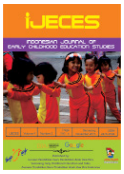
IJECES 7 (1) (2018)

Indonesian Journal of Early Childhood Education Studies

http://journal.unnes.ac.id/sju/index.php/ijeces



Academic Achievement Reflected the Quality of Life and Neurocognitive Status in Malaysian Primary School Children

Vionalita Gisely[1] ✉, I Zalina[1], WA Aasim[1], SM Ali[2]

[1]BRAINetwork Centre for Neurocognitive Science, School of Health Sciences, Universiti Sains Malaysia, Health Campus 16150 Kubang Kerian, Kelantan, Malaysia

[2]School of Education University Sains Malaysia, Main Campus 11800 Penang

Article Info

Received April 2018
Accepted May2018
Published June 2018

Keywords:
CANTAB; primary school children; cognitive status; academic achievement

Abstract

Academic achievement is not the only indicator of achievement in school. The neurocognitive profile, as measured by the quality of life (QoL) and neurocognitive status are important markers that make academic achievement more relevant with regard to optimum brain utilization. The main objective of this study was to determine the relationship between quality of life, neurocognitive status and academic achievement in a sample of children in a Malaysian primary school. QoL was measured using three versions of the TNO-AZL quality of life (TACQOL) questionnaire from the children's (CV), parents' (PV) and teachers' (TV) perspectives. Neurocognitive status was assessed in two domains, executive function and visual memory using Cambridge Neuropsychology Tests Automated Battery (CANTAB®). A convenience sampling was undertaken for all 95 Standard One Zainab 2 Primary School children (7 Years Old), 95 parents and 4 teachers. Regarding executive function, 42.1% of children experienced difficulties in extra dimensional shift which measures attention flexibility in accepting a new rule. However, they performed well in the intra extra dimensional shift, indicating that most children responded positively to experiential learning. For visual memory, 49.5% of children experienced some difficulties in terms of their short term visual memory. The relationship between QoL, neurocognitive status and academic achievement of the children showed that only 'cognitive complaint' and 'negative mood' had a significant linear positive relationship with academic achievement. No other significant relationship was noted between neurocognitive status and academic achievement. Thus, this study has shown that academic achievement does not necessarily reflect the neurocognitive status of children implying that some neurocognitive problems remain undetected. A more meaningful assessment of academic achievement, in primary schools should include an assessment of both QoL and neurocognitive profile.

✉Corresponding author:
Universiti Sains Malaysia, Health Campus 16150 Kubang Kerian, Kelantan, Malaysia
E-mail: gisely.vionalita@gmail.com

p-ISSN 2252-8415
e-ISSN 2476-9584

INTRODUCTION

Current research indicates that contrary to previous concepts which postulate that learning occurs at specific periods of the developing brain, there is evidence that both the developing and the mature brain are structurally altered when learning occurs. These structural changes are believed to encode the learning process in the brain. Studies have found that direct contact with a stimulating physical environment and an interactive social group can alter the structure of nerve cells and of the tissues that support them (Breslow, 1999). The nerve cells develop a greater number of synapses through which they communicate with each other and the structure of the nerve cells themselves is correspondingly altered.

Quality of life (QoL) is a multidimensional construct referring to the subjective perception of physical, mental, social, psychological and functional aspects of well-being and health. From an epidemiological point of view, information on quality of life is important to define health problems and to evaluate the well-being and functioning of populations (Bullinger *et al.,* 2008). QoL has been defined in terms of the impact of illnesses on the physical, mental and social aspects of patients' lives, and provides a more comprehensive measure of health outcomes in children (Wee *et al.*, 2005). QoL has also been defined as the individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns (Saxena & Orley, 1997). Indeed, QoL conceptualised as the individual's self-evaluation of their health status, is an important criterion in evaluating health and health care. Until now, few systematic attempts have been made to develop instruments to assess the QoL of children using such a conceptualisation (Vogels *et al.,* 2000). In this study the QoL is one of the variables that will be used in the self-evaluation of wellness and the tool chosen is the Netherlands Organisation for Applied Scientific Research Academic Medical Centre (TNO-AZL) child quality of life (TACQOL) questionnaire. In this case, the QoL, as assessed by the TACQOL, is defined as children's health status, weighted by the emotional response of their health status problems from their own perspectives.

Indeed, children are the best source of information concerning their own feelings and evaluations even though they may be lacking in their vocabulary and reading skills. The TACQOL takes this into consideration and has been designed with simple language and can be completed in a short period of time. TACQOL is a multidimensional instrument, with 7 subscales. The subscales covered by the TACQOL are based on a review of the literature, discussions with experts (child psychologists, paediatricians) and statistical testing (Vogels *et al.,* 2000). The TACQOL was constructed to enable a systematic, valid and reliable description of quality of life of children aged 6 till 15 by the children themselves or their parents (Arnould *et al.*, 2004).

In this study, the neurocognitive profiling and the assessment of neurocognitive status of primary school children will focus on the executive functions of the prefrontal cortex in relation to the limbic system and how they impact on the academic achievement and QoL of these children. The neurocognitive evaluation of school children was carried out using the Cambridge Neuropsychological Tests Automated Battery (CANTAB®) (Luciana, 2003). These tests are comparable across cultures as they have the advantage of being language-independent and culture-free.

In this study, the CANTAB® was chosen for the assessment of neurocognitive status as it allows for a complete assessment of the neurocognitive profile through an extensively validated neuropsychological battery of tests. It is highly portable and uses a touch screen computer system which can be easily applied to all respondents. The CANTAB® is rigorously standardized and provides precise recordings of qualitative or quantitative data and high homogeneity of testing conditions (Stip *et al.*, 2008).

The CANTAB® consists of several well validated tests, each of which taps one or more cognitive domains, and produces a number of outcome variables. There are six domains which are assessed in CANTAB®. In this study, two tests from CANTAB® were used from two domains (executive function and visual memory) which are closely related to learning and memory. IED Intra-Extra Dimensional Set Shift (IED) was used to assess executive function of the children while Paired Associates Learning (PAL) was used to assess the visual memory of the children.

IED is primarily sensitive to changes affecting the fronto-striatal areas of the brain (Scaife & Duka, 2009). It is sensitive to cognitive changes associated with visual discrimination and attentional set formation maintenance, shifting and flexibility of attention (Heinzel *et al.,* 2010). The IED assesses rule acquisition and attentional set shifting. Specifically, this test measures the visual discrimination, attentional set formation maintenance, shifting and flexibility of attention. It spe-

cifically allows for the assessment of the frontostriatal areas of brain (Ozonoff *et al*, 2005) which are known to be linked to the limbic system in the processing of learning and memory.

The PAL (Paired Associates Learning) was chosen from the CANTAB® as one of two tests that were carried out in this study. PAL measures visual memory and it assesses episodic memory, new learning and is sensitive to medial temporal lobe functioning. Thus, in this study, PAL allowed for the assessment of the learning of items (as syllables, digits or words) in pairs so that one member of the pair evokes recall of the other. Specifically this test was chosen as it measures associative learning which is defined as a learning process in which discrete ideas and precepts which are experienced together become linked to one another (De Jager *et al.,* 2002).

In the context of this study, academic achievement is defined as the outcome of education in the form of knowledge, skills and attitude, which a student has achieved through attaining specific educational goals. Academic achievement is commonly measured by examinations or continuous assessment but there is no general agreement on how it is best tested or which aspects are most important (Von Stumm *et al.*, 2011). Academic achievement can also been seen as a motivator for children to become more achievement oriented and successful not only for their studies but also for their future (Meece *et al.,* 2006). It is one of the indicators that can describe the school based performance of children.

METHOD

This cross-sectional study involved the observation of all members of a population, at one specific point in time. In this case, the study involved all Standard One children (7 Years Old) of Zainab 2 Primary School, Kota Bharu, Kelantan and included their parents as well as teachers.

1. Quality of life

Quality of life was assessed from primary data obtained from a translated and validated TACQOL questionnaire with three versions. A parent and teacher version of the TACQOL questionnaire was constructed for parents and teachers to assess the quality of life of the children from their perspectives. The TACQOL - Child Version (TACQOL-CV) was constructed for children to assess themselves. The TACQOL – Parent/ Teacher Version (TACQOL-P/TV) specifically asked parents and teachers to evaluate and assess the children's feelings with regard to their physical, emotional and cognitive status. The major difference between the versions (child, parent and teacher) was in terms of the perspective of the questions asked. The parent and teacher questionnaires used the following format: "has your child had…. or did your child have…?", while the child questionnaire used the format: "have you had …. or did you have…?".

The English version of the TACQOL was forward translated into Bahasa Malaysia and subsequently back translated into English. This questionnaire had 56 items, with a Likert scale type of assessment (never, occasionally, only within the past weeks, often and always). The TACQOL questionnaire covered seven subscales: physical complaints and motor functioning (physical), autonomous functioning (daily living), social functioning (social), cognitive functioning and positive moods and negative moods (Verrips *et al.,* 1999). All respondents were interviewed and observed within the school setting using the translated and validated questionnaire. Informed consent was obtained from all respondents of the study, following which the questionnaire was completed by 95 Standard One children of Zainab 2 Primary School, Kota Bharu Kelantan, 95 parents of the same children and 4 teachers who taught these Standard One children.

2. Neurocognitive status

Neurocognitive function was analysed from primary data obtained from two tests: IED (Intra Extra Dimensional Set Shift) and PAL (Paired Associates Learning) from within the CANTAB® battery tests. These two tests were sequentially administered to the respondents by trained data collectors. The tests were administered to 95 children in a conducive and quiet place with minimal distractions. These tests were completed within 20 minutes and were simple to understand. All the children were supervised by the same instructor for both tests.

The IED screened for executive function in nine stages. Stage 1 started with two simple, colour-filled shapes and required children to learn and touch the correct stimuli to show simple discrimination learning. In Stage 2, the contingencies were reversed to show reversal learning. In Stage 3, the second dimension was introduced, with shapes and lines together as distraction. The contingencies were not changed in Stage 4 but included overlapping and simple discrimination. Reversal learning occurs again in Stage 5. New compound stimuli were presented in Stage 6. Subjects were required to be attentive to the previously relevant dimension of shapes and learn

which of the two exemplars were correct. Stage 7 completed an intradimensional shift. In Stage 8, children were required to shift attention to the previously irrelevant dimension and learn which of the two exemplars in this dimension were now correct. This gave a good indication of attentional flexibility. In Stage 9, the contingencies were again reversed (Figure 2.7).

PAL screened the visual memory ability in 5 separate stages. The children were required to remember the shapes displayed on the screen. The test started with 1 shape and then progressed to 2 shapes, 3 shapes, 6 shapes and 8 shapes. For each stage, boxes were displayed on the screen. All were opened in a randomized order. Two or more of them contained a pattern.

The patterns in the boxes were then displayed in the middle of the screen, one at a time, and the subject was asked to touch the box where the pattern was originally located. Each stage had up to ten trials. If the subject made an error, the patterns were presented to remind the subject of their locations. When the subjects correctly identified all the locations, they proceeded to the next stage. If the subject was unable to complete a stage correctly, the test was terminated.

The CANTAB® battery of tests were computerized and provided automatic results that were presented based on the requested outcome measurement. From the summary template definition, the researcher was able to select the outcome measurement that was required. The results were automatically calculated within the datasheet format for further statistical analysis. In this study, the outcome measurement for executive function and visual memory were a measure of the total errors.

3. Academic achievement

Academic achievement was analyzed from secondary data obtained from the school database of the Zainab 2 Primary School. The data was obtained from the average of mid-year examination of 2011. The data provided information on six subjects taught within the Standard One school curriculum.

RESULTS AND DISCUSSION

The average scores of the subscales in quality of life assessments from children's, parents' and teachers' perspectives together with total error of both the IED and PAL tests were assessed in terms of their relationship to the average academic achievement of the Standard One children from Zainab 2 Primary School. Simple linear regressions followed by multiple linear regression were applied in analyzing the relationship between QoL, neurocognitive status and academic achievement. As a requirement for applying the multiple linear regression, simple linear regression was applied first to check the significance of the factors. From the simple linear regression for univariable analysis, it was found that all the variables were significant factors for academic achievement ($p<0.25$) (Table 1.1). Following this, all the variables were subjected to multiple linear regression for variable selection. It was seen that only 'cognitive' and 'negative mood' had a significant linear relationship with academic achievement ($p<0.05$) (Table 1.2).

Multiple linear regression analysis showed a significant linear positive relationship between both cognitive and negative domains of the quality of life assessment with the academic achievement. One single improvement in cognitive problem increased the academic achievement by a score of 0.78 and for one single improvement in negative problem the academic achievement improved by 1.27. However, there was no significant linear relationship between neurocognitive status

Table 1.1 Simple linear regression for variables

Variable	b[a] (95% CI)	P-Value
Physical	0.78 (-0.22, 1.79)	0.126
Motor	0.68 (-0.40, 1.75)	0.215
Autonomy	1.01 (0.08, 1.94)	0.003
Cognitive	1.43 (0.85, 2.02)	0.000
Social	0.99 (-0.15, 2.13)	0.087
Positive Mood	0.77 (-0.15, 1.68)	0.098
Negative Mood	1.91 (1.18, 2.64)	0.000
Total Error IED	-0.16 (-0.36, 0.26)	0.090
Total Error PAL	-0.26 (-0.53, 0.02)	0.052

[a]Crude regression coefficient
P-value significant at <0.25

and academic achievement, indicating that the neurocognitive status of the children is not fully represented by the academic achievement.

Table 1.2 Relationship between variables with academic achievement in Standard One children of Zainab 2 Primary School

Variable	b[a] (95% CI)	t-stat	P-value
Cognitive	0.78 (0.03, 1.53)	2.08	0.041
Negative	1.27 (0.33, 2.22)	2.68	0.009

[a]adjusted regression coefficient
[b]P-value significant at <0.05

Forward multiple linear regression applied. Model assumptions are fulfilled.
There were no interactions amongst independent variables. No multicollinearity detected.
Coefficient of determination (R2) = 0.254
Final model equation
Academic achievement= 31.26 + 1.27 * Negative + 0.78 * Cognitive

Discussion

The objective of this study was to evaluate the relationship between quality of life, neurocognitive status and academic achievement. As mentioned earlier, the average scores of the subscales in quality of life assessments from children's, parents' and teachers' perspectives together with total error of both the CANTAB® IED and CANTAB® PAL tests were assessed in terms of their relationship to the academic achievement of the Standard One Zainab 2 Primary School children.

From the statistical analysis, involving seven subscales in QoL and two domains in neurocognitive status, it was found that a significant relationship existed between two subscales of the QOL. Five other subscales were not significantly related to academic achievement. Those five subscales are physical, motor, autonomy, social and positive moods. These findings correlate well with De Oliveira Filho & Vieira, 2007, where the researchers were also unable to detect any significant association between academic performance and residents' perceptions about their subjective quality of life. These findings might suggest that any knowledge gained, occurred independently and was unrelated to how people perceived their quality of life.

However, in contrast to the study done by De Oliveira Filho and Vieira, 2007, this study explored the neurocognitive status of children and it was found that there were two subscales that had a significant relationship with academic achievement. These two subscales were from the perspective of cognition and negative moods. Both of these subscales are closely related to perceptions of negativity and can thus be linked to perceptions of the ability in catch up with school-work and the frequency negative feelings in children, both of which have been shown in this study to be the main factors affecting the QoL and at the same time is able to influence the academic achievement.

In terms of the relationship between neurocognitive status and academic achievement as measured by the CANTAB® battery of tests, no significant relationship was found between executive function and the academic achievement of the children as measured by their examination results. Similarly, there was no statistically significant relationship between visual memory and the academic achievement in these children.

Executive function is one of the important factors in learning, and with IED it is possible to detect the ability of the children in simple discrimination, reversal learning and also experiential learning. Those abilities are very useful to improve the learning abilities of children. Similarly, PAL is useful in the assessment of visual memory and any learning difficulties with visual memory in young children will often lead to a significant problem in both long term and short term memory and difficulty in new learning. It also affects a person's ability to relearn appropriate behaviour (Cusimano, 2001). However, there is no association between both of the executive function and visual memory with the academic achievement. The main purpose of the current educational system is to measure ability and success of students. These measurements still do not reflect the neurocognitive function of those children and some problems with neurocognition remain undetected. In Malaysia itself, the numbers of children with learning disabilities have almost doubled over the last three years period for primary school (473 to 656). This is an estimated increase of about 57% in the number of programs for special education for primary school level (Mohamad, 2007). In order to make academic achievement more efficient, the education system needs a neurocognitive profiling system that include all the information about the quality of life and neurocognitive wellness from the neurocognitive status of the children.

CONCLUSION

In conclusion, The fact that cognitive status of the children have no correlation with the academic achievement is indicate that the school

examination for the Standard one children cannot represent the cognitive ability in terms of executive function and the visual memory. It can be explained that the academic achievement from the school still does not reflect the neurocognitive status of those children and some problems with neurocognition remain undetected. This information about the cognitive status of the children is very important to improve the education system. Thus, the neurocognitive status can act as important indicators of a childs' academic achievement. This study will be expanded through perspective of the children about other domain in cognitive status and its relation with their academic achievement.

ACKNOWLEDGEMENTS

This study was supported by BRAINetwork Centre for Neurocognitive Science School of Health Universiti Sains Malaysia. The authors would like to express their deepest gratitude to children and teachers who participated in this study and the staff at primary schools in SK Zainab 2 Kota Bharu, Kelantan.

REFERENCES

Abbott, N. J., Rönnbäck, L. & Hansson, E. (2006). Astrocytes endothelial interactions at the blood brain barrier. *Nature Reviews Neuroscience,* **7(1),** 41-53.

Alvarado, M. C. & Bachevalier, J. (2000). Revisiting the maturation of medial temporal lobe memory functions in primates. *Learning & Memory,* **7(5),** 244-256.

Arnould, C., Penta, M., Renders, A. & Thonnard, J. L. (2004). ABILHAND-Kids. A measure of manual ability in children with cerebral palsy**.** *Neurology,* **63(6),** 1045-1052.

Breslow, L. (1999). New research points to the importance of using active learning in the classroom. Teach Talk Articles in the Faculty Newsletter. *TLL Library,* **13 (1***).*

Bullinger, M., Brütt, A. L., Erhart, M. & Ravens-Sieberer, U. (2008). Psychometric properties of the KINDL-R® questionnaire: results of the BELLA study. *European child & adolescent psychiatry,* **17,** 125-132.

Cicchetti, D. & Curtis, W. J. (2006). The developing brain and neural plasticity: Implications for normality, psychopathology, and resilience. In: Cohen, D. J. Developmental psychopathology: Developmental neuroscience. John Willey & Son Inc. **2,** 1.

Cusimano, A. (2001). Learning Disabilities : there is a cure a guide for parents, educators and physicians Second (Ed.). Lansdale Pennsylvania USA: Achieve Publication. Pp: 26-35.

De Jager, C. A., Milwain, E. & Budge, M. (2002). Early detection of isolated memory deficits in the elderly: the need for more sensitive neuropsychological tests. *Psychological medicine,* **32(3),** 483-491.

De Oliveira Filho, G. R. & Vieira, J. E. (2007). The relationship of learning environment, quality of life, and study strategies measures to anesthesiology resident academic performance. *International Anesthesia Research Society. Anesthesia & Analgesia,* **104(6),** 1467-1472.

Haines, B. (2007). Cognitive-Affective Learning Bibliography (Revised 2007). *Journal of Cognitive Affective Learning,* **4(1),** 32-80.

Heinzel, A., Northoff, G., Boeker, H., Boesiger, P. & Grimm, S. (2010). Emotional processing and executive functions in major depressive disorder: dorsal prefrontal activity correlates with performance in the intra-extra dimensional set shift. *Acta Neuropsychiatrica,* **22(6),** 269-279.

Hollingsworth, M. A. (2009). Wellness and academic performance of elementary students. Paper based on a program presented at the American Counselling Association Annual Conference and Exposition, Charlotte, NC.

Jensen, E. (2000). Brain Based Learning. Revised edition. San Diego, CA. USA: The Brain Store (R).,

Lackney, J. (1998). 12 Design Principles Based on Brain-Based Learning Research. [Online] [Accessed 27th December 2011]. Available from:DesignShare. http://www. designshare. com/Research/BrainBasedLearn98. htm

Lowndes, G. & Savage, G. (2007). Early detection of memory impairment in Alzheimer's disease: a neurocognitive perspective on assessment. *Neuropsychology review,* **17(3),** 193-202.

Luciana, M. (2003). Practitioner review: computerized assessment of neuropsychological function in children: clinical and research applications of the Cambridge Neuropsychological Testing Automated Battery (CANTAB®). *Journal of Child Psychology and Psychiatry,* **44(5),** 649-663.

Meece, J. L., Anderman, E. M. & Anderman, L. H. (2006). Classroom goal structure, student motivation, and academic achievement. *Annual Review. Psychol.,* **57,** 487-503.

Mohamad, N. B. M. T. (2007). Malaysia. Special Education Department. School Management Concerning Collaboration with Social Resources in the Community – Its Approaches and Problem the Ministry of Education **27**, 56-64.

NCLD (2010). What is Executive Function? [Online] [Accessed 3rd February 2012]. Available from: http://www.ncld.org/ld-basics/ld-aamp-executive-functioning/basic-ef-facts/what-is-executive-function

Ozonoff, S., Cook, I., Coon, H., Dawson, G., Joseph, R. M., Klin, A., McMahon, W. M., Minshew, N., Munson, J. A. & Pennington, B. F. (2004). Performance on Cambridge Neuropsychological Tests Automated Battery subtests sensitive to frontal lobe function in people with autistic

disorder: evidence from the Collaborative Programs of Excellence in Autism network. *Journal of Autism and Developmental Disorders,* **34(2),** 139-150.

Rothbart, M. K., & Posner, M. I. (2006). Temperament, attention, and developmental psychopathology. In: Cicchetti, D & Cohen, D. (Eds.). Developmental psychopathology: Developmental neuroscience **3(2**), 1–64.

Saxena, S. & Orley, J. (1997). Quality of life assessment: the World Health Organization perspective. *European psychiatry,* **12,** 263s-266s.

Soori, H. (2004). Measuring health-related quality of life among primary school children in Ahwaz, Iran. *The Journal of Primary Prevention,* **25(1),** 125-132.

Stip, E., Lecardeur, L. & Sepehry, A. A. (2008). Computerised Assessment of Visuo-spatial Cognition in Schizophrenia An Exploratory Meta-analysis of CANTAB® Findings. *European Psychiatric Review*. **1(2),**48-54

Strong, T. K. (2010). Neuro plastic possibilities for expanded consciousness: A consideration of the effects on brain dynamics and consciousness of neurophysiological alterations attributed to temporal lobe epilepsy and post temporal lobectomy recovery. Ph.D Thesis. California Institute of Integral Studies.

Verrips, E. G. H., Vogels, T. G. C., Koopman, H. M., Theunissen, N. C. M., Kamphuis, R. O. B. P., Fekkes, M., Wit, J. A. N. M. & Vanhorick, S. P. V. (1999). Measuring health-related quality of life in a child population. *The European Journal of Public Health,* **9(3),** 188-193.

Visser, M. R. M., Oort, F. J. & Sprangers, M. A. G. (2005). Methods to detect response shift in quality of life data: a convergent validity study. *Quality of life research,* **14(3),** 629-639.

Vogels, A. G. C., Verrips, G. H., Koopman, H. M., Theunissen, N. C. M., Fekkes, M. & Kamphuis, R. P. (2000). TACQOL Manual. Leiden Center for Child Health and Pediatrics LUMC-TNO.

Vogels, T., Verrips, G., Verloove-Vanhorick, S., Fekkes, M., Kamphuis, R., Koopman, H., Theunissen, N. & Wit, J. (1998). Measuring health-related quality of life in children: the development of the TACQOL parent form. *Quality of life research,* **7(5),** 457-465.

Wee, H., Lee, W., Ravens-Sieberer, U., Erhart, M. & Li, S. (2005). Validation of the English version of the KINDL® generic children's health-related quality of life instrument for an Asian population-results from a pilot test. *Quality of life research,* **14(4),** 1193-1200.

Zelazo, P. D. & Paus, T. (2010). Developmental social neuroscience: An introduction. *Social Neuroscience,* **5(5-6),** 41