Art. # 1419, 11 pages, https://doi.org/10.15700/saje.v37n3a1419

Comparing the achievement goal orientation of mathematics learners with and without attention-deficit hyperactivity disorder

Erica Dorethea Spangenberg
Department of Science and Technology Education, Faculty of Education, University of Johannesburg, Auckland Park, South Africa
ericas@uj.ac.za

Many learners with different learning challenges are accommodated in the same classroom in South Africa, which could result in poor performance in mathematics. By reinforcing or disregarding certain goals, a teacher can influence the way in which learners learn mathematics. This study compared the achievement goal orientation of Grade Nine mathematics learners in a conventional classroom. The two groups studied were learners experiencing attention-deficit hyperactivity disorder (ADHD) and learners without ADHD. A quantitative, exploratory research design was used. Twenty Grade Nine learners, of whom 10 experienced ADHD, were purposefully selected from one school in Ekurhuleni-East, South Africa. Data was collected with an existing questionnaire. The results revealed that while learners without ADHD compare themselves against their peers' behavioural and cognitive engagement, as well as the level of their mastery goal orientation, learners with ADHD rely more on their personal performance-avoidance goal orientation and the goal orientation of their parents. Differences between the achievement goal orientation of mathematics learners with or without ADHD could assist teachers in recognising methods to direct learners' goals for better engagement with and improved results in mathematics, which could support learners to develop to their full potential in the subject.

Keywords: achievement goal orientation; attention-deficit hyperactivity disorder (ADHD); learners; mastery; mathematics; performance

Introduction

Attention-deficit hyperactivity disorder (ADHD) is common worldwide, though not recognised as a behavioural challenge by many countries, for its difficulty to diagnose and unpleasant effect on learners, teachers, parents and communities as a whole (Faraone, Sergeant, Gillberg & Biederman, 2003). South Africa as a developing country with a prominent emerging economy can, however, generate effective solutions for current global behavioural challenges, such as ADHD. According to the United Nations Children's Fund (UNICEF, 2006), South Africa's economy has grown significantly – by approximately 4.5% since the beginning of the new formal democracy in 1994 – and equal education for all has been immensely expanded. The South African Constitution, grounded on an acute cognisance of previous injustices, is globally acknowledged as highly reformist (UNICEF, 2006). Nevertheless, despite the country's economic growth, South African government schools struggle with poor quality of education, under-qualified teachers and deprived systems for inclusive education, especially for learners with learning challenges.

Mathematics performance at school level in South Africa is poor, which could be a result of learners with different learning challenges being accommodated in the same classroom. Conventional classrooms in South Africa are characterised by being inclusive, catering for a range of learning challenges (Department of Education (DoE), 2001), such as learners with ADHD. These classrooms are mostly overcrowded, regarded as being competitive, and often academically benefit only learners who can work independently, take responsibility for their own progress and set clear achievement goals.

For this paper ADHD will be described as a 'condition' where learners display characteristics of hyperactivity, inattention and disorganisation as identified by teachers, grounded on the criteria for ADHD indicated by the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) of 2013, rather than therapeutically diagnosed by a paediatrician or neurologist, or other specialist (American Psychiatric Association, 2013).

Goals affect how learners approach mathematics learning activities, which could influence their attitudes towards mathematics, and consequently determine their achievement in the subject. According to Ames (1990) goal orientation is one of the fundamental determinants influencing the achievement patterns of learners. Martin (2012:91) concurs that "goals play a significant role in students' academic development" and found that learners with ADHD who are committed to their studies and display goal-directed behaviour, achieve positive academic outcomes.

Several decades of research (DeShazo Barry, Lyman & Klinger, 2002; Greenop & Kahn, 2007; Lamminmäki, Ahonen, Närhi, Lyytinen & Todd de Barra, 1995; Martin, 2012; Zentall, 1990; Zentall, Smith, Lee & Wieczorek, 1994) have been dedicated to the impact of ADHD on school performance. However, most research on academic success and ADHD has focused on reading challenges in children with ADHD rather than achievement goal orientations of mathematics learners. Furthermore, many studies on ADHD compare achievement levels of mathematics learners with or without ADHD (Martin, 2012), without taking cognisance of these learners' goal orientations toward mathematics.

Although there have been investigations into the types of goals learners assume in the classroom and the contextual factors that play a role in learners' choices of goals and learning activities (Vedder-Weiss & Fortus, 2011), none of these have been devoted to comparing the goal orientation of mathematics learners experiencing ADHD with learners without ADHD within a conventional classroom.

This study contributes to research on goal orientations and ADHD in terms of mastery and performance goals of learners with and without ADHD. These differences between the achievement goal orientation of mathematics learners with and without ADHD can make teachers conscious of methods to enhance learners' achievement goal orientation within a conventional classroom, which could increase classroom engagement, improve Mathematics performance, and assist learners in developing their full potential despite their different learning challenges. The research question arising is: how does the achievement goal orientation of mathematics learners with ADHD compare with those without ADHD pertaining to performance goal orientation and mastery goal orientation?

In the following sections, achievement goal orientation and its environmental features will be discussed, ADHD will be defined, and studies on mathematics learners with and without ADHD will be reviewed, by means of a literature inquiry. Thereafter, the research methodology utilising an exploratory, quantitative research approach will be outlined, followed by a discussion on the findings from the data analysis process.

Achievement Goal Orientation and Its Environmental Features

This study is guided by achievement goal theory (Ames, 1990) with specific reference to one of its key constructs, namely goal orientation. Goal orientation is concerned with the milieu of academic behaviour and learners' ways of and reasons for engaging in academic activities (Vedder-Weiss & Fortus, 2011).

Achievement goal orientation is based on a modern "goal-as-motives" theory suggesting "all actions are given meaning, direction and purpose by the goals that individuals seek out, and that the quality and intensity of behavior will change as these goals change" (Covington, 2000:174). Specifically, goal orientation refers to "a person's set of beliefs that reflect the reasons why they approach and engage in academic and learning tasks" (McGrew, 2008:1). According to Vedder-Weiss and Fortus (2011:200), the adoption of different goal orientations leads to differences in the way learners engage with schoolwork and their consequent emotional experiences at school. By reinforcing particular goals and disregarding others, a teacher can influence learners' motivation to learn and change the way in which they learn (Covington, 2000; McGrew, 2008), which could lead to better performance in mathematics.

In relation to goal orientation, there is a difference between performance goal orientation and mastery goal orientation. Whereas performance goal-orientated persons are primarily concerned with their personal abilities within society, in comparison to others, mastery goal-orientated people focus on the understanding and completion of tasks, learning and mastering of new skills and problem-solving (McGrew, 2008). Learners with ADHD often underachieve in mathematics due to short attention spans, which could lead to the perception that they have less ability in the subject than learners without ADHD. According to Martin (2012:49) "low achievement and poor behavioural engagement including poor self-regulation and difficulty completing tasks such as homework and assignments" are usual characteristics of learners with ADHD. These features could steer towards an emphasis on understanding mathematics, thus having a mastery goal orientation, rather than striving for results in mathematics with a performance goal orientation. However, performance goal orientation is not superior to the mastery goal orientation pertaining to performance in Mathematics. These different goal orientations only reveal why learners interact with mathematics in a specific way.

According to Vedder-Weiss and Fortus (2011:200) mastery goal orientation is associated with a wide range of "adaptive cognitive, emotional, and behavioural outcomes, such as self-efficacy, effort and persistence, preferences for challenges, interest and continuing motivation, self-regulated learning, learning for understanding strategies, retention of information learned, depth of information processing, and transfer of problem-solving strategies." Performance goal orientation entails the tenacity to represent ability. Within this goal orientation, a distinction is made between performance-approach and performance-avoidance goals. The first construct focuses on accomplishing approving judgments of ability, while the second construct converges on avoiding unpleasant judgments of proficiency, which could lead to either low goal setting or else disengagement with the task if there is a possibility of failure.

Achievement goal theory is also concerned with environmental features that may direct learners' different orientations, such as classroom engagement and perceptions of peers' and parents' goals (Kim, Schallert & Kim, 2010; Shih, 2005; Vedder-Weiss & Fortus, 2011). Gonida, Kiosseoglou and Voulala (2007) claim shared support from parents and peers influence academic motivation, while Friedel, Cortina, Turner and Migley (2010:111) argue the achievement goals advocated in the classroom and home environment

could either encourage or weaken learners' efficacy beliefs.

Classroom Engagement and Goal Orientation

Vedder-Weiss and Fortus (2011) claim that a decline in motivation and attitude toward learning are common across different subjects, and are often linked to changes in classroom environment. Patrick, Ryan and Kaplan (2007:93) also emphasise the important role classroom social environment plays in terms of learner engagement. Learners are more willing to interact with mathematics activities if they feel their teachers assist them emotionally, and motivate them to communicate their experiences with the content, while their peers support them academically. Topkin, Roman and Mwaba (2015:1) concur that teachers play an important role in establishing a classroom atmosphere, which enhances academic, social and emotional attainment of learners with ADHD.

Classroom environments appreciate diligence that can lead to attainment in mathematics and may support learners to adopt a mastery goal orientation (Shih, 2005). Such an engaging environment enhances learners' understanding of the subject and sense of efficacy. Walker and Greene (2009:466) add that learners experiencing "a sense of belonging in the classroom are more likely to focus on the development of understanding and then use cognitive effort to make that understanding possible." If learners feel they are appreciated and assisted by both their teachers and peers, and that their inputs are contributing to their future, they are more motivated to engage in the classroom. Patrick et al. (2007) found a significant correlation between classroom interaction and learners' mathematics achievement. Furthermore, they established that learners' perceptions of their classroom social environment and teacher-learner relationships were intertwined with their motivation and engagement. Learners with a mastery goal orientation perceive challenges in solving problems as an anticipated means to enhance proficiency in mathematics and do not allow learning challenges, such as these associated with ADHD, to inhibit their ability to grow (Shih, 2005). Furthermore, learners adopt a mastery goal orientation in a classroom that promotes self-assessment, and allows them to set their own targets, as well as to take responsibility for their own development, without fearing failure (Self-Brown & Mathews, 2003). Such an environment

> has the potential to enhance the quality of learners' involvement in learning, increases the likelihood that [learners] will opt for and persevere in learning and challenging activities, and increases the confidence they have in themselves as learners (Self-Brown & Mathews, 2003:110).

Competitive classrooms characterised by normative assessments may promote a performance goal orientation. Learners with a performance goal orientation compare themselves socially with their peers. Although learners' challenges for acceptance in this environment might be rewarded through high performance in mathematics, Gonida et al. (2007:32) found achievement to be overvalued in the classroom. Learners in an environment where performance is rewarded may prefer easier mathematics tasks, strive to satisfy the teacher and get good results, and depend on their peers to appraise their work, which could lead to the avoidance of setting goals that involve learning and determination (Self-Brown & Mathews, 2003). Kim et al. (2010) examined learners' classroom goal structures and found that learners' performance goal-avoidance approaches strongly predict their mathematics performance. These learners "seemed motivated to outperform others in their class not when they perceived their class as encouraging their competition but when they understood their environment as a place where they had to avoid showing incompetence" (Kim et al., 2010:433). Walker and Greene (2009) also reveal performance-approach goals not to be predictive of cognitive engagement.

A mathematics classroom should, thus, strive to combine both mastery and performance goal orientations, as these may relate to different educational products. Linnenbrink (2005) argues while an environment characterised by a mastery goal orientation might enhance emotional wellness, motivation and cognitive engagement, a performance goal orientation classroom competition could enhance a sense of group solidity and cooperation, which could promote learning and subsequently lead to better results.

Influences of Peer Groups on Goal Orientation

Mathematics teachers are encouraged to utilise a variety of authentic activities, allow learners to explore new avenues of learning and acknowledge learners' progression, but also advocate competitive group work, which promote group cohesion (Patrick et al., 2007). According to Patrick et al. (2007) classrooms where teachers promote interaction among learners, are characterised by greater learner engagement and peer support and are associated with learners' orientation toward learning and understanding in the classroom. Hancock (2004) found that learners who have a high peer orientation are significantly more motivated to learn when they are exposed to cooperative learning strategies than learners with a low peer orientation.

Influences of Parental Goals

Kim et al. (2010) disclose parental influences to be less strongly associated with learners' motivation and own goal orientations compared to learners' perceptions of their classroom as a motivating environment. In contrast, Gonida et al. (2007)

reveal only perceived parent mastery goal orientation to directly influence learners' emotional and behavioural engagement in the classroom, while parents' performance-avoidance goals are significant negative predictors of classroom engagement and parents' performance-approach goals are not predicting learner engagement. When learners recognise that their parents appreciate the enhancement of learning and skills, they tend to be more actively engaged in the mathematics classroom and enjoy mathematics more. Luo, Aye, Hogan, Kaur and Chan (2013:274) concur that parents' interests in their children's learning are related to the learners' mastery goal orientation, such as "self-regulated engagement in learning activities, low anxiety, high perceived competence, and high achievement", while parental control are associated with performance avoidance goals, for example low tenacity, high anxiety and low attainment. Furthermore, parents pressurising their children to meet their expectations and setting normative benchmarks might motivate learners rather to outperform their peers than being regarded as mediocre, which might enhance learners' avoidance goals. Nevertheless, parents are urged to focus more on helping their children in their learning activities as Luo et al. (2013:283) established "parental strictness or supervision to be positively related to mastery goals and academic performance […] and negatively related to external behavioural problems."

Mathematics of Learners with or without ADHD

Learners with ADHD, in comparison with learners without ADHD, have difficulty with cognitive skills or executive functions (EF) (Barkley, 2009), which could according to Martin (2012:94) be linked to, amongst others, learners' "self-regulation of affect, motivation and arousal (self-control, perspective taking, goal-directed action)." Although many learners with ADHD may have some characteristics of ADHD, such as hyperactivity, inattention and disorganisation, they do not have brain damage, but rather a 'condition', which can be supported (Erk, 1995).

Poor performance in Mathematics and achievement goal orientation can be accredited to various subtypes of ADHD found typically as behavioural characteristics: distractibility, hyperactivity, and impulsivity. Lamminmäki et al. (1995) found that poor achievement goal orientations in calculations and problem solving in mathematics may be associated with two major characteristics of ADHD, namely hyperactivity and distractibility. According to Zentall (1990) intelligence quotient (IQ) and reading comprehension skills showed no indications concerning the mathematical skills of learners with ADHD. Lamminmäki et al. (1995) concur that learners with ADHD are no more impaired in mathematics than those without ADHD, although Zentall et al. (1994) discovered that boys with ADHD showed lower problem-solving ability than girls with ADHD.

Zentall et al. (1994) believed when a learner with ADHD is distracted, the learner is attempting to lessen his or her under-stimulated mind by seeking tasks or reactions increasing the levels of stimulation. Thus, by using external stimulating factors during a boring but routine task, the learners with ADHD will perform better. Although it has been shown that mathematics learners with ADHD are slower and less accurate when conducting calculations than learners without ADHD (Lamminmäki et al., 1995), Greenop and Kahn (2007) found that both learners with and without ADHD executed mathematics problems more accurately under extra-task stimulation, such as music playing.

Martin (2012) found a significant correlation between personal best (PB) goals, which are targets set by learners themselves, and academic outcomes for learners with and without ADHD. Both groups indicated parents' engagement, openness and conscientiousness to be important. Only learners without ADHD claim gender, age, socio-economic status, persistence and disengagement to play a role in setting personal goals. Learners with ADHD scored lower on behavioural engagement, such as goal-directed behaviour and commitment, and outcome measures, than learners without ADHD. DeShazo Barry et al. (2002) focused on the negative consequences ADHD has on an individual's academic achievements due to behaviour, and argued:

> children with ADHD experience shortfalls in some of the abilities establishing the executive functions such as planning, organizing, [*sic*] maintaining an appropriate problem-solving set to achieve a future goal, inhibiting an inappropriate response or deferring a response to a more appropriate time representing a task mentally (i.e. in working memory), cognitive flexibility and deduction based on limited information (p. 274).

DuPaul, Volpe, Jitendra, Lutz, Lorah and Gruber (2004) also examined different factors, including behavioural observations determining academic achievement in learners with ADHD. In particular, the strongest factor for academic achievement found was teachers' perceptions of academic skills of the learners with ADHD.

In conclusion, teachers and parents have the responsibility to create an engaging and motivating environment for both leaners with ADHD and learners without ADHD. Constructs such as learners' perceptions of their personal and peers' goal orientation, the classroom environment and school culture, their cognitive and behaviour engagements, including self-efficiency, in the classroom, their engagement in extra-curricular activities and parental and teachers' influences or emphases in terms of performance goal orientation and mastery goal orientation (Vedder-Weiss & Fortus, 2011),

are all indicators of learners' performance in mathematics, whether they experience ADHD or not.

Method

A social-cognitive paradigm, which is concerned with how learners gain knowledge within the context of social interactions (Bandura, 2001) and distinguishes between acquisition and performance (Wood & Bandura, 1989), was tailored by adopting a quantitative, exploratory research method of a descriptive nature to establish differences between the achievement goal orientations of learners with ADHD and learners without ADHD.

Sample

A purposeful convenient sampling technique (Creswell, 2003) was used to select Grade Nine mathematics learners experiencing ADHD and those not experiencing ADHD. Due to the sensitivity of this study, only one secondary school in the Ekurhuleni-East District in South Africa granted permission for conducting the study at their premises, of which only one Grade Nine mathematics teacher volunteered for data to be collected from learners in her classroom. The school is a mainstream school with conventional classrooms, consisting of learners with and without ADHD. The area was chosen for easy access to the school, and the participants were invited to participate through postings in the school's weekly newsletter and private discussions with the school counsellor and parents of learners with ADHD. From a population of 270 Grade Nine learners in the school, 10 learners without ADHD and 10 learners with ADHD from one class agreed to participate. All the learners in the study were proficient in reading, speaking and writing in English, which were important skills to understand and complete the survey. Participants in the sample of learners with ADHD were required to have a diagnosis of ADHD from a physician or psychologist, but no diagnosis of a neurological challenge or genetic syndrome, for example pervasive developmental challenges, psychotic challenges or Tourette's disorder. Also, the learners without ADHD were required not to have any previous diagnosis of ADHD or any learning or behavioural challenges identified by parents. Seven of the learners with ADHD had been taking psycho-stimulant medication for their characteristics of ADHD, for example Ritalin or Concerta. Many learners without ADHD use ADHD stimulants illegally during assessment periods to reduce academic stress and exhaustion and to increase attention and memory (Rabiner, Anastopoulos, Costello, Hoyle, McCabe & Swartzwelder, 2009). Because data were gathered during the school's examination period, they had been asked to be medication-free. A risk, however, was that learners with ADHD might also not have used their prescribed medicine, which could have influenced the results of the study. Eight learners with ADHD were receiving some form of special education service, including support from an educational tutor. The sample size for this study was very small due to its sensitive nature. Many parents did not want to expose their children, who had ADHD to such a study, concerned that they may be labelled as abnormal. Furthermore, this study was exploratory, constituting an enquiry into whether this topic would be viable for larger studies of the same nature in future. Thus, the intention is not to generalise the results of this study to other contexts.

Data Collection: Questionnaire

Data was collected through a survey based on an existing questionnaire (Appendix A) amended by Vedder-Weiss and Fortus (2011) used for a similar study in Israel comparing goal orientations of Grades Five to Eight learners in science learning. The questionnaire of Vedder-Weiss and Fortus (2011) was based on the standardised Patterns of Adaptive Learning Scales (PALS) (Midgley, Maehr, Hruda, Anderman, Anderman, Freeman, Gheen, Kaplan, Kumar, Middleton, Nelson, Roeser & Urdan, 2000). Vedder-Weiss and Fortus (2011) reaffirmed its validity and reliability with the Cronbach α coefficient for each construct, which ranged between 0.62 and 0.82. Permission was obtained to utilise and adapt the questionnaire for mathematics. The questionnaire consisted of 89 mixed-survey items with a 1–5 point Likert scale (1 = Not true at all and 5 = Very true) relating to 17 key constructs. The questionnaires were completed in test conditions, and took approximately one hour.

Data Analyses

The Statistical Package for the Social Sciences, edition 23 (SPSS 23) was used to conduct the quantitative data analyses. The results for each question in the questionnaire were averaged, and calculations were done to categorise these into the 17 key constructs. The Mann-Whitney *U*-Test, as an appropriate non-parametric statistical technique, was undertaken to examine differences between the medians of the responses of learners without ADHD and learners with ADHD on the 17 key constructs, respectively.

Reliability and Validity

To address reliability, the internal consistency of each of the 17 key constructs was determined by using the Cronbach α coefficient and the constructs identified by Vedder-Weiss and Fortus (2011).

Theoretical validity was ensured by providing a thorough literature review focusing on the core constructs of the paper, namely achievement goal orientation and ADHD. To ensure measurement

validity, Vedder-Weiss and Fortus (2011) granted permission for the amendment and usage of their questionnaire on goal orientations in science learning, and its intellectual property rights are acknowledged. The questionnaire had already complied with all validity aspects. To ensure face and content validity, the questionnaire was shown to colleagues for comment and input, to ensure the constructs were clearly conceptualised. The questionnaire was also piloted with two individuals, one with and one without ADHD, who were not participating in the research study. Consequently, the questionnaires were amended with regard to timeframes, terminology, readability and clarity. The purpose was to ensure coherency and consistency of the questions. The questionnaires were administered under examination conditions.

To ensure inferential validity, the discriminant validity of the data was assessed by exploratory factor analysis. Principal Components Analysis (PCA) was used for factor extraction.

Ethical Measures

The ethical committee of the Faculty of Education of the university granted approval for the study, and permission was obtained from the district and the participating school to conduct the research. Ethical measures, namely anonymity of participants, voluntary participation, written consent and withdrawal from the study without any penalty, were considered. All information was treated confidentially and data were stored safely.

Results

The results are presented in terms of descriptive statistics determining the internal reliability of the 17 key constructs of achievement goal orientation followed by PCA extract determining the discriminant validity of the key construct. Inferential statistics follow including test statistics of the cross variables, namely learners without ADHD and learners with ADHD, and the key constructs according to the Mann-Whitney *U*-Test.

For internal consistency, a Cronbach α coefficient score of 0.7 and higher was assumed to be reliable. Table 1 indicates the internal reliability of the 17 key constructs.

Table 1 Internal reliability of the key constructs

Construct	No. of items	Cronbach α
Learners' perception of teacher's mastery goals emphasis	8	0.683
Learners' perception of teacher's performance-approach goals emphasis	4	0.746
Learners' perception of teacher's performance-avoid goals emphasis	4	0.701
Learners' perception of school's mastery goals emphasis	5	0.694
Learners' perception of school's performance goals emphasis	5	0.722
Learners' personal mastery goal orientation	7	0.715
Learners' personal performance-approach goal orientation	5	0.675
Learners' personal performance-avoid goal orientation	5	0.677
Learners' self-efficacy	5	0.716
Learners' perception of peers' mastery goal orientation	4	0.709
Learners' perception of peers' performance-approach goal orientation	4	0.693
Learners' perception of peers' performance-avoid goal orientation	4	0.678
Learners' perception of parents' mastery emphasis	5	0.717
Learners' perception of parents' performance emphasis	4	0.727
Behavioural and cognitive engagement	5	0.716
Active extra-curricular engagement	7	0.763
Active extra-curricular rejection	6	0.761

The discriminant validity of the 17 key constructs was assessed by PCA with orthogonal rotation (varimax). Constructs with a factor loading less than 0.4 and loading simultaneously on two constructs were removed. Any construct seeming to be ill-aligned with the factors was deleted, and eight constructs remained. Table 2 represents the rotated component matrix, with the eight constructs with item loadings of 0.4 and above with respect to five factors affecting achievement goal orientation in mathematics.

A Mann-Whitney *U*-Test was executed to determine whether there were significant differences between the two groups and the 17 key constructs. Table 3 presents data on the calculated *z*-values and the approximately calculated statistical significance of differences between the crossed variables. A correlation at the 0.05 level was assumed as significant.

As there were statistical significant differences between crossed variables, there was a need to analyse the data, indicating which continuous variable was higher on average as shown in Table 4.

Table 2 Item loadings with respect to five factors affecting achievement goal orientation in mathematics

	Factors				
Key construct	1	2	3	4	5
Learners' perception of teacher's mastery goals emphasis				.589	
Learners' perception of teacher's performance approach goals emphasis	-.816				
Learners' perception of school's mastery goals emphasis				.727	
Learners' personal performance avoid goal orientation		.853			
Learners' perception of peers' performance approach goal orientation		.858			
Learners' perception of parents' mastery emphasis			.800		
Behavioural and cognitive engagement	.107	-.244	.850	.230	.109
Active extra-curricular engagement	.814				

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalisation.
a. Rotation converged in seven iterations.
b. Kaiser-Meyer-Olikin Measure of Sampling Adequacy = 0.302
c. Barlett's Test of Sphericity *p*-value = 0.000

Table 3 Test statistics of learners without ADHD and learners with ADHD and the key constructs

Constructs	*U*	Wilcoxon W	*z*	Asymp. Sig. (2-tailed)	Exact Sig. (2-tailed)	Exact Sig. (1- tailed)
Learners' perception of teacher's mastery goals emphasis	34.000	89.000	–1.218	0.223	0.247	0.124
Learners' perception of teacher's performance- approach goals emphasis	30.500	85.500	–1.492	0.136	0.143	0.072
Learners' perception of teacher's performance-avoid goals emphasis	46.000	101.000	–0.303	0.762	0.796	0.400
Learners' perception of school's mastery goals emphasis	47.000	102.000	–0.229	0.819	0.853	0.427
Learners' perception of school's performance goals emphasis	47.000	102.000	–0.229	0.819	0.853	0.427
Learners' personal mastery goal orientation	32.500	87.500	–1.334	0.182	0.190	0.100
Learners' personal performance-approach goal orientation	40.000	95.000	–0.760	0.447	0.481	0.24
Learners' personal performance-avoid goal orientation	21.000	76.000	–2.209	0.027*	0.029*	0.015
Learners' self-efficacy	43.500	98.500	–0.498	0.619	0.631	0.316
Learners' perception of peers' mastery goal orientation	22.500	77.500	–2.127	0.033*	0.035*	0.018
Learners' perception of peers' performance-approach goal orientation	34.000	89.000	–1.220	0.222	0.247	0.124
Learners' perception of peers' performance-avoid goal orientation	28.500	83.500	–1.645	0.100	0.105	0.053
Learners' perception of parents' mastery emphasis	17.500	72.500	–2.533	0.011*	0.11*	0.056
Learners' perception of parents' performance emphasis	13.000	68.000	–2.824	0.005*	0.004*	0.001
Behavioural and cognitive engagement	12.500	67.500	–2.866	0.004*	0.003*	0.001
Active extra-curricular engagement	48.500	103.500	–0.114	0.909	0.912	0.456
Active extra-curricular rejection	42.000	97.000	–0.607	0.544	0.579	0.290

Note. * Correlation is significant at the 95% level.

Table 4 Ranks of key constructs of learners without ADHD and learners with ADHD

Construct	Independent variables	*N*	*M*	Sum of ranks
Learners' personal performance-avoid goal orientation	Without ADHD	10	7.60	76.00
	ADHD	10	13.40	134.00
Learners' perception of peers' mastery goal orientation	Without ADHD	10	13.25	132.50
	ADHD	10	7.75	77.50
Learners' perception of parents' mastery emphasis	Without ADHD	10	13.75	137.50
	ADHD	10	7.25	72.50
Learners' perception of parents' performance emphasis	Without ADHD	10	6.80	68.00
	ADHD	10	14.20	142.00
Behavioural and cognitive engagement	Without ADHD	10	14.25	142.50
	ADHD	10	6.75	67.50

Discussion

As an emerging economy, South Africa can potentially generate effective solutions for global behavioural challenges, such as ADHD. South Africa envisages a growing inclusive economy being given voice in a single, democratic educational system. The DoE is devoted to provide all learners, despite their learning challenges, access to the same quality of learning and teaching, equal educational opportunities and improved quality of life (DoE, 2001). However, despite policies, such as White Paper 6 on Inclusive Education (DoE, 2001) to address responsibilities towards learners with learning challenges, a review of the strategic plans of the provincial departments of the DoE discloses inadequate provision to assist learners with learning challenges (Department of Social Development (DSD), Department of Women, Children & People with Disabilities (DWCPD) & UNICEF, 2012). Besides South Africa's historical legacy of apartheid, there is still inadequate access of services to learners with learning challenges in most ordinary public schools, and these schools are not well-resourced to assist learners with learning difficulties. Also, teachers are not well-trained to teach learners with ADHD. Attitudes and practices marginalising learners with learning challenges also need to be changed.

The interpretations of data should be viewed as mere trends rather than specific and explicit findings. Preliminary descriptive analyses indicated that for both learners with and without ADHD each construct was reliable (see Table 1) and ranged between 0.675 and 0.763. This finding is confirmed by Vedder-Weiss and Fortus (2011), who also found the questionnaire to be reliable. Although Vedder-Weiss and Fortus (2011) only used the questionnaire across different subjects and age groups, this finding implies that the questionnaire might also be useful across different learning challenges, such as learners with ADHD and in different contexts for example mathematics learners in South Africa. Even though the Bartlett's test of sphericity was significant (p = .000 < .05), the Kaiser-Meyer-Olkin (KMO) measure was 0.302, which indicated the sampling was not adequate for factor analysis. Thus, the researcher was not able to perform multi-group factor analyses.

Learners without ADHD and learners with ADHD differed significantly at a 95% level in terms of five of the 17 key constructs mentioned by Vedder-Weiss and Fortus (2011), namely learners' personal performance-avoid goal orientation (p = .027 < .05); learners' perception of peers' mastery goal orientation (p = .033 < .05); learners' perception of parents' mastery emphasis (p = .011 < .05); learners' perception of parents' performance emphasis (p = .005 < .05); and behavioural and cognitive engagement (p = .004 < .05).

From this data, it can be concluded learners without ADHD regarded their goal orientation significantly higher than learners with ADHD, pertaining to:

- Learners' perception of peers' mastery goal orientation (without ADHD *Mdn* = 5 vs ADHD *Mdn* = 4), U = 34.0, p = .033 < .05 (at the 95% level of confidence), r = .27 (a finding with a low to moderate practical significance).
- behavioural and cognitive engagement (without ADHD *Mdn* = 5 vs ADHD *Mdn* = 4), U = 12.5, p = .004 < .05 (at the 95% level of confidence), r = .03 (a finding with a low practical significance).

In contrast, learners with ADHD regarded their goal orientation significantly higher than learners without ADHD, pertaining to:

- learners' personal performance-avoid goal orientation (without ADHD *Mdn* = 3 vs ADHD *Mdn* = 4), U = 21.0, p = .027 < .05 (at the 95% level of confidence), r = .49 (a finding with moderate to high practical significance).
- Learners' perception of parents' mastery emphasis (without ADHD *Mdn* = 5 vs ADHD *Mdn* = 4), U = 17.5, p = .011 < .05 (at the 95% level of confidence), r = .57 (a finding with moderate to high practical significance).
- Learners' perception of parents' performance emphasis (without ADHD *Mdn* = 4, vs ADHD *Mdn* = 5), U = 13.0, p = .005 < .05 (at the 95% level of confidence), r = .63 (a finding with moderate to high practical significance).

The above-mentioned results indicate significant differences in the achievement goal orientation between learners with ADHD and learners without ADHD. These findings concur with Friedel et al. (2010:111), arguing that teachers and parents could

either encourage or weaken learners' beliefs about their efficacy, which directs their achievement goals. The results pertaining to learners with ADHD also concur with the finding of Vedder-Weiss and Fortus (2013), that learners perceive goals emphasised by parents as better predictors of their motivation than those emphasised by their peers.

Given, from the results, that mathematics learners without ADHD direct their achievement goal orientation on mastery goals emphasised by peer groups and on cognitive engagement, it might be that these learners compare their commitment to work in the subject with their peers, due to social pressure, and could be more cognitively engaged, since they know they have the abilities. In contrast, learners with ADHD are perhaps aware of their learning challenge, and do not want to compete with their peers, for they may believe they do not have the same abilities than learners without ADHD, thus resulting in an avoidance approach. Mathematics learners with ADHD might avoid to set goals to perform in the subject as they might be concerned that they will not give full attention to the subject in the class or during tests, as they tend to become quickly distracted, and make careless mistakes. Another reason could be that they do not want to apply mental effort as it causes over-exertion of the memory. However, learners with ADHD could view their parents emphasising commitment and good results as a motivating factor, in the sense that parents believe in their abilities and willingness to work without judging them.

Since the achievement goal orientation of learners with ADHD is guided by themselves and by their parents' goal emphasis, mathematics teachers with these learners in their classroom could assist them, with the inputs of their parents, to set goals in mathematics, which focus rather on commitment and mastering of the content than performance in the subject, for example monitor whether learners have done all their mathematics homework activities, rather than on the immediate correctness of the homework. Teachers should not compare the performance of learners with ADHD to that of learners without ADHD. Goals should be achievable and realistic.

Conclusion

One reason for poor Mathematics performance at school level in South Africa could be that learners with different learning challenges, such as ADHD, are accommodated with learners without ADHD in the same classroom. Teachers in those classrooms might create classroom environments that support learners to adopt either a mastery goal orientation, or a performance one.

This study revealed that while learners without ADHD perceive their peers' mastery goal orientation and behavioural and cognitive engagement to direct their goals, learners with ADHD rely more on their personal performance-avoidance goal orientation and the goal orientation of their parents, whether mastery or performance. Differences between the achievement goal orientation of mathematics learners with or without ADHD could assist teachers in recognising methods to direct learners' goals for better engagement with and improved results in mathematics, which could, in turn, support learners to grow maximally in the subject, notwithstanding their different learning challenges.

Further research could be extended to examine teacher strategies to strengthen learners' achievement goal orientation with larger samples in different contexts, so as to make final conclusions as well as to ensure external validity. However, it is worth noting that clinical populations are predictably small, and that this often impedes multivariate analyses at item level. As the questionnaire was amended, it is important to establish its validity for larger populations. Another methodological attempt could be to involve qualitative data, such as observations and interviews with learners that do and do not have ADHD, to explore behavioural and cognitive engagement more attentively. Future research on the environmental factors affecting the motivation in mathematics of learners with ADHD and without ADHD is also recommended. Designing of a test to assist teachers in reflecting on factors that may inhibit or promote mathematics for learners with ADHD is recommended. Further, it is important to examine the same constructs using data derived from additional sources, such as that from teachers, peers and parents. However, the ways in which empirical realities manifest are much more complex than the key constructs pointed to in this paper.

Mathematics teachers should decisively utilise learners' achievement goal orientations when planning learning activities and engaging learners cognitively in mathematical tasks. Learners should be allowed to set goals for Mathematics performance personally, but also within a healthy group cohesion and with the assistance of parents. Such action on the part of teachers can ultimately influence learners' attitudes towards learning and consequently their achievement. An understanding of the goals of learners with different learning challenges might provide clues on how to improve academic success in Mathematics for these learners, and avoid high failure rates and drop-outs. Negotiating goals with learners could lay the foundation for learners to take accountability and responsibility for their own learning in mathematics.

Some interventions Mathematics teachers may employ is to first start identifying how, when and why the learners with ADHD are inattentive,

impulsive and hyperactive. They could use diagnostic assessments and informal classroom observations to determine the strengths of learners with ADHD. Secondly, Mathematics lessons could be planned according to the capabilities of learners with ADHD. Teachers are also encouraged to use mathematics content that would gain the attention of learners with ADHD, like mathematics board games, computer games or manipulatives. Mathematics teachers should set clear learning and behavioural expectations. Lastly, an individualised educational programme, with the assistance of other mathematics teachers, and with the parents of learners with ADHD could be integrated with current mathematics activities provided to other learners without ADHD in the class. Yet, Mathematics teachers should prevent by all means any instruction or assessments that could lead to competition or performance comparisons between learners with and without ADHD.

Acknowledgements

I am grateful to the participants and the participating school for their cooperation. A special word of thanks to my honours students, who assisted with data collection. I also want to acknowledge Dr Xenia Kyriacou for language editing and Dr Christel Trotskie-de Bruin for her professional advice pertaining to the writing of the article. Lastly, many thanks to my colleagues at SciTechEd for their continuous support and encouragement.

Note

References

American Psychiatric Association 2013. *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)* (5th ed). Arlington, VA: American Psychiatric Association. https://doi.org/10.1176/appi.books.9780890425596.x00preface

Ames C 1990. *Achievement goals and classroom structure: Developing a learning orientation*. Paper presented at the Annual Meeting of the American Educational Research Association, Boston, 16–20 April.

Bandura A 2001. Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52:1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Barkley RA 2009. Attention deficit hyperactivity disorder. In RE Ingram (ed). *The International Encyclopedia of Depression*. New York, NY: Springer.

Covington MV 2000. Goal theory, motivation and school achievement: An integrative review. *Annual Review of Psychology*, 51:171–200. https://doi.org/10.1146/annurev.psych.51.1.171

Creswell JW 2003. *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed). Thousand Oaks, CA: Sage Publications, Inc.

Department of Education (DoE) 2001. *Education White Paper 6. Special needs education: Building an inclusive education and training system*. Pretoria, South Africa: DoE. Available at https://www.gov.za/sites/default/files/educ6_1.pdf. Accessed 26 August 2017.

Department of Social Development (DSD), Department of Women, Children & People with Disabilities (DWCPD) & UNICEF 2012. *Children with disabilities in South Africa: A situation analysis 2001-2011*. Executive Summary. Pretoria, South Africa: DSD, DWCPD & UNICEF. Available at https://www.unicef.org/southafrica/SAF_resources_sitandisabilityes.pdf. Accessed 26 August 2017.

DeShazo Barry T, Lyman RD & Klinger LG 2002. Academic underachievement and attention deficit/hyperactivity disorder: The negative impact of symptom severity on school performance. *Journal of School Psychology*, 40(3):259–283. https://doi.org/10.1016/S0022-4405(02)00100-0

DuPaul GJ, Volpe RJ, Jitendra AK, Lutz JG, Lorah KS & Gruber R 2004. Elementary school students with AD/HD: predictors of academic achievement. *Journal of School Psychology*, 42(4):285–301. https://doi.org/10.1016/j.jsp.2004.05.001

Erk RR 1995. The evolution of attention deficit disorders terminology. *Elementary School Guidance & Counselling*, 29(4):243–248.

Faraone SV, Sergeant J, Gillberg C & Biederman J 2003. The worldwide prevalence of ADHD: is it an American condition? *World Psychiatry: Official Journal of the World Psychiatric Association (WPA)*, 2(2):104–113. Available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1525089/pdf/wpa020104.pdf. Accessed 23 August 2017.

Friedel JM, Cortina KS, Turner JC & Migley C 2010. Changes in efficacy beliefs in mathematics across the transition to middle school: Examining the effects of perceived teacher and parent goal emphases. *Journal of Educational Psychology*, 102(1):102–114. https://doi.org/10.1037/a0017590

Gonida EN, Kiosseoglou G & Voulala K 2007. Perceptions of parent goals and their contribution to student achievement goal orientation and engagement in the classroom: Grade-level differences across adolescence. *European Journal of Psychology of Education*, 22:23. https://doi.org/10.1007/BF03173687

Greenop K & Kahn L 2007. Extra-task stimulation on Mathematics performance in children with and without ADHD. *South African Journal of Psychology*, 37(2):330–344. https://doi.org/10.1177/008124630703700208

Hancock D 2004. Cooperative learning and peer orientation effects on motivation and achievement. *The Journal of Educational Research*, 97(3):159–168. https://doi.org/10.3200/JOER.97.3.159-168

Kim JI, Schallert DL & Kim M 2010. An integrative cultural view of achievement motivation: Parental and classroom predictors of children's goal orientations when learning mathematics in Korea. *Journal of Educational Psychology*, 102(2):418–437. https://doi.org/10.1037/a0018676

Lamminmäki T, Ahonen T, Närhi V, Lyytinen H & Todd de Barra H 1995. Attention deficit hyperactivity disorder subtypes: Are there differences in academic problems? *Developmental*

Neuropsychology, 11(3):297–310. https://doi.org/10.1080/87565649509540621

Linnenbrink EA 2005. The dilemma of performance-approach goals: The use of multiple goal contexts to promote students' motivation and learning. *Journal of Educational Psychology*, 97(2):197–213. https://doi.org/10.1037/0022-0663.97.2.197

Luo W, Aye KM, Hogan D, Kaur B & Chan MCY 2013. Parenting behaviors and learning of Singapore students: The mediational role of achievement goals. *Motivation and Emotion*, 37(2):274–285. https://doi.org/10.1007/s11031-012-9303-8

Martin AJ 2012. The role of personal best (PB) goals in the achievement and behavioural engagement of students with ADHD and students without ADHD. *Contemporary Educational Psychology*, 37(2):91–105. https://doi.org/10.1016/j.cedpsych.2012.01.002

McGrew KS 2008. *Beyond IQ: A model of academic competence & motivation (MACM)*. Available at http://www.iapsych.com/acmcewok/Achievementgoalorientation.html. Accessed 1 November 2016.

Midgley C, Maehr ML, Hruda LZ, Anderman E, Anderman L, Freeman KE, Gheen M, Kaplan A, Kumar R, Middleton MJ, Nelson J, Roeser R & Urdan T 2000. *Manual for the Patterns of Adaptive Learning Scales (PALS)*. Ann Arbor, MI: University of Michigan. Available at http://www.umich.edu/~pals/pals/PALS%202000_V13Word97.pdf. Accessed 13 October 2016.

Patrick H, Ryan AM & Kaplan A 2007. Early adolescents' perceptions of the classroom social environment, motivational beliefs, and engagement. *Journal of Educational Psychology*, 99(1):83–98. https://doi.org/10.1037/0022-0663.99.1.83

Rabiner DL, Anastopoulos AD, Costello EJ, Hoyle RH, McCabe SE & Swartzwelder HS 2009. Motives and perceived consequences of nonmedical ADHD medication use by college students: Are student treating themselves for attention problems? *Journal of Attention Disorders*, 13(3):259–270. https://doi.org/10.1177/1087054708320399

Self-Brown SR & Mathews S II 2003. Effects of classroom structure on student achievement goal orientation. *The Journal of Educational Research*, 97(2):106–112. https://doi.org/10.1080/00220670309597513

Shih SS 2005. Role of achievement goals in children's learning in Taiwan. *The Journal of Educational Research*, 98(5):310–319. https://doi.org/10.3200/JOER.98.5.310-319

Topkin B, Roman NV & Mwaba K 2015. Attention deficit disorder (ADHD): Primary school teachers' knowledge of symptoms, treatment and managing classroom behaviour. *South African Journal of Education*, 35(2): Art. # 988, 8 pages. https://doi.org/10.15700/saje.v35n2a988

UNICEF 2006. *Girls education movement: South Africa*. Pretoria, South Africa: UNICEF. Available at http://www.unicef.org/southafrica/SAF_resources_gembrief.pdf. Accessed 27 October 2016.

Vedder-Weiss D & Fortus D 2011. Adolescents' declining motivation to learn science: Inevitable or not? *Journal of Research in Science Teaching*, 48(2):199–216. https://doi.org/10.1002/tea.20398

Vedder-Weiss D & Fortus D 2013. School, teacher, peers, and parents' goals emphases and adolescents' motivation to learn science in and out of school. *Journal of Research in Science Teaching*, 50(8):952–988. https://doi.org/10.1002/tea.21103

Walker CO & Greene BA 2009. The relations between student motivational beliefs and cognitive engagement in high school. *The Journal of Educational Research*, 102(6):463–472. https://doi.org/10.3200/JOER.102.6.463-472

Wood R & Bandura A 1989. Social cognitive theory of organizational management. *Academy of Management Review*, 14(3):361–384. https://doi.org/10.5465/AMR.1989.4279067

Zentall SS 1990. Fact-retrieval automatization and math problem solving by learning disabled, attention-disordered, and normal adolescents. *Journal of Educational Psychology*, 82(4):856–865. https://doi.org/10.1037/0022-0663.82.4.856

Zentall SS, Smith YN, Lee YB & Wieczorek C 1994. Mathematical outcomes of attention-deficit hyperactivity disorder. *Journal of Learning Disabilities*, 27(8):510–519. https://doi.org/10.1177/002221949402700806

Appendix A: Sample of Achievement Goal Orientation Questionnaire

Items are numbered according to the items in the questionnaire of Vedder-Weiss and Fortus (2011).

Instructions: Circle the numbers that best fits what you think. Use the following code:

1	2	3	4	5
Not true at all	Not so true	Somewhat true	True	Very true

		1	2	3	4	5
1.	When discussing or writing down ideas, I like criticizing others' way of doing things.					
5.	In my school it's easy to tell which learners get the highest grades and which learners get the lowest grades.					
10.	In our Mathematics class, really understanding the material is the main goal.					
14.	My parents think getting the right answers in Mathematics class is very important.					
22.	My Mathematics teacher points out those learners who get good marks as an example to all of us.					

Note. Source: Vedder-Weiss and Fortus (2011).