

A Tentative Model of the Link between Constructivist Learning Approach and Attention-Deficit Hyperactivity Disorder

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Samira Sadat Sajadi

Brunel University London, UK

Abstract—This paper examines whether a Constructivist-Learning Approach could be used to help learners with Attention-Deficit Hyperactivity Disorder (ADHD). Preliminary work is discussed here, in which the author seeks to determine the reason why Constructivist-learning is difficult for learners with ADHD. Results based on literature analysis lead to recommendations of two stages: (1) why we think ADHD learners might find it difficult to engage in a constructivist learning environment, (2) how ADHD learners could benefit from a constructivist approach, for instance through the managed use of a pedagogy model. A tentative model of the link between constructivist principles and ADHD is presented, which is married to positive aspects of having ADHD.

Index Terms—Attention-Deficit Hyperactivity Disorder, Constructivist learning, Pedagogy, Special Educational Needs, Typically Developing Learners

I. INTRODUCTION

The term *learning* can refer to acquiring new information, skills, and behavior or adopting existing knowledge in the working memory [1]. Learning or gaining knowledge is unique to each learner. Learning theory involves principles to explain the circle of changes in human learning performance, through which we can observe how learning occurs. In education and psychology, a model of learning or, alternatively, learning theory is defined as ‘a description of how learning takes place in different people’. In fact, today’s teaching strategies and interventions for both typically developing learners (TDLs) and special educational needs (SEN) are based on various psychological learning theories [2, 3]. Since it is hard to irrefutably prove a learning theory, the author prefers to adopt the term ‘model of learning’, since it connotes the idea that the process is conjectured description rather than a universally accepted explanation of the internal workings of the human mind. However, the term *learning theory* will be used interchangeably with *model of learning* to remain consistent with the general literature.

Constructivism is often defined as an extension or subdivision of cognitivism with more precise consideration. Constructivism relates to the nature of knowledge, as well as the relationship between the brain and information. In [4], constructivism has been defined as a learning approach whereby learners create meanings from their own understanding, rather than an instructionism approach, which is viewed as teacher-

driven. Over the last 25 years, constructivism has developed exponentially in a psychological context [5] (i.e. cognitivist approach).

The significant idea derived from the constructivism learning paradigm is that ‘learning is an active process’, whereby an individual constructs his/her own perception of the world based on prior knowledge, experience and pre-existing outlines. This approach expresses the view that learners should use their rich background of knowledge to develop new concepts. However, the understanding of some learners is restricted; thereby illustrating that they may not have the required knowledge. In [6], learning is viewed as an active and constructive process, in which learners are challenged to resolve problems in the classroom. In fact, this perspective concerns learning and teaching as an interactive process that requires negotiation of meaning. The current paper has investigated the link between constructivist learning requirements and ADHD symptoms and aims to produce a preliminary model named ‘Tentative model of the link between constructivist learning criteria and ADHD symptoms’.

With this in mind, the paper will start with an overview of current understanding of constructivism theory and the prominent work of [7, 8]. Importantly, this paper pays more attention to the significant constructivist learning requirements as a fundamental to learners’ academic success. Understanding ADHD and how it may influence learning will be discussed. As a consequence of such discussion, the paper will then proceed to examine the links between constructivist learning requirements and ADHD and how to overcome barriers to satisfy these requirements. The argument will then concentrate on how relevant and appropriate is the proposed model in designing an appropriate pedagogy for learners with ADHD. In this respect, the paper intends to examine the issue of whether or not constructivist learning theory is an appropriate assumption for pedagogy designers when seeking to teach learners who diagnosed with ADHD.

The guidelines provided in this paper, in which characteristics of ADHD (i.e. attention-deficit, poor information processing) are cross-referenced with the demands of constructivist learning experiences, offer a tentative reference scheme for distinguishing between available options in the future pedagogy design process. In recognizing the link between ADHD, impairments, advantages and the demands placed on learners from particular learning theories (constructivism) and approaches, the work extends current understanding of

educational interventions for special education needs (SEN) in general and ADHD in particular. It is now more apparent why educational tools may or may not work successfully for individuals in specific situations because instructors can tie in the functions of any pedagogy model with the demands of a learning task and the effects of ADHD in this situation. Therefore, literature on ADHD and learning theories are both extended through the cross-referenced table which will be provided later in the study, and becomes more transparent due to the explicit connections contained within.

II. RESEARCH BACKGROUND

A. Constructivist Approach

Constructivism theory influenced by the study of [7, 9] on cognitive psychologists supports learners to develop their knowledge based on special experience and ideas. Educational settings from the constructivist perspective of [8] concentrate on the need for learner-driven learning, which means learners are actively involved in the learning process to assimilate new information into their existing knowledge structure. Constructivism supports learners to be active in the learning environment, understanding from the content of study and enjoying learning, and to learn to think in an efficient manner. Constructivism studies, is all about two critical principles of creativity and knowledge. Therefore, in order to approach successful learning, teachers modify instruction from 'passive' to 'active learning'. Active learning as a significant perception of constructivism refers to a mental representation of a learner to realize his/her own mental processing [10]. As a result, active learning allows learners to be highly creative and explore new knowledge through existing knowledge. This is because successful learning is a process by which learners discover concepts, facts and principles by themselves. It is vital to note that the critical factor in an active learning environment is the ability to combine ideas and concepts from prior knowledge. This transfers learners into their long-term memory to find any connections between the new concept and the prior knowledge and pull these out to the short-term memory. Therefore, the role is concentrating knowledge through interactions with the environment. This requires the educational environment to be transferred from educator-driven to learner-driven.

Turning to the next step, working memory focuses on knowledge construction and requires learners to use their prior knowledge. This needs a strong short-term memory to pull out information from long-term memory into short-term memory. In this regard, learners need to find the connections between the new concept and the knowledge that is already stored in their long-term memory. Accordingly, generating new knowledge requires learners to recall any concepts and items from permanent memory which are similar to the knowledge given by the instructor and find connections [11]. Successful recalling from the long-term memory illustrates that item as being correctly reconstructed. For this to happen requires independence which relates to active learning. Short-term memory represents an active content of mind. In contrast, unsuccessful reconstruction attempts indicate that no connections have been found between the concept and existing knowledge in the long-term memory. Therefore, 'strong working memory' would count as a critical

principle of a constructivist learning environment for the purpose of generating new knowledge. However, [1] noted that the limited capacity in working memory simply prevents the existing knowledge to transfer from long-term memory to short-term memory. As individuals, each learner has a different learning style, with different understanding and unique experiences of the world. Constructivist approaches concentrate on the process and the product of learning, which requires 'integrating of knowledge'. Thus, learners need to find a relationship between prior knowledge to generate an integrative and coherence knowledge to reach meaningful learning [12]. There is no possibility to integrate new knowledge without any structure developed from prior knowledge to build on. Integrating of knowledge is supposed to be based on both verbal and non-verbal information. Selected information from verbal and visual channels needs to be organized. Constructivist learners need to develop their awareness and autonomy. This requires learners to feel responsible for their learning outcome. From an educational perspective, the term 'motivation' could apply to any process that activates and maintains learning behavior. Finally, 'reflection' refers to making a connection to existing knowledge with new information, in order to construct new understanding. This action allows the learner to integrate the content of study and develop new knowledge connections, and integration of prior knowledge. Reflections also include what the learner is feeling, and processing knowledge through the learning procedure.

In summary, constructivism is based upon the fundamental statement that our knowledge, impressions, and awareness cannot stay outside of our minds. Therefore, learning theory, or model of learning, explains understanding as the generating of mental structures, and the restructuring of prior mental structures to provide new experiences [8]. Overall, constructivism suggests that experience is not stored as a basket containing facts. It is organized in schemata which refer to a unit of organized information.

B. Attention-Deficit Hyperactivity Disorder

One of the prevalent neurobehavioral disorders during childhood is called attention-deficit/ hyperactivity disorder that influences many school-aged children worldwide [13]. In [14] ADHD defined as follow:

"Attention-deficit hyperactivity disorder (ADHD) is a neuropsychiatric syndrome affecting 3-16% of school children with world prevalence of 5.29%. It is characterized by inattention, hyperactivity, and/or impulsivity, occurring in at least two different settings, and often leads to academic, social and occupational dysfunction."

Investigation shows that ADHD children may unconsciously display abnormal behavior (e.g. movement, not listening, fidgeting in their seats, playing around, talking without permission, etc.). Impairments of inattentiveness, hyperactivity, and impulsiveness are core challenges associated with ADHD. However, the combination of such symptoms with other developmental impairments is significant. According to [15], almost 70% of ADHD children or adolescents are at risk of co-morbidity. Co-morbidity is a term that refers to two or more functional or behavioral disorders that occur simultaneously [16].

TABLE I.
ADHD CHALLENGES

| ADHD Challenges | Definition |
|--|--|
| Academic Impairments | ADHD characteristics lead to academic failure. This might be caused by inattention (lack of focus/attention) or deficient study skills [17] |
| Speech and Language/Verbal Processing | Children with ADHD have specific language and speech difficulties; they do not have serious or generalized language delays [18]. Having said that, language impairment is a highly prevalent comorbidity in children with psychiatric disorders and behavioral problems [13] |
| Motor Difficulties | Motor difficulties often co-occur with ADHD, referred to as Developmental Coordination Disorder (DCD) |
| Motivation | Children with ADHD often experience low motivation toward learning. In [19], motivation is defined as one of the significant psychological theories in education in order to have successful learning |
| Social Impairments | A child with ADHD might also engage with social impairments (e.g. peer relationships or rejection) [20] |
| Emotional Characteristics | The emotional characteristics of ADHD children are associated with self-regulation, depression, aggression, or anxiety, frustration, and poor self-esteem [21] |

Table I demonstrates other challenges that might be associated with AD/HD. The literature review has identified weaknesses which often make performance worse [22], including: academic impairment; intellectual development; speech and language impairment; motor difficulties; motivation; social impairment, and emotional characteristics. In general, the question is what makes AD/HD children different from typically developing learners? In other words, what specific impairments might play significant roles in an academic context?

III. RESEARCH METHOD

This paper employed literature analysis (desk elements). Because it is important that outcomes of the study are evidenced based, it was decided to focus on a gap existing in the literature, so for instance, desk research, which was based on an analysis of literature, depended on a solely rational approach distinct from any empirical input. This approach was suitable for analysis of current learning theories, and so was applied in the study analysis in constructivist learning theory and separately for ADHD perception. The study was interested in learning about teachers' thoughts on the reasons for constructivist-learning approach as a pedagogy model. Admittedly, the purpose here was to move towards a common understanding of constructivist approach and its principles within the ADHD context, but this was so as to achieve a workable to assist teachers and pedagogy designers in the workplace.

The author noted what was learnt from other scholars' thoughts, ideas and arguments on the subject, and explored the literature while producing a conceptual framework.

IV. FINDINGS

Although a number of studies have been conducted on ADHD and learning difficulties, investigations have been made into the relationship between ADHD's educational tools and the use of learning theory (e.g. Constructivist Learning Theory). Thus, this paper offers a new perspective on the development of support tools for learners with special education needs. The following section examines the associations indicated in Table II and presents an explanation of the impact of the relevant ADHD impairment on a particular constructivist principle requirement.

A. Active Learning

As considered earlier on the constructivism requirements, active learning as an important perception of constructivism requires learners to actively engage with a task. In order to construct new concepts, a learner with ADHD should refer back into his/her long-term memory to find out any connections between the new concept and the prior knowledge and pull these out to the short-term memory [23]. This requires a high level of focus and concentration by a learner on the task. Since learning is an active process, inattentiveness as a major symptom of ADHD might prevent a child from acting as an active learner in the learning process. A learner might pick the wrong concept from working memory, which is not matched with the new concept. Moreover, motivation is another critical factor within the process of active learning [24]. Low motivation among ADHD children could affect reflection and the ability to be active learners. ADHD learners have difficulties in focusing and attending to details, therefore active learning as an initial constructivist learning principle would be fail among such learner. As a result, the first requirements of constructivism would be rejected.

B. Knowledge Integration

One of the other requirements of constructivism is named 'integrating of knowledge'. In [25], working memory functions as a system for temporary space and management of important information for complicated cognitive tasks. Temporary space of information is facilitated by two subsystems, including a phonological loop for verbal information and a visuo-spatial sketchpad with respect to visual information. Both channels are managed by working memory, which is referred to as an attention-controlling system. Based upon the constructivism perspective, learners need integration of knowledge. Therefore, by means of dual-channel processing, information could process in two different channels of visual and verbal [26]. For instance, words process in the verbal channel and pictures process in the visual channel. Both verbal and pictorial information need to be integrated. Since ADHD learners have difficulties with the verbal processing, pictorial information could be more helpful. In this respect, their pictorial channel could function accurately compared to their verbal channel. A learner with ADHD is not capable of integrating verbal and pictorial knowledge simultaneously. This may cause a failure of a constructivist approach with the requirements of knowledge integration.

C. Strong Short-Term Memory

Short-term memory [27] is likewise other principle necessary to employ constructivism theory implementation. Learners should extract prior knowledge, ideas and previous experiences from their long-term memory and paste these into short-term memory in order to construct a new knowledge. The reason for this process is simply that a constructivist approach requires generating knowledge from experiences and prior ideas. Therefore, it should be an interaction between short-term memory and long-term memory. However, poor short-term memory of a learner with ADHD and his/her lack of focus show difficulties with regard to interaction. Thus, results illustrate that a constructivist approach could not be an appropriate teaching technique for teachers, as children need to have strong short-term memory with a high level of focus.

D. Motivation

Motivation has been identified as an essential parameter in the construction of knowledge. In [19], motivation is defined as one of the significant psychological theories in education. Motivation could be one of the most vital attributes that learners should have in order to demonstrate successful learning performance. While learners are within the process of learning (information processing), they need to use their existing knowledge, interests, goals, and beliefs to understand any new information. In order to have comprehensive learning, learners require effort and if effort were fundamental then motivation would be required. Therefore, constructivist theory claims motivation to be an essential condition and requirement for learning. The level of willingness to continue a task, and engagement in an activity, would be a difficult issue from the point of view of ADHD children. As a result, based on the issues above, constructivism would fail as a learning theory for ADHD children.

E. Reflection

Reflection final constructivist learning principle explains the integration of new knowledge and how individual minds construct knowledge in order to approach deeper theoretical understanding. Hence, reflection provides opportunities for learners to revise misconceptions and tackle deficient understanding.

V. DISCUSSION

Table II illustrates the relationships between constructivist principles as a learning theory for successes on one side, and academic difficulties experienced by ADHD learners on the other side. The intention is to establish to what extent ADHD learners are able to satisfy principles for constructivism to be viable. In this respect, the theoretical background of this research explores the complications that the author was attempting to solve. Findings indicate that ADHD difficulties might lead to academic underachievement. The first row shown on the table is labelled as a set of constructivist-learning principles. In contrast, the first column on the left is labelled as ADHD difficulties and strengths. More precisely, the table is divided into two categories of stable characteristics (referring to the element that substantively affects ADHD

learners and does not change in its effects), and unstable characteristics (referring to the element that can momentarily affect ADHD learners but subsequently has no effect). The distinction between stable and unstable characteristics is based on the context to which an affective quality is present or a cognitive state persists. It can be clearly seen from the table that there are sets of stable and unstable characteristics; therefore, the author evaluated whether the effects are consistently positive, negative, or changeable. In this respect, firstly stability and instability of individual characteristics have been assessed in order to confirm that the specific impairment or strength is always present. Secondly, whether the effects are also consistently positive, negative, or changeable has been examined. It is significant to note that children with ADHD are potentially incapable of meeting learning demands. However, it is misleading to consider simply the limitations and weaknesses of ADHD since it frequently happens that these children demonstrate several advantages [28].

Figure 1 clarifies the strengths of ADHD children at three different levels of ‘cognitive strengths’ (brain strengths), ‘internal effects’ and ‘observable strengths’. Cognitive strengths such as hyper-focus, hours of engagement, mental attention to a concept, rapid-fire mind, and hyper speech information processing among ADHD children may lead a child to engage in multitasking, being creative, and impulsive. The difference is that ADHD impairments may be beneficial or detrimental to achieving specific learning goals. It can be seen from Table II that, for instance, attention deficit as a stable and negative characteristic prevents learners from concentrating for extended periods of time. On the other hand, hyper-focus as a stable characteristic, and viewed as a positive characteristic of ADHD, provides an opportunity to enhance the rate of learning outcomes. In this respect, the constructivist-learning environment as a pedagogy could be designed to integrate the strengths of a child and capitalize on them. As a result, an appropriate pedagogical element that relies on learning must incorporate principles that can compensate for the consequences of every individual learning difficulty.

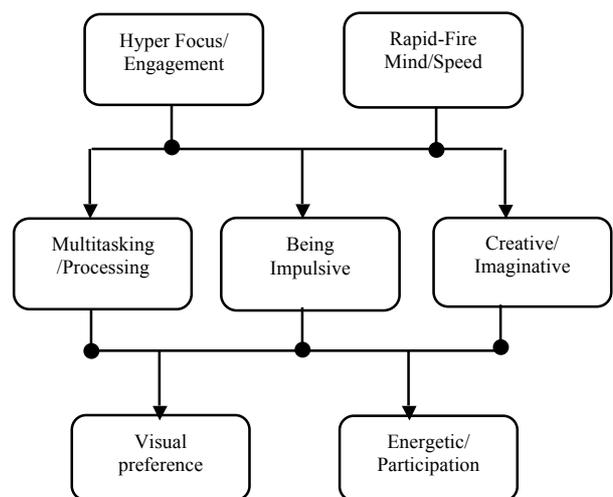


Figure 1. Positive Aspects of ADHD

TABLE II.
TENTATIVE MODEL OF THE LINK BETWEEN CONSTRUCTIVIST PRINCIPLES AND ADHD

| ADHD Difficulties and Strengths | | Constructivist Principles | | | | |
|---------------------------------|---|---------------------------|-----------------------|--------------------------|------------|------------|
| | | Active Learning | Knowledge Integration | Strong Short-Term Memory | Reflection | Motivation |
| Stable Characteristics | Attention Deficit (N) | ✗ | ✗ | | ✗ | ✗ |
| | Poor Short-Term Memory (P/N) | ✗ | ✗ | ✗ | ✗ | |
| | Difficulty in Information Processing (P/N) | ✗ | ✗ | ✗ | ✗ | ✗ |
| | Difficulty in Following Instructions (N) | ✗ | ✗ | ✗ | ✗ | ✗ |
| | Difficulty in Reflecting to the Knowledge (N) | ✗ | ✗ | ✗ | ✗ | ✗ |
| | Poor Knowledge Integration (N) | ✗ | ✗ | ✗ | ✗ | ✗ |
| | Poor Language/Speech (N) | ✗ | ✗ | | | |
| Unstable Characteristics | Hyper-Focus (P/N) | ✓ | ✓ | ✓ | ✓ | |
| | Rapid-Fire Mind (P/N) | ✓ | ✓ | ✓ | ✓ | |
| | Impulsivity (P/N) | | | | | |
| | Hyperactivity (P/N) | ✓ | | | | |
| | Motivation (P) | ✓ | | | | ✓ |

✓ Represents strengths of AD/HD; ✗ Represents ADHD impairments; P Represents positive aspects; N Represents negative effects

VI. CONCLUSION

This paper aimed to bridge a gap that exists between the individual special needs learner, particularly ADHD and constructivist approach as a pedagogical model to support special education teachers and pedagogy designers in developing lesson plans. The study provides a comprehensive and rich exploration of the impairments and strengths of ADHD learners in an academic context. The study also offers a lens onto an interesting area of ADHD, which requires theoretical consideration to accumulate an inclusive knowledge in the pedagogical literature. Having successful educational strategies is essential for schools to enhance the academic performance of both typically developing learners and those with special needs. Research into teaching strategies pays more attention to the significance of instructional practices as fundamental to learners' academic success. Accordingly, the author's investigation of constructivist learning illustrates that the pedagogical strategies require an understanding of different aspects of the teaching process. Designing a constructivist learning environment for ADHD learners requires understanding of a set of principles which need to be carefully reflected by ADHD impairments and strengths. In this respect, the study proposed a tentative model of the link between constructivist-learning criteria and ADHD symptoms. As a result, a constructivist learning approach would anticipate that the learners would reflect on the new concept and develop their own comprehension before into transfer their personally constructed long-term memory.

From the instructor's perspective, the learner would require different interventions from them to support the learning process as governed by the determining constructivist approach to learning theory.

Findings based on literature analysis identified the central principles of constructivism as a model of learning. By relating the constructivist principles to the strengths and impairments of specific ADHD learners, designing appropriate pedagogy is even more sensitive to the particular needs [29]. Most identified principles may make inappropriate demands on learners with ADHD. This illustrates difficulties for ADHD learners to fulfil particular requirements. Consequently, when a particular requirement cannot be satisfied, there is potential for the constructivist approach to fail. In this respect, it is necessary to adopt suitable pedagogy interventions compatible with ADHD impairments and strengths. This study shows that prior research was not clearly investigated as an appropriate pedagogical model for ADHD learners in order to provide support and help them with their academic difficulties. This inadequate investigation in the area of special needs proves that several substantial factors were missed. Current research recommends future study to design an appropriate pedagogy model to help AD/HD learners with their learning and approach to better results in academic performance. Therefore, a pedagogy scheme will be considered as being a product that develops from decisions taken about a set of significant dimensions of learning which has not been discussed as a complete package of the lesson plan.

REFERENCES

- [1] J. R. Anderson, "ACT: A simple theory of complex cognition," *American Psychologist*, vol. 51, no. 4, pp. 355-365, 1996. <http://dx.doi.org/10.1037/0003-066X.51.4.355>
- [2] I. Garcia and C. L. Pacheco, "Constructivism in Mexican elementary school education: Designing a platform for cooperative learning," *Journal of software*, vol. 5, pp. 565-572, 2010. <http://dx.doi.org/10.4304/jsw.5.6.565-572>
- [3] R. S. Sheih, "The impact of technology-enhanced active learning (TEAL) implementation on student learning and teachers' teaching in a high school context," *Computers & Education*, vol. 59, no. 2, pp. 206-214, 2012. <http://dx.doi.org/10.1016/j.compedu.2012.01.016>
- [4] P. D. Eggen, and D. P. Kauchak, "Teaching and learning: research-based methods," (Fourth edition). Allyn and Bacon, 2003.
- [5] R. A. Young, and A. Collin, "Introduction: Constructivism and social constructionism in the career field," *Journal of Vocational Behavior*, vol. 64, no. 3, pp. 373-388, 2004. <http://dx.doi.org/10.1016/j.jvb.2003.12.005>
- [6] P. Cobb, E. Yackel, and T. Wood, "A constructivist alternative to the representational view of mind in mathematics education," *Journal for research in mathematics education*, vol. 23, no.1, pp. 2-33, 1992. <http://dx.doi.org/10.2307/749161>
- [7] J. Piaget, "Commentary on Vygotsky's criticisms of language and thought of the child and judgment and reasoning in the child," *New ideas in Psychology*, vol. 13, no. 3, pp. 325-240, 1995. [http://dx.doi.org/10.1016/0732-118X\(95\)00010-E](http://dx.doi.org/10.1016/0732-118X(95)00010-E)
- [8] S. Papert, *Mindstorms: Children, computers, and powerful ideas*. New York: Basic Books, 1980.
- [9] L. S Vygotsky, *Mind in society: The development of higher psychological processes*, Cambridge, MA: Harvard University Press, 1978.
- [10] W. Zhenlin, To teach or not to teach: Controversy surrounding constructivism in early childhood education, *Journal of Early Childhood*, vol. 8, no. 1, pp. 56-65, 2009.
- [11] A. S. C. Thorn, S. E. Gathercole, and C. Feankish, "Redintegration and benefits of long-term knowledge in verbal short-term memory: An evaluation of Schweickert's (1993) multinomial processing tree model," *Cognitive psychology*, vol. 50, no. 2, pp. 133-158, 2005. <http://dx.doi.org/10.1016/j.cogpsych.2004.07.001>
- [12] Y. Woo, and T. C. Reeves, "Meaningful interaction in web-based learning: A social constructivist interpretation," *The Internet and higher education*, vol. 10, no. 1, pp. 15-25, 2007. <http://dx.doi.org/10.1016/j.iheduc.2006.10.005>
- [13] S. Jonsdottir, A. Bouma, J. A. Sergeant, and E. J. A. Scherder, "The impact of specific language impairment on working memory in children with ADHD combined subtype," *Archives of Clinical Neuropsychology*, vol. 20, no. 4, pp. 443-456, 2005. <http://dx.doi.org/10.1016/j.acn.2004.10.004>
- [14] K. Sedky, D. S. Bennett, and K. S. Carvalho, "Attention deficit hyperactivity disorder and sleep disordered breathing in pediatric populations: A meta-analysis," *Sleep Medicine Reviews*, vol. 18, pp. 349-356, 2014. <http://dx.doi.org/10.1016/j.smrv.2013.12.003>
- [15] C. R. Garcia, C. H. D. Bau, K. L. Silva, S. M. Callegari-Jacques, C. A. I. Salgado, A. G. Fischer, M.M., Victor, N.O. Sousa, R. G. Karam, L. A. Rohde, P. Belmonte-de-Abreu, and E. H. Grevet, "The burdened life of adults with ADHD: impairment beyond comorbidity," *European psychiatry*, vol. 27, no. 5, pp. 309-313, 2012. <http://dx.doi.org/10.1016/j.eurpsy.2010.08.002>
- [16] R. Donfrancesco, S. Miano, F. Martines, L. Ferrante, M. G. Melegari, and G. Masi, "Bipolar disorder co-morbidity in children with attention deficit hyperactivity disorder," *Psychiatry research*, vol. 186, no. 2-3, pp. 333-337, 2011. <http://dx.doi.org/10.1016/j.psychres.2010.07.008>
- [17] G. DuPaul and, G. Stoner, "ADHD in the schools: Assessment and intervention strategies," New York: The Guilford Press, 1994.
- [18] R. Barkley, Associated cognitive, developmental, and health problems. In: R. Barkley (Ed.) *Attention deficit hyperactivity disorder: A handbook for diagnosis and treatment*, New York: Guilford Press, 2006b.
- [19] D. U. Supanakorn, S, and Ch. Boggs, "Impact of podcasting on student motivation in the online learning environment," *Computers & Education*, vol. 55, no. 2, pp. 714-722, 2010. <http://dx.doi.org/10.1016/j.compedu.2010.03.004>
- [20] J. Uekermann, M. Kraemer, M. Abdel-Hamid, B.G. Schimmelmann, J., I. Hebebrand, Duam, J. Witfand, and B. Kis, "Social cognition in attention-deficit hyperactivity disorder (ADHD)," *Neuroscience and Biobehavioral Review*, vol. 34, no. 5, pp. 734-743, 2010. <http://dx.doi.org/10.1016/j.neubiorev.2009.10.009>
- [21] P. M. Wehmeier, A. Schacht, and R. A. Barkley, "Social and emotional impairment in children and adolescents with ADHD and the impact on quality of life," *Journal of Adolescent health*, vol. 46, no. 3, pp. 209-217, 2010. <http://dx.doi.org/10.1016/j.jadohealth.2009.09.009>
- [22] E. L. Wodka, Ch. Loftis, S. H. Mostofsky, C. Prahme, J. C. G. Larson,, M. B. Denckla, and, E. M. Mahone, "Prediction of ADHD in boys and girls using the D-KEFS," *Archives of clinical neuropsychology*, vol. 23, no 3, pp. 283-293, 2008. <http://dx.doi.org/10.1016/j.acn.2007.12.004>
- [23] U. Brook, and M. Boaz, "Attention deficit and hyperactivity disorder/learning disabilities (ADHD/LD): parental characterization and perception," *Patient Education and counseling*, vol. 57, no. 1, pp. 96-100, 2005. <http://dx.doi.org/10.1016/j.pec.2004.03.018>
- [24] J. I. Rotgans, and H. G. Schmidt, "Situational interest and academic achievement in the active-learning classroom," *Learning and Instruction*, vol. 21, no. 1, pp. 58-67, 2011. <http://dx.doi.org/10.1016/j.learninstruc.2009.11.001>
- [25] A. D. Baddeley, and G. J. Hitch, "Working memory". In Bower, G. (Ed.), *the Psychology of Learning and Motivation*, Academic Press, New York, vol. 8, pp. 47-90, 1974. [http://dx.doi.org/10.1016/s0079-7421\(08\)60452-1](http://dx.doi.org/10.1016/s0079-7421(08)60452-1)
- [26] A. Paivio, Dual coding theory: retrospect and current status, *Canadian Journal of Psychology/Revue Canadienne de psychologies*, vol. 45, no. 3, pp. 255-287, 1991.
- [27] A. D. Baddeley, *Working Memory*, Oxford University Press, Oxford, 1986.
- [28] P. Tymms, and C. Merrell, "ADHD and academic attainment: Is there an advantage in impulsivity," *Learning and individual differences*, vol. 21, no. 6, pp. 753-758, 2011. <http://dx.doi.org/10.1016/j.lindif.2011.07.014>
- [29] S.S.Sajadi, and T. Khan, "Development of a pedagogy framework in social-networked based learning: Support for special educational needs," ICELW: The International Conference on E-learning in the workplace, New York, USA, 2012.

BIOGRAPHY

Samira Sajadi has received her PhD degree in Educational Management from Brunel University London on 2013, and M.Sc. degree in System Management and Productivity from Iran University of Science and Technology in 2008. Currently she is with the College of Business, Arts, and Social Sciences, Brunel University London, UK.

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