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# Latent factors of elementary school students' self-control in online learning

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## Abstract
Online learning during the pandemic has been a contributing factor to learning loss. However, for students who possess self-control, their learning outcomes still fall within the good category. This research aims to analyze the latent factors of self-control among elementary school students in the context of online learning. This study applied coding analysis, exploratory and confirmatory factor analysis. It involves 6th-grade students (N=24) purposively selected from one elementary school in the Tanjungpandan district for the coding analysis study, resulting in 84 responses that formed 16 codes for designing the students' self-control instrument model. Additionally, 4th to 6th-grade elementary school students (N=146) from four districts in Belitung, Bangka Belitung, Indonesia were randomly selected for the factor analysis study to construct latent factors based on the 16 formed codes. The data for the coding analysis and factor analysis were collected through online surveys. The coding analysis survey used open-ended questions, while the factor analysis survey used items designed on a Likert scale with a response model based on the degree of "alwaysness". The results of the coding analysis have been presented. The factor analysis yielded two latent factors, each constructed from 6 and 10 codes, respectively. The findings of this research reveal the results of the reduction technique applied to each set of 6 and 10 codes into self-control factors in online learning, namely: (1) productive learning habits, and (2) effective learning strategies. These two factors can be considered for students' self-control during online learning.

## Keywords
Effective learning strategies, online learning, self-control, productive learning habits.

## INTRODUCTION
Elementary school students are part of the online learning population during the COVID-19 pandemic. Online learning refers to the activity of learning from home, which has been widely implemented during the pandemic. Even after the pandemic, some students continue to engage in online learning, such as for tutoring purposes in middle school or higher education. During online learning, some students still rely on the supervision of others or even depend entirely on external support, while others have become capable of independent learning [1], [2]. For those who rely on others, they experienced burnout due to the amount of work they handle simultaneously, which would otherwise be used to prepare for other learning tasks. On the other hand, students who have become independent, try to adapt and prepare themselves for school assignments and future schedules. Wulandari et al. [3] have reported that burnout due to the shift

from face-to-face learning to online learning resulted in decreased absorption capacity and independent learning activities among Indonesian students. This phenomenon has also been observed in China [4]. Students in Iran have also experienced increased negative emotions due to being unprepared for virtual education [5].

On the other hand, for the independent students, they are capable of adapting and preparing themselves for school assignments and future schedules. Here, individual factors such as adaptation are one of the effective online learning strategies for elementary school students [6], stemming from conscious awareness coupled with responsibility [7], in addition to the online learning environment itself which also enhances students' self-control, regulation, motivation, and supervision [8], or external support in sufficient capacity [9]. Adaptation and preparation are forms of self-control [10], [11] within self-management, which contributes to high-quality organizational resources [12] and is a characteristic of self-regulated learning [13]. Although several studies (e.g., [14], [15]) have reported that online learning during the pandemic is a major cause of learning loss, students who possess self-control and self-management in their learning had a significant impact on students' learning outcomes since younger age [16] and tend to fall into the higher category [17].

Self-control refers to an individual's regulation of their physical, psychological, and behavioral processes, guiding them to suppress impulsive actions [11] and perform actions that are appropriate [18]. Self-control sometimes overlaps with self-regulation, but the difference is that self-control is a personality trait to achieve long-term goals through controlling one's impulses and resisting temptations, whereas self-regulation refers to the exercise of human control over oneself by activating the most effective strategies to stay on the preferred path [16]. Self-control becomes the dominating component during the pandemic and lockdown compared to self-regulation [9]. Within self-control, there is the ability to read or assess one's own situation and environment, manage and adapt to the environment, and express oneself during social interactions [19]. Therefore, self-control involves efforts to organize, guide, manage, and direct behavior towards positive consequences [18], [20]. These efforts are encompassed in the three initial management processes of planning, organizing, and directing [21], by involving the stages of forethought, a focus on performance, and reflection [9]. Thus, self-control is part of the individual's self-management cycle [10], [11], aimed at maintaining behavior with low probability without external support [22] to ensure the quality implementation of planning and actions [12].

Self-control involves the influence exerted on oneself. It is embedded in the concept of self-management by Peter F. Drucker, with the key lying in the understanding of the interaction between cognition, behavior, and the environment [21]. Various psychological theories, such as behaviorism, humanism, and cognitive theories, have influenced the development of this concept. Bandura's social learning theory, in particular, provides an important theoretical foundation for exploring self-control as an active adjustment to the external environment.

Research on self-control relevant to the aforementioned definition and concept has been extensively discussed in several studies, both prior to and during the pandemic. Hendra et al.'s study categorized the self-control abilities of students using smartphones for learning during the pandemic as moderate [19], while Sari et al. [23] classified them as high. Juliawati, Yandri, and Afrifadela [24] found that students' self-control fell within the category of fairly good, while Damayanti and Ilyas [25] reported that students' self-control was good. On the other hand, Hamonangan and Widiyarto [26] found a significant influence of self-control on learning outcomes, and Pradnyaswari and Susilawati [27] discovered that self-control, together with self-regulated learning, had a significant effect on academic procrastination. Additionally, studies have found significant relationships between self-control and: (a) adjustment skills [11], (b) academic achievement [20], (c) learning outcomes [18], (d) online gaming intensity [28], and (e) academic procrastination [29]. Based on the identified findings, it is apparent that research on students' self-control in learning has primarily focused on categorization levels and the role or relationship with other variables. However, one aspect that determines this focus is latent factors, which will be the primary focus of this study.

When there is a change in context, certain latent factors continue to influence the concept of self-control in learning, such as the shift from pre-pandemic to online learning during the pandemic. For example, students would prepare

themselves and wake up earlier in the pre-pandemic period compared to online learning during the pandemic. This is because students need travel time from home to school [30]. In contrast, online learning can eliminate the need for such preparation or habits, as students can simply turn on their devices shortly before the scheduled school time [31]. However, early preparation by students is a result of planning to organize their learning activities effectively and efficiently [32], and it also contributes to their expression in other activities. This adaptation by students to the pandemic learning situation [11] will be reflected in the escalation of latent factors within self-control. Therefore, this study aims to analyze the latent factors of self-control among elementary school students in the context of online learning, like during the pandemic.

## RESEARCH METHOD

This research applied coding analysis, exploratory and confirmatory factor analysis. In the coding analysis stage, data were obtained from an online survey. The survey provided to students consisted of open-ended questions about how they self-regulated to ensure optimal online learning from home. Alongside the question, five columns were provided for short answers from the students, of which three had to be filled out. A total of 24 students from one elementary school in Tanjungpandan, all from the sixth grade, were purposively selected to answer the question. Only six students provided answers for both the fourth and fifth columns. In total, there were 84 student responses for that question. The answers to the question were analyzed using a coding system, and the results were summarized in Table 1.

Table 1. Analysis of self-control codes among elementary school students

| Code | Total | Description |
|---|---|---|
| X1 | 30 | Studying diligently, always prepared, motivated, serious, focused, not (too much) play |
| X2 | 11 | Time management for studying |
| X3 | 7 | Completing assignments on time and as instructed |
| X4 | 5 | Avoiding distractions (reducing gaming), creating a conducive study environment |
| X5 | 4 | Maintaining health and immunity |
| X6 | 4 | Strict study schedule |
| X7 | 4 | Taking responsibility, attempting to find own solutions |
| X8 | 4 | Asking the teacher or searching on YouTube for assistance |
| X9 | 3 | Data package and internet connection |
| X10 | 3 | Self-motivation |
| X11 | 2 | Studying in a designated place |
| X12 | 2 | Using school uniform |
| X13 | 2 | Reviewing materials |
| X14 | 1 | Creating a task list |
| X15 | 1 | Completing textbooks |
| X16 | 1 | Listening to teacher's explanations |

Based on Table 1, a total of 16 codes were identified as follows: (a) Codes X1, X10, X13, and X15 include self-control aspects related to delaying gratification or controlling emotional impulses [16], as well as how students manage their emotions [8]; (b) Codes X2 and X5 are associated with self-control aspects related to thinking through long-term goals [16]; (c) Codes X3, X6, X7, and X8 represent the ability to make plans and carry them out in the face of difficulties and challenges; (d) Codes X4 and X11 pertain to the aspect of resisting temptations [16]; (e) Codes X12 and X16 are examples of actions demonstrating that students respect rules of interaction during online classes, as suggested by Alsubaie [8]. Additionally, as Derkach [9] clearly stated, one of the challenges faced in online learning is network connections, which makes code X9 fall under the pattern of coping behavior. Furthermore, code X14 represents the online self-control profile in planning and mapping effective self-control strategies. Please remember that these codings represent the construction of self-control for elementary school students.

These codes were developed into a research instrument that will be used to collect data in the exploratory and confirmatory factor analysis study, specifically as an instrument to measure students' self-control. The research instrument was created using a Likert scale, which consisted of statements referring to the 16 codes. The statements used in the measurement represented

the degree of "alwaysness" by students in certain aspects (corresponding to the codes) of self-control during online learning activities. Each student self-assessed the degree of "alwaysness" using an interval scale from 0 to 100, based on their own experiences, where 0 indicated never and 100 indicated always performing the action at 100%.

Next, this research classified codes X1-X16 into several factors of student self-conrol in the context of online learning using Exploratory Factor Analysis (EFA) to uncover latent structures. For this purpose, a survey based on the 16 codes was created and distributed to students through online forms and social media to measure and obtain responses from participants. The participants' responses are quantitative data for the study of exploratory and confirmatory factor analysis. The participants of this study were students who met specific criteria detailed in Table 2.

Table 2. Number of respondents based on school and grade level

| School | Grade | Total | School | Grade | Total |
|---|---|---|---|---|---|
| SD Negeri Tanjungpandan | IV | 34 | SD Negeri Badau | V | 25 |
| | V | 43 | | VI | 1 |
| | VI | 33 | SD Negeri Sijuk | IV | 1 |
| SD Negeri Selat Nasik | IV | 1 | | V | 3 |
| | V | 1 | | VI | 1 |
| | VI | 3 | | | |

Based on Table 2, it is known that the total number of respondents participating in this study was 146 students. They are 4th to 6th-grade elementary school students who provided responses to an online survey distributed randomly through social media. They came from schools located in four districts in Belitung, namely Tanjungpandan, Selat Nasik, Badau, and Sijuk. The highest number of respondents came from schools in the Tanjungpandan district, with a total of 110 students. Furthermore, the majority of respondents were from the fifth grade of elementary school, with 43 students from Tanjungpandan, 25 students from Badau, 1 student from Selat Nasik, and 3 students from Sijuk. All of these students voluntarily participated by completing a survey regarding their self-control in online learning during the pandemic situation, and their responses constituted the research data to be analyzed.

Once the data was collected, the analysis of student self-control factors in the context of online learning in this research followed the following steps: (1) assessing variable suitability using Kaiser Meyer Olkin (KMO) and measure of sampling adequacy (MSA), with an MSA standard of over 0.5, (2) classifying factors using the principal component analysis method, (3) factor rotation using the varimax method, (4) determining the reproduced correlation matrix (Rr) and residual correlation matrix (Res), (5) employing Confirmatory Factor Analysis (CFA) with Goodness of Fit (GoF) statistics to test the adequacy of the codes, and (6) interpreting the results of the factor analysis [33]–[37].

## RESULT AND DISCUSSION

The first stage of the analysis involved calculating descriptive statistics. Based on the data analysis, the results are presented in Table 3.

Based on Table 3, it can be observed that there are responses with a minimum scale of zero for six codes, namely X2, X11-X15. This indicates that some students have never: (1) managed their study time (X2), (2) studied in a designated place (X11), (3) used a school uniform (X12), (4) reviewed materials (X13), (5) created a task list (X14), and (6) completed textbooks (X15). These zero responses for the six codes do not come from a single student. If they did, there would be a potential for that student to experience learning loss.

Additionally, the highest mean degree of "alwaysness" was observed for code X16, which refers to listening to teacher explanations. Certainly, this is not an indication for students in the high-level online self-control profile category according to Derkach [9], because in this category, there is almost no need for tailored support on the side of instructors to provide psychological and technological support, or services and knowledge available.

On the other hand, the lowest mean degree of "alwaysness" was observed for code X11, which corresponds to studying in a designated place.

This lowest "alwaysness" is about the frequency of implementation of effective self-control strategies found by Derkach [9] concerning students facing challenges in noisy study spaces. Based on the highest and lowest degrees mentioned, it can be said that students are still highly dependent on the support of their classroom teachers [22], or as stated in Derkach's study [9] that they need to reflect on the effectiveness of the strategies they are using.

Table 3. Descriptive statistics of the 16 codes

| Code | Min | Max | Mean | Varians | Code | Min | Max | Mean | Varians |
|---|---|---|---|---|---|---|---|---|---|
| X1 | 10 | 100 | 86.061 | 198.875 | X9 | 9 | 100 | 90.430 | 227.971 |
| X2 | 0 | 100 | 83.900 | 383.149 | X10 | 10 | 100 | 87.770 | 197.559 |
| X3 | 10 | 100 | 89.521 | 197.072 | X11 | 0 | 100 | 76.270 | 649.966 |
| X4 | 10 | 100 | 86.792 | 214.829 | X12 | 0 | 100 | 87.210 | 441.737 |
| X5 | 10 | 100 | 90.050 | 199.301 | X13 | 0 | 100 | 84.150 | 299.329 |
| X6 | 9 | 100 | 88.280 | 260.107 | X14 | 0 | 100 | 79.650 | 471.525 |
| X7 | 10 | 100 | 87.606 | 185.670 | X15 | 0 | 100 | 88.110 | 307.864 |
| X8 | 9 | 100 | 79.260 | 317.049 | X16 | 10 | 100 | 90.920 | 230.015 |

The first step of the factor analysis was to assess variable suitability using KMO (Kaiser Meyer Olkin) and MSA (Measure of Sampling Adequacy) with a standard of over 0.5. The results of the analysis are presented in Table 4.

Table 4. KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | 0.930 |
| Bartlett’s Test of Sphericity | Approx. Chi-Square | 2402.188 |
| | *df* | 120 |
| | *Sig.* | 0.000 |

All the correlation values in the anti-image matrix were above 0.5, ranging from 0.880 to 0.960. The KMO analysis was conducted to determine whether the factor analysis could proceed or not. Based on Table 4, the KMO value is 0.930, which is greater than 0.5. Moreover, the Sig. Sphericity value is 0.000, indicating significant correlation among the correlation matrix. Therefore, the factor analysis can proceed.

The next step was to classify factors using the principal component analysis method, based on eigenvalues and total variance. The results are presented in Table 5.

Table 5. Eigenvalues and total variance

| Component | Initial eigenvalue | | |
|---|---|---|---|
| | Total | Varians | Cumulative |
| 1 | 10.260 | 64.123 | 64.123 |
| 2 | 1.145 | 7.155 | 71.278 |
| 3 | 0.827 | 5.170 | 76.448 |
| … | … | … | … |
| 16 | 0.055 | 0.346 | 100 |

Based on Table 5, since eigenvalues considered are those greater than or equal to 1, it is known that two factors will be formed from the 16 analyzed codes. However, since code X11 has loading values close for both the first and second factors (0.500 and 0.637), a factor rotation using the varimax method was performed. Loading factor values above 0.70 are considered excellent, 0.63 very good, 0.55 good, 0.45 fair, and 0.32 poor [33]. The results of the factor rotation using the varimax method are presented in Table 6.

Based on Table 6, it can be seen that all factor loadings meet Watkins' [33] recommended categories. Out of the 16 codes, they were reduced to two factors. Additionally, 14 codes (X1-X16 excluding X9 and X11) had factor loading values that fit into the two-factor grouping. Therefore, the loading values with higher values than the other factor were selected.

Consequently, the first factor includes codes X1-X7, X9, X10, and X16, with a reliability coefficient of Cronbach's Alpha (α) of 0.961. The second factor includes codes X8, X11-X15, with α of 0.852. The residual correlation matrix results showed that 43 (35%) absolute values were above 0.05.

Table 6. Results of factor rotation using the varimax method

| Factor | Code | Component | | Factor | Code | Component | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | | | 1 | 2 |
| 1 | X1 | 0.783* | 0.502 | 1 | X9 | 0.826 | |
| 1 | X2 | 0.767* | 0.350 | 1 | X10 | 0.707* | 0.532 |
| 1 | X3 | 0.857* | 0.366 | 2 | X11 | | 0.810 |
| 1 | X4 | 0.813* | 0.400 | 2 | X12 | 0.420 | 0.602* |
| 1 | X5 | 0.602* | 0.522 | 2 | X13 | 0.421 | 0.713* |
| 1 | X6 | 0.752* | 0.426 | 2 | X14 | 0.384 | 0.665* |
| 1 | X7 | 0.840* | 0.457 | 2 | X15 | 0.495 | 0.644* |
| 2 | X8 | 0.405 | 0.592* | 1 | X16 | 0.662* | 0.544 |

Note: *=The selected loading values for the factor.

The next step involved conducting a Confirmatory Factor Analysis (CFA) to test the adequacy of the model. The results of the analysis are presented in Figure 1.

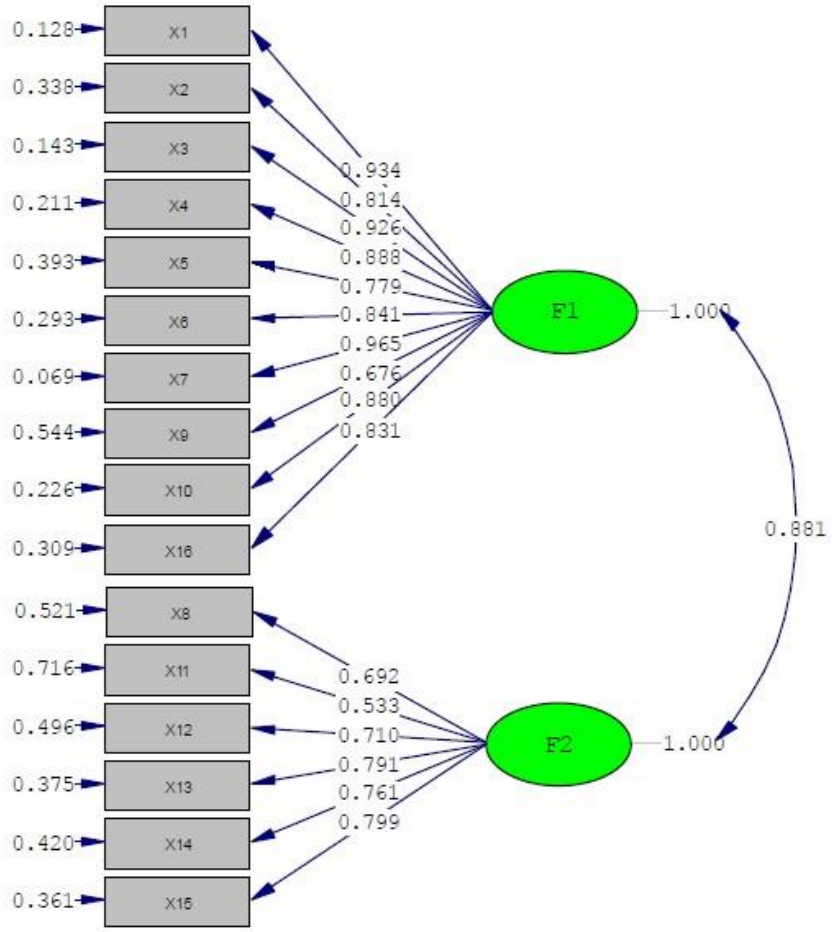


Figure 1. CFA correlation model

The results of the CFA using the correlation model in Figure 1 indicate that the Goodness of Fit (GOF) falls into the good category according to several comparison standards in Watkins (2021). Specifically, all factor loading values are above 0.5, $\chi 2/df=413.78/103=4.017$, Root Mean

Square Error of Approximation (RMSEA) Standardized Root Mean Square Residual (SRMR)=0.055, Comparative Fit Index (CFI)=0.960, Goodness of Fit Index (GFI)=0.740, Adjusted Goodness of Fit Index (AGFI)=0.650, and Normed Fit Index (NFI)=0.940.

**Two latent factors of students' self-control**

Based on the data analysis results, the first latent factor is formed from 10 codes (X1-X7, X9, X10, X16). The code descriptions of the first latent factor include: studying diligently, always prepared, enthusiastic, serious, focused, not playing (too much); managing study time, completing tasks (on time, as instructed), avoiding distractions (reducing gaming) and setting up the study environment, maintaining health and immunity, time discipline in studying, taking responsibility, trying to find their own solutions, data packages and connectivity, self-motivation, and listening to teacher explanations. As explained in Meng and Ning [21], the collection of code descriptions in this first latent factor represents the interaction between environmental aspects, self-behavior, and psychology. Self-motivation is an example of a psychological aspect. Examples of environmental aspects include managing distractions, learning environment, data packages, and connectivity. These examples indicate the context of online learning. Also, students' habits of maintaining health and immunity are relevant contexts of online learning experienced by students during the pandemic. Additionally, aspects of self-behavior, such as time management, task completion, diligence, discipline, and responsibility, are included. After categorization, the environmental aspect is considered by students in their self-control planning program. This self-control is examples of students' adaptation and preparation to participate in online learning [4], [5], [9], [11], [14], [15], [18]. Meanwhile, psychological aspects (such as self-motivation) are included in the organizing program. Of course, both programs are supported by aspects of self-behavior, making this first latent factor a combination of internal and external factors.

The codes in the construction of this first latent factor include the habits of how students attend lessons, the habits of consolidating lessons, or the habits of reading reference sources [38], [39]. In this first factor construction, the planning program includes several codes (X2, X4, X5, and X9), making all of these codes part of the online learning environment factor. In the organizing program, it also includes several codes (X3, X6, X7, and X10), making all of these codes part of the self-directed learning ability factor. The characteristic of students with self-directed learning ability is the ability to self-motivate and use any learning resources to solve problems in learning tasks, as well as knowledge acquisition and management [40]. In this context, the factor of students' ability to learn independently is independent of the online learning context as students are expected to be independent learners regardless of the learning environment. Similarly, in the guiding program, with the mentioned codes (X1 and X16), it is also a factor independent of the online learning context. On the other hand, this study also highlights the two following codes, X1 and X4, as they indicate the consequences of learning using digital devices. While students recognize that the digital world can fulfill their imagination needs, they face either productive or interfering characteristics [41]. Additionally, Derkach's study [9] found that online learning exposes students to an inability to sustain attention for a long time.

From all the codes that construct the first latent factor, three aspects can be summarized based on interpretation, namely learning habits, independent learning ability, and productive or interfering characteristics. Referring to several factors described by Thompson [41], such as not giving up in short-term boredom, recognizing one's own responsibility, the ability to control multitasking, seeking various sources of information, the ability to focus on explanations, and remaining focused on tasks while studying with peers, the first latent factor, which is the finding of this research, is indicative of a scale called productive learning habits. Productive learning habits refer to cognitive behaviors associated with learning, such as focusing attention and engaging in deep processing rather than shallow processing, and also include the ability to be flexible and learn from a variety of different situations [41].

Meanwhile, the second latent factor is formed from 6 codes (X8, X11-X15). The code descriptions of the second latent factor include: asking the teacher or watching on YouTube, studying in a special place, wearing a school uniform, reviewing materials, making task lists,

and completing textbooks. All of these code descriptions in the second latent factor are categorized under the aspect of self-behavior. In this second factor, it is identified that only planning (X12 and X14) and guiding (X8, X11, X13, and X15) cycles occur. These codes align with the indicators measured in the studies of Sartika et al. [39], and Ulfa et al. [38] such as: habits in following lessons, habits in solidifying lessons, habits in reading books. Furthermore, codes X11 and X12, it is respectively to represent effective self-control strategies as described by Derkach [9] about the context of students facing challenges such as dealing with noisy study spaces, and respecting rules during online classes [8].

In detail, behaviors such as asking for help from teachers, preparing reading materials before class, taking notes for assignments to manage resources, and keeping up with work like finishing required tasks, indicate the learning strategies applied by students in a blended course according to the study by Zhu et al. [16]. Therefore, from all the codes that construct this second latent factor, several aspects can be summarized based on interpretation, namely effective self-control strategies and learning strategy. The second latent factor, which is the finding of this research, indicates effective learning strategies. Effective learning strategy refers to constructive approaches in assimilating or accommodating schemas [42], [43].

Thus, the latent factors of elementary school students' self-control in online learning based on the findings of this study are: (1) productive study habits, and (2) effective learning strategies. Productive study habits for elementary school students refer to their ability to study independently, maintain focus, take responsibility, and seek solutions. Meanwhile, effective learning strategies include studying in a conducive environment, communicating with teachers for assistance, prioritizing tasks, and completing required assignments. Effective learning strategies are often overlooked, yet not all students are capable of implementing them.

## CONCLUSION

Based on the research findings, two latent factors of self-control in online learning have been identified. These two factors are reduced from the 16 analyzed codes. The first factor is formed from 10 codes, and the second factor is formed from 6 codes. The results of the model fit analysis indicate that both factors fall into the good category for the students' self-control variable. The two latent factors are productive learning habits and effective learning strategy. These two factors can be considered for students' self-control during online learning. After that, this study also proposes conducting further research on other unexplored codes, as well as delving into the construction of codes and latent factors from the results of this study that have not been analyzed in greater detail, such as individual traits, technological adaptability, parental involvement, and the presence of supportive learning environments.

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