA results corroborated the structural model established in the EFA, that is, the three-dimensional structure for the EMA-TDIC scale was confirmed. However, item 2 of Dimension 1 – Controlled Motivation was discarded, since it did not achieve a satisfactory factor loading index (factor loading = -.055), which led to the completion of

Table 1.
Distribution of Items by Dimension and their Respective Factor Loadings - EFA

No.	Questions	1	2	3	Dim. Value	
1	I use the internet to do school/academic tasks because the teacher asks me to.	.713			1 Controlled Motivation	α=.660
2	I use internet resources to study because I can't find the information in any other way.	.342				
4	I search on the internet to do academic work because it is faster than other forms of research, such as going to the library.	.866				
7	I use the internet to get more information about the topic I'm studying and get better grades.	.633				
10	I use the internet so that I finish the tasks that the teacher asked me to do faster.	.907				
12	I use the internet to study because I enjoy expanding my learning.		.524		2 Autonomous Motivation	α=.813
17	I use instant messaging to discuss or ask for help on a topic I've studied because I think it's important to improve my level of knowledge.		.433			
18	I watch online videos about content taught in the classroom because it facilitates my studies on topics that I'm interested in.		.683			
19	It is a pleasure for me to study watching an online video that talks about a topic that was taught at school/university.		.972			
20	It is a pleasure for me to learn from the contents and information that are available on the internet, when I am studying a school/academic topic.		.647			
22	I really enjoy using internet resources to study.		.313			
23	I think it's a waste of time to use the internet to study			.488	3 Demotivation	α=.841
24	I see no reason to use the internet to study or do school/academic work.			.479		
25	I think academic content should not be researched/ studied using the internet.			.446		
26	I really don't see how the internet can contribute to what I need to learn at school/university.			.460		
27	I hate it when the teacher asks us to use the internet to conduct school/academic research.			.471		
28	I don't think the internet can contribute to my learning.			.453		
29	I think the internet is not a resource that can contribute to my studies.			.461		
30	I think the internet is a resource that hinders my studies.			.413		

Source: The authors

the scale structure with 18 items. Under these conditions, the items were again grouped and 4 items (1, 2, 3 and 4) were confirmed for Dimension 1 - Controlled Motivation, 6 items (5, 6, 7, 8, 9 and 10) for Dimension 2 - Autonomous Motivation and the 8 items (11, 12, 13, 14, 15, 16, 17 and 18) for Dimension 3 – Demotivation. The lowest factor loading index of the items was .352 and the highest was .930. The factor loadings of the scale dimensions were also computed and the results denoted an alpha value of .756 for the Controlled Motivation factor, .793 for the Autonomous Motivation dimension and .982 for the Demotivation factor.

After confirming the structural dimensions of the scale, descriptive analyses were carried out to calculate the frequency, minimum and maximum scores, mean and standard deviation of the established factors. Table 3 presents the data collected with the total sample of students (N = 822).

It was found that Dimension 1 - Controlled Motivation scores showed that most students (75.2%; n = 618) obtained a score equal to or lower than the mean points established for Dimension 1, that is, most students investigated were not perceived to be guided by controlled motivation regarding the use of DICT to study. The indices obtained for the Autonomous

Table 2.
Discarded Items by Dimension and their Factor Loadings After EFA

º	Questions	Factor loading	Dim.
3	I use the internet to study because I don't want them to think that I don't know how to use digital technological resources.	-.327	Controlled
5	I use the internet for school research because that's what I'm supposed to do.	.067	
6	I use the internet to study or do academic work because I have to.	-.298	
8	I use the internet to research a topic studied because I realize that everyone uses it.	-.011	
9	I use the internet to show teachers and colleagues that I have up-to-date information about the content studied.	-.014	
11	I use the internet to research subjects I have to study because I don't feel comfortable bringing up my doubts in the classroom.	.222	
13	I use instant messages (WhatsApp, Messenger) to discuss doing schoolwork because it is a way to learn more from the comments of my colleagues.	.288	Autonomous
14	I use the internet to study because I know I will find up-to-date information to use in my profession.	.286	
15	It is a pleasure for me to use internet research resources to study.	-.008	
16	I consider it important to make use of internet resources to study.	.081	

Source: The authors

Table 3.
Means, SD, Variation and Minimum and Maximum of the EMA-TIDC Scores

Dimension	*M*	*SD*	Score variation	Minimum score	Maximum score
Controlled motivation	4.91	2.97	0 to 12	0	8
Autonomous motivation	7.31	2.93	0 to 18	4	10
Demotivation	5.72	3.74	0 to 24	0	16

Source: The authors

Motivation dimension revealed that 62.2% (n = 234) of the participating students achieved indices equal to or higher than the mean achieved for that dimension, that is, they presented autonomously motivated behavior for learning using digital information and communication technologies. Regarding the Demotivation dimension, the scores achieved highlighted that 73.0% (n = 600) had a score equal to or lower than the mean points, and also that 50.1% (n = 402) of the participants presented a minimum score (0; zero) for this dimension. These indices made it possible to infer that a significant portion of the participants did not consider themselves unmotivated to use DICT in their activities or study tasks.

Next, Pearson's correlation was calculated to investigate possible correlations between the dimensions of the EMA-TDIC scale. This analysis considered the following values: indices below .30 were considered to be of low magnitude; between .30 and .50 of moderate magnitude; and correlations equal to or greater than .50 were treated as high magnitude (Cohen, 1998). The coefficients showed a strong and negative correlation between the Autonomous Motivation and Demotivation dimensions (r = -.732, p = .001) and also a strong, but positive correlation between the Controlled Motivation and Demotivation dimensions (r = .591, p = .001). In turn, a moderate, significant and negative correlational index was found between the Autonomous Motivation and Controlled Motivation dimensions (r = -.350, p = .001).

Discussion

The structuring of the items that made up the constructed instrument, that is, the Motivation scale for learning with the use of DICT (EMA-TDIC) occurred according to the precepts of the theoretical framework presented. The composition of the questions pertaining to the EMA-TDIC scale was based on the assumptions of the Self-Determination Theory (Ryan, 2009; Ryan & Deci, 2019) and on studies that assessed the academic motivation of high school and higher education students (Guimarães, 2008; Scacchetti et al., 2014, among others).

As previously explained, it was observed in the literature dealing with the assessment of school/academic motivation that the items in the available instruments did not cover the use of DICT. One of the possible reasons for the absence of instruments with these specificities is due to the fact that digital resources are historically recent and the investigated generation, which did not know the world without these technologies, has just finished high school (Mccrindle & Wolfinger, 2014; Twenge, 2018).

Regarding the structure of the EMA-TDIC scale, initially consisting of 30 questions and later reduced to 18 items, the scores resulting from the EFA denoted an internal structure of three dimensions: Controlled Motivation (8 items; α = .71), Autonomous Motivation (11 items; α = .88) and Demotivation (4 items; α = .96). Items that did not achieve a significant factor loading index were discarded. The excluded questions were part of the dimensions pertaining to Controlled Motivation and Demotivation, with the Autonomous Motivation dimension maintaining all the questions originally proposed. Adequate fit indices were found, confirmed by both the EFA and the CFA, in addition to the good internal consistency of the analyzed scale dimensions and their psychometric properties to measure, in a distinct way, the motivation for learning with the use of DICT constructs.

The results obtained with the application of the EMA-TDIC scale also allowed the investigation of the students' motivation to adopt online technologies in learning situations. In general, both the high school and university students reported behaviors motivated in a controlled and autonomous locus to use digital technologies for learning and only a few presented demotivation. These students scored on issues that allude, for example, to the pleasure of studying with digital technologies and/or the importance/appreciation that the student attaches to these technologies as resources that help them to deepen or improve their studies. Some studies (Arlia & Sumiati, 2015; Fathali & Okada, 2017; Montes & Vallejo, 2016; Sergis et al., 2018) also confirm the fact that students feel motivated to learn (whether controlled or autonomously), when the various resources of DICT can be used in this learning. Considering these results, it is assumed that the challenge for educational institutions in the coming years will be to develop attractive forms which promote the motivation for learning. This scenario is also predicted considering Flaning & Kiewra (2018) and Livingstone (2019), who highlighted that sometimes students misdirect their motivation for learning. Therefore, as emphasized by Heafner (2004), when faced with challenging academic tasks, students who are motivated to adopt DICT, especially resources they master or are familiar with, feel more confident and tend to persist in carrying out the activity.

Given that some of the students reported autonomously motivated behaviors to use digital technologies for learning and that they recognized the educational potential of these technologies when used properly, the relevance of teachers also making use of DICT in their practices is highlighted. The practices in which the teacher adopts technologies to teach, and also those in which they encourage and guide their use for study activities, provide opportunities for the student to broaden the understanding of what DICT can offer for learning and how to use them in a productive, innovative, critical and responsible way (Arlia & Sumiatti, 2015; Heafner, 2004; Sergis et al., 2018).

Finally, it is appropriate to talk about the indices resulting from the correlational analyses. Regarding the correlational analyses, a weak negative correlation was detected between autonomous and controlled motivation and a strong positive correlation was identified between controlled motivation and demotivation. A strong negative correlation was also found between demotivation and autonomous motivation. It should be noted that the results achieved with the aforementioned correlational analyses are consistent with what is scientifically established by the Self-Determination Theory, the theoretical principles of which support these present studies (Ryan, 2009; Reeve & Jang, 2006).

This result is not theoretically discrepant since controlled and autonomous motivation do in fact differ in their constitution (which would explain the weak negative correlation). The first is more guided by extrinsic factors regulating this motivation (a more controlled way that expresses behaviors regulated by fear or rewards - e.g., I need to study to earn a good salary) and the other by more intrinsic factors (factors oriented toward internal causes related to the self – e.g. I need to study to have enough knowledge to be a good professional).

Likewise, the strong correlation between controlled motivation and demotivation and the strong negative correlation between demotivation and autonomous motivation also seem to be predictable. Controlled motivation is under a different locus of control than autonomous motivation, which presents aspects more intrinsic to the subject (motivational ideal. e.g. if my course did not exist anymore I would still continue studying, as I like to learn new things) and, therefore, closer to unmotivated behaviors, that is, if the locus of control of fear or reward no longer existed, it is very likely that this person would move to lack of motivation for learning than to intrinsic motivation. Considering the above, these results also reinforce that the dimensions are coherent in terms of how they are associated with each other.

With these data, it is possible to conclude that most respondents demonstrated being motivated in a controlled way. This data, although it highlights an important component that indicates that these students do not have an absence of motivation for learning, on the other hand, it also shows that there is still work to be done in that more autonomous forms of motivation in this context need to be constructed with students. Therefore, the EMA-TDIC should be further investigated in terms of attributing new psychometric evidence to this measure. It is estimated that the use of DICT in teaching practices, with a view to reinforcing the motivation for learning of the students, would be relevant, in order to have an instrument that can help psychologists and educators to improve teaching actions.

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