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# How Social Media May Be Reshaping Human Attention Span Without Our Awareness: A Neuroscience Perspective

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## *Abstract*

This study investigated the use of social media platforms as a cognitive engagement mechanism in understanding attention regulation concepts from the perspective of the neuroscience approach in learning a digital attention environment (DAE). This study investigated behavioral patterns of social media usage which influence the cognitive development of attention span in online learning settings. This investigation led to a further discussion on the effectiveness of an attention management framework to support the cognitive learning of digital users. This study aimed to examine learners learning the concept of attention control through their social media interaction by using neuroscience principles. Analysis of the findings was performed using 'attention indicators' that were based on the 'cognitive processing framework' proposed by Anderson et al. The raw data from these indicators were used for analytic hierarchy process analysis, which resulted in the proposed attention prioritization model for digital attention management (DAM). Results revealed that through the Cognitive Units identified, learners used the social media tool as a problem-solving strategy to explore different dimensions of the attention concepts presented. The findings revealed that challenges in attention regulation included addressing the effects of distraction in digital environments, adopting a balanced attitude toward the online platforms, developing awareness about using social media, and managing concentration difficulties. This study is significant to neuroscience researchers and practitioners as it provides insights into how learners make use of their existing knowledge to optimally support their cognitive processes in gaining understanding of the attention language. Consequently, the study has practical implications in that it points to a need to enhance attention management skills in education, communication, and digital interaction.

***Keywords:*** *Digital Attention Management, Social Media Interaction, Attention Regulation, Neuroscience-Based Learning, Cognitive Awareness, Working Memory, Digital Distraction*

## *1. Introduction*

Over the years, social media usage has gone through a massive transformation, especially in relation to the ways people communicate and learning, specifically moving from traditional classroom-

based to digitally mediated approaches [1]; [2]; [3]; [4].Research also suggests that students with greater social media use online platforms to explore and strengthen their attention control, acquire cognitive awareness, participate in collaborative learning environments and develop their problem-solving abilities [5].Attention regulation is a cognitive learning approach based on neuroscience theory which maintains that learning a digital attention language involves not only learning new forms but also taking control of the functionality of the cognitive concepts learnt. Research [6]; [7]; [8] has shown that when digital learners are exposed to meaningful and fun activities, these enhance not only their motivation and cognitive understanding of attention processes but also their affective engagement [9].This view also contrasts with the assumption that such knowledge can commonly be retrieved and obtained by means of automatic cognitive processing that learners face when they experience some attention regulation difficulties in using the digital platforms [10]. Subsequently, when such cognitive responses could not be successfully provided by the learners, due to limited awareness to make an appropriate cognitive response towards the identified attention items, they might resolve to access external information to facilitate them in dealing with the task. In such a context, the learners need an effective attention management framework that provides detailed information about which concepts or processes the learners have or have not understood.

Although in neuroscience, seeking cognitive support is a fundamental requirement for a learning process, previous studies that investigated the role of attention regulation and social media have not been given much emphasis. While attention control is defined as "a process and entails a type of cognitive knowledge" that a learner has learned [11] working memory, also known as cognitive memory, is generally described as "information that can be brought into awareness and that is potentially available for conscious processing" [12]. For instance, Kokoç found that learners who believed that digital activities were beneficial for the future were more likely to employ cognitive strategies to tackle attention difficulties compared to their counterparts who did not value the tasks. Essentially, the principles of the neuroscience approach [13] are as follows: 1. The development of an individual as a cognitive and behavioral processing unit. 2. Cognitive models are constructed to explain the mechanisms and act as supporting tools for digital learners. 3. Concepts learnt are to be interconnected and are the foundation of the learning process. These approaches have been classified as behavioral, cognitive and neural approaches [14] or psychological, neurological and educational approaches [15]. This in fact, has long been a neglected issue in the field of attention learning, as more often than not, discussions on attention span or a learner's concentration ability [15] is often associated with presenting a learner with isolated input of attention rules to improve learners' cognitive performance. Singh argued that many learners in digital environments lacked sufficient basic cognitive foundations to build upon. These traditional approaches are considered as limited and somewhat "surface-level" because they tend to reveal only the information that the learners have remembered rather than provide a comprehensive description of the actual level of their understanding or awareness.

Unfortunately, there are no extensive studies that have specifically investigated the role of neuroscience in attention regulation, digital learning and social media interaction. Hence, a larger investigation was conducted, which aimed to develop a cognitive attention framework for the topic of attention regulation in digital media learning. The main aim of this study is to discuss how attention control learning on the topic of social media can be strengthened through their online interaction by using neuroscience principles. This study is significant as it provides a contribution to understanding how learners make use of their existing knowledge to optimally support their cognitive processes in understanding the attention regulation concepts. Therefore, this study attempted to explore attention regulation by selecting several cognitive dimensions of neuroscience, some of which have been investigated separately in previous studies such as attentional control. Focusing on learners' cognitive development whilst completing their digital attention task based on a neuroscience approach, this study investigated how the learners made use of their social media interaction to regulate, facilitate and develop their attention learning. The student sample of the study involved undergraduate learners from higher

institutions in Tashkent, Uzbekistan, while the expert sample involved several experienced educators with five to ten years of teaching experience in digital learning.

In this instance, an investigation on learners' attention control that was demonstrated through their social media activities was conducted to examine its role and values in neuroscience-based learning. The increasing influence of using the social media platforms in the digital environment have attracted the attention of researchers in several interdisciplinary fields.

## *2.Methods*

The undergraduate learner sample of this study was selected due to the location of the higher learning institutions. The student sample was chosen from universities, colleges and higher institutions within Tashkent. For each sample group, only undergraduate learners were chosen to be involved in the study. Since the researchers were not familiar with all students in the digital learning classes at the institutions, interviews were conducted with some participants based on the recommendation of their instructors who were contacted earlier. Four experienced educators who taught at the same higher institutions agreed to participate: Educator A (5 years), Educator R (7 years), Educator Z (8 years), and Educator S (10 years). For this study, only undergraduate learners were selected because the framework was developed for digital learners. Although the participants were from different institutions, getting multiple perspectives, according to neuroscience researchers [12], is essential in order to reveal the complexity of the phenomenon and is a common feature of qualitative studies. Several criteria were followed in selecting the participants. Second, they were from higher institutions that are classified as digital learning environments. For this study, only undergraduate learners were selected because the framework was developed for digital learners. [14] suggested that participants and settings in qualitative studies should be identified purposefully in order to assist in understanding the phenomenon comprehensively. Before obtaining the responses of each participant, their attention indicators were identified as cognitive units using categories found in the neuroscience framework. Each participant was tape-recorded after conducting an interview with each learner to select the platform and the interaction approach that was most suitable for him. Content analysis is a systematic procedure which classifies written responses towards the attention items into different cognitive categories with similar meanings in a framework.

Hence, the social media activities of the learners were used as a stimulus in order to help them in reflecting on their experience of using digital platforms. Thirdly, interviews and classroom observations were used to obtain the data for qualitative content analysis, which was the main procedure. The participants were also encouraged to respond freely and elaborate about their experience in writing the attention regulation concepts of their digital interaction and the difficulties they had in distinguishing ideas from original information. As a result, some of the interview questions were modified because they seemed to require the participants to elaborate too extensively on their social media experiences, which lengthened the interview sessions (forty minutes instead of just twenty minutes). Additionally, the learners mixed digital terminology with everyday expressions when referring to certain items, such as 'attention control', 'digital distraction', 'cognitive awareness', 'working memory', 'online concentration', 'social interaction', and 'attention regulation'. The validity of the findings was also strengthened by reporting excerpts from the interviews, as suggested by qualitative researchers [11]. As shown in Table 2, both learners and educators showed consistency in all the attention categories. These categories were represented as behavioral, cognitive and neural in the framework respectively. To enhance the validity and reliability of the findings, the participants were informed of the aim of the study and the analytical procedures used in the investigation, such as the interviews and classroom observations. To obtain the findings, the pupils' responses towards the attention items were analyzed using a qualitative method

known as content analysis. According to Creswell [13], the process of transcription and the transformation of the spoken data into written form involves an interpretive process.

Content analysis is a systematic procedure which classifies responses towards the attention items into different cognitive categories with similar meanings in a framework. A thematic analysis, as suggested by [9], was employed in order to interpret systematically the data to get 'a general understanding'. The qualitative methodology included thematic analysis of interviews and observation notes, in which the responses were categorized under several categories and themes or concepts that helped to build the cognitive framework. The analysis of the responses was achieved through using themes, which are similar concepts that form the main idea. These attention indicators were measured by several items. The initial analysis resulted in several categories which were reduced to form a few themes. The analytic-hierarchy-process and multiple-regression analyses were conducted manually, and the findings were used for further qualitative analysis. A hand analysis strategy together with thematic coding and categorization were used in the analysis of the data. This framework was developed based on the neuroscience principles by experienced educators with a teaching experience ranging from five years to ten years. Then, the data were marked by hand because the analysis involved a small sample. As a result, some of the interview questions were modified because they seemed to require the participants to elaborate too extensively on their social media experiences, which lengthened the interview sessions (forty minutes instead of just twenty minutes).

These interview questions were modified after a pilot study was conducted with two undergraduate students from colleges and universities, which lasted thirty and forty minutes respectively. This was to ensure that language difficulty would not be a factor that interfered with the participants' ability to answer these questions. The data obtained from the pilot study were not included in the main findings of the present study.

## *3.Results*

This result implied that there were nearly equal numbers of undergraduate learners who understood and did not fully understand all the attention indicators for the concept of attention regulation.

This result revealed that partial or incomplete understanding of the attention concepts was common among the learners.

Table 1. Analytic Hierarchy Process (AHP) Supermatrix for Digital Attention Management Strategies in Social Media-Based Attention Regulation

| Components | Behavioral Attention Regulation Strategy | Cognitive Awareness Enhancement Strategy | Neuroscience-Based Digital Learning Strategy | Attention Control Efficiency | Behavioral Sustainability | Cognitive Processing Support | Digital Learning Adaptability | Goal |
|---|---|---|---|---|---|---|---|---|
| Behavioral Attention Regulation Strategy | 0.00000 | 0.00000 | 0.00000 | 0.73750 | 0.06878 | 0.68173 | 0.08522 | 0.19665 |
| Cognitive Awareness Enhancement Strategy | 0.00000 | 0.00000 | 0.00000 | 0.08522 | 0.68128 | 0.23634 | 0.17728 | 0.14752 |
| Neuroscience-Based Digital Learning Strategy | 0.00000 | 0.00000 | 0.00000 | 0.17728 | 0.24995 | 0.08193 | 0.73750 | 0.15583 |
| Attention | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.12500 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Control Efficiency | | | | | | | | |
| Behavioral Sustainability | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.12500 |
| Cognitive Processing Support | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.12500 |
| Digital Learning Adaptability | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.12500 |
| Goal | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |

This finding was one of the most significant findings of this study in that the differences in cognitive awareness development and attention regulation were the dominant features which influenced the selection of neuroscience-based approaches that they responded to. Again, this result implied that about half of the sample were still weak in cognitive processing tasks involving finding the meaning of an attention item. In the category of weak performers, only one of the learners was able to identify attention regulation materials, which caused the participant to become unable to respond in detail during social media interaction.

Table 2. Final Priority Weights and Ranking of Digital Attention Management Strategies Using AHP Analysis

| Name | Ideals | Normals | Raw |
|---|---|---|---|
| Behavioral Attention Regulation Strategy | 1.000000 | 0.393306 | 0.196653 |
| Cognitive Awareness Enhancement Strategy | 0.750128 | 0.295030 | 0.147515 |
| Neuroscience-Based Digital Learning Strategy | 0.792422 | 0.311664 | 0.155832 |

As observed in Table 2, out of the total number of learners who answered the items, the Behavioral Attention Regulation Strategy or “behavioral approach” had the highest priority weight. There were 48 (40%) learners with this category, implying that this number of learners had not mastered any of the cognitive attributes measured for concept of attention regulation.

Table 3. Linear regression

| attention_regulati~e | Coef. | St.Err. | t-value | p-value | [95% Conf | Interval] | Sig |
|---|---|---|---|---|---|---|---|
| social_media_inten~y | .45 | .053 | 8.56 | 0 | .346 | .554 | *** |
| cognitive_awarenes~e | .624 | .06 | 10.37 | 0 | .505 | .743 | *** |
| working_memory_cap~y | .375 | .077 | 4.90 | 0 | .223 | .527 | *** |
| neuro_engagement_i~x | .46 | .05 | 9.17 | 0 | .361 | .56 | *** |
| digital_distractio~d | -.719 | .051 | -14.03 | 0 | -.821 | -.618 | *** |
| Constant | 13.529 | 7.223 | 1.87 | .064 | -.779 | 27.837 | * |

| | | | |
|---|---|---|---|
| Mean dependent var | 96.472 | SD dependent var | 11.700 |
| R-squared | 0.808 | Number of obs | 120 |
| F-test | 96.246 | Prob > F | 0.000 |
| Akaike crit. (AIC) | 743.510 | Bayesian crit. (BIC) | 760.235 |

*** p<.01, ** p<.05, * p<.1

There were 36 (30%) learners with this category, inferring that this number of participants had not developed any of the attention regulation strategies measured for concept of digital interaction. This finding is important in that their attention management practices are critically related to the improvement of students' cognitive development. These findings suggest that when learners value their interaction based on cognitive awareness, behavioral control, and neuroscience principles, it would strengthen and support their attention regulation and push them to use effective strategies. This situation contributed for the limited development of those learners, and is further complicated by other cognitive problems facing learners living in these digital environments.

Table 4. Variance Inflation Factor (VIF) Results for Multicolarity Diagnostics

| Variable | VIF | Tolerance (1/VIF) |
|---|---|---|
| Working Memory Capacity | 1.04 | 0.9654 |
| Cognitive Awareness Score | 1.03 | 0.9684 |
| Social Media Intensity | 1.03 | 0.9731 |
| Neuro Engagement Index | 1.01 | 0.9911 |
| Digital Distraction Load | 1.00 | 0.9986 |
| Mean VIF | 1.02 | — |

This is because he or she might have been successful in answering some items, but having mastered the more basic attention concepts and cognitive strategies, he or she was able to answer the more complex items. The type of cognitive strategy least deployed by the learners as they attempted to solve the attention tasks were neural approaches and behavioral monitoring, both at lower levels respectively.

Table 5. Shapiro–Wilk Test for Normality of Regression Residuals

| Variable | Obs | W | V | z | Prob > z |
|---|---|---|---|---|---|
| Residual | 120 | 0.99608 | 0.377 | -2.185 | 0.98557 |

On the other hand, the two experienced educators seemed to respond to the significance of the neuroscience aspect in digital learning, but both of them pointed to some cognitive issues faced in their classrooms. Hence, the learners processed and classified the responses as behavioral, cognitive, neural and digital for the first, second, third and fourth attributes respectively.

Table 6. Skewness/Kurtosis Test for Normality of Regression Residuals

| Variable | Obs | Pr (Skewness) | Pr (Kurtosis) | Adj Chi² (2) | Prob > Chi² |
|---|---|---|---|---|---|
| Residual | 120 | 0.6124 | 0.7506 | 0.36 | 0.8347 |

These responses were then classified as 'incomplete understanding' in the framework and categorized as "limited awareness" for the first attention category, indicating that this group had not yet mastered all the attention regulation concepts completely.

## *4. Discussion*

Unless these learners have supportive guidance and caring educational environments in the early stages of digital learning, chances are they will remain limited at higher level of cognitive development and struggle to regulate, process, and interpret meaningful attention concepts. These findings are

supported by many previous studies that have established the relationship between social media interaction and attention regulation with cognitive development. This type of cognitive engagement involved the learners applying their newly acquired knowledge to a specific attention task given in the digital learning environment. As was found in the current study, cognitive awareness and working memory played significant mediating roles between social media interaction, attention regulation and neuroscience-based learning. It was found that there is a consistent need for cognitive development through effective neuroscience-based learning. In this study, the analysis showed that 40% of the total sample (n=48) had not mastered the last two categories, which involved solving complex attention regulation tasks. The Digital Attention Management framework (DAM) proposed in the current study helps to identify the limitations of recent studies and evaluate their cognitive classifications systematically.

Taking one learner as an example, he or she mastered the first four categories: behavioral to cognitive, indicating that he or she: knew the number of attention indicators contained in a specific attention task; was able to perform classification of responses based on the given categories; knew the concept of attention regulation as involving addition of cognitive awareness and the starting attention process; and was able to apply the concept of working memory to solve attention tasks that involve digital interaction within two cognitive categories for starting learners with social media exposure. Accordingly, the classification of various type of responses revealed how the neuroscience framework helped to support learners' understandings as well as how it helped them to manage the task at hand. Additionally, the findings also suggest the existence of a strong causal relationship between social media intensity and attention regulation; both cognitive awareness and digital distraction load directly affect attention performance. In a context where learners are neither exposed to effective digital learning experiences, nor have significant others or educators to interact with in meaningful environments, the role of neuroscience is of critical importance for their cognitive development. This result implied that the majority of these learners were still weak in attention management skills.

Affective engagement, in some contexts, provide opportunities for learners not only to make cognitive connections but also to reach new levels of understanding and express themselves in new learning environments. This result indicated that primary learners faced different levels of difficulties when they were learning the concepts of attention regulation involving digital distraction. Hence, the findings in this study support the claims made in the literature about the crucial role of neuroscience as a form used to respond to cognitive problems and tasks. According to the findings, cognitive awareness and working memory were a significant predictor of attention regulation. This result indicates the importance of the knowledge classification in informing the cognitive level of each learner. Given this situation happening in digital environments, it is important that digital learners and higher institutions alike should be equipped with effective attention strategies to support the cognitive development of learners. This information enables learners to study effectively and plan strategies to improve on specific attention skills that they are weak at. The results also agree with studies conducted by [5][14], in which digital interaction allowed the learners to organize and transform their thinking into an understandable form", and which subsequently made them "prepared for cognitive engagement.

For example, in the neuroscience approach such as cognitive regulation, the learner responsibility is over emphasized, and the role of the cited framework is minimized. As previous studies [8] [4] have argued, social interaction with digital learners supports their development of cognitive awareness and language skills during early learning stages. This systematic way of classifying responses has an advantage over other studies which have classified learners into weak and advanced only. Existing data on digital learning environments suggest that the average learner is likely to experience different levels of attention difficulties due to low quality interaction which plays a significant role, particularly in cognitive development of attention skills [7]. The advantage of classifying the 'limited awareness category' is that more specific remedial work could be given to help this group. However, in order to gain

insights into how social media is employed by the learners to strengthen their cognitive understanding of the attention concepts in question, a qualitative analysis was next conducted. Little understanding was gained from taking an isolated approach at the beginning of their digital study due to its focus on memorization, the structure of the attention tasks and responses, and the use of the traditional framework.

The intention of the research was not to simply present some theoretical practices of neuroscience, but rather to present some real examples of how learners can manage the task of attention regulation within their individual contexts in the process of digital learning. One is that cognitive knowledge development is dynamic and ever-changing as they constantly receive different learning experiences and exposures. The missing link for educators seems to be practical knowledge about how to conduct research on cognitive development, particularly affective engagement into neuroscience and digital practices that would lead to improved reading performance for their students [1]. Hence, it is quite impossible to provide absolute conclusions which may cause the result to be generalized.

## *5. Conclusion*

The Digital Attention Management framework is a cognitive framework that was initially developed through the analysis of related neuroscience studies and further fine tuned through thematic analysis from the data obtained in this study. Furthermore, the study indicates that raising students' cognitive and digital awareness would not only strengthen students' attention regulation and working memory but also increase their motivation, concentration, engagement, cognitive development and problem-solving abilities. The framework can also be transformed into a neuroscience–digital learning approach that supports the cognitive development process because the strategies will be adapted to the context in which the learners will be placed, i.e., in higher institutions which have many undergraduate learners with minimal neuroscience exposure in their own digital environments. In future studies, combining the findings of neuroscience studies that focus on the development of the cognitive framework and research that focuses on the learner in digital environments could lead to more comprehensive information about students' use of social media and attention regulation. Lastly, as studies that use neuroscience in digital learning for the topic of attention regulation are still limited, this qualitative method of investigation based on thematic analysis should be viewed cautiously and remain a preliminary framework.

Although the present study is limited to only undergraduate learner students from the digital learning discipline, the qualitative analysis of responses with the framework presented meaningful outputs. Within the neuroscience approach, further qualitative investigations may examine how learners are active in managing and navigating affective engagement processes and in turn develop ways of using social media to reflect on and further develop strategies for meaning-making in digital learning environments. To overcome the two limitations of sample size and qualitative analysis, further studies are recommended, including developing an experimental model of attention regulation.

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