AN EXPLORATORY RESEARCH ON THE BENEFITS OF A WEB-BASED COGNITIVE TRAINING PROGRAMME FOR HIGHER EDUCATION STUDENTS

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Abstract

Prior research has revealed that benefits of cognitive training include greater ability to carry out daily activities in adults (Willis et al: 2006), reduced risks of being involved in a motor vehicle accident (Ball et al: 2010) and improvements in academic performance (Merzerich et al: 1996; Holmes et al: 2009). The study explores whether a web-based cognitive training programme supported any improvement on the cognitive skills of higher education students. The quantitative research study was conducted with the use of a survey questionnaire on a group of third-year Travel and Tourism Management students after participating in the brain training over a 4-week period. Results showed positive cognitive outcomes being perceived by the respondents in the areas of working memory, attention, speed of processing and problem-solving skills. Respondents found a positive general result in their daily activities, such as overall improvement in their visual attention. Respondents indicated a small improvement in their memory skills such as being able to remember the content of a lecture more accurately. The results of the study also show that respondents found an improvement in their concentration in the classroom, their ability to react faster to questions and their ability to work faster with less errors. Problem-solving skills such as being able to calculate figures mentally also showed an improvement. It is recommended that further exploration on the ability of the mind to change in all phases of the life-cycle be pursued and further attention be given to present such a programme to higher education students as an added value to their studies and daily activities.

1. Introduction

The purpose of this study is to explore whether a web-based cognitive training programme is perceived to have any benefits for students studying towards a specific module at a tertiary institution in Gauteng, South Africa.

Educators need to reflect continuously on their classroom practice. They need to extend their knowledge base to support effective learning. Until recently, the neuroscience

community held the opinion that the brain's cognitive capacity is essentially fixed after a critical period of early development (Hardy et al:2011). In this view, very little could be done to enhance cognitive skills as an adult. However, recent studies by Buschkuehl and Jaeggi (2010) as well as Ball et al (2002) and Green and Bavelier (2003) have shown that these abilities are improvable under certain conditions, and may have a positive influence on the academic achievements of young adult and adult students. It is now understood that, with the right kind of exercise, the brain can reshape itself to be more efficient and effective (Holmes et al: 20010; Willis et al (2006).

 In terms of cognitive skills, it is important to note that the core cognitive capacities of the brain are divided into working memory, attention, speed of processing and fluid reasoning (also called fluid intelligence). Fluid intelligence is the ability to creatively solve new problems, and it is measured as part of standard IQ testing. Michelon, P. (2006) states that the cognitive skill that we use the most in our everyday lives is working memory. Remembering a PIN number, telephone number, following spoken directions, calculating how much the bill is going to be at the supermarket while adding items to our trolley, are all examples of using the working memory as a sort of mental notepad. These fundamental abilities are an important part of normal living as we engage in work, school, leisure and social activities. For this reason, improving these abilities is of interest to a wide audience (Hardy:2011).

Many learning activities too are reliant on working memory and attention span. For instance, if a student needs to write something down from the board or PowerPoint slide, while at the same time listening to the lecturer, it imposes a considerable burden on working memory. Students with a poorer working memory or weak ability to focus on one thing while other activities are also taking place, will battle to successfully navigate through such a lecture (Holmes: 2013). People with poor cognitive skills will skip words or sentences and lose their place. Working memory is important because it provides a mental workspace in which we can hold information whilst mentally engaging in other activities (Gathercole:2007; Alloway:2007).

Cognitive skills training allows for clearer and quicker thinking (Ng et al :2012). With that comes better use of memory for names and numbers amongst other things. There is also an improvement in listening skills, attention skills, and even emotional growth in areas such as self-control and self-confidence.   In today's technological and internet-connected era, people are increasingly engaging with cognitive training software. The technology is easily accessible over the internet and offered at a relatively low cost (Mishra, Gazzaley:2014). A cognitive training programme that will be used within the context of this research is Lumosity.

It is an easy-to-use, free Internet-based programme that uses engaging gaming characteristics to stimulate cognitive development. The website allows the user to complete 36 exercises designed to enhance cognitive performance, and includes assessments to measure cognitive abilities. With over 45 million users worldwide, it holds the world's largest database of human cognitive performance. Lumosity's games are based on the latest neuroscience discoveries, with continuous independent third-party studies being conducted by Harvard, Stanford and other academic institutions (Sternberg et al:2012).

Educators are increasingly interested in enhancing their student's cognitive abilities. Lumosity has provided free subscriptions to over 14 000 students worldwide through their Lumosity Education Access Programme (LEAP). LEAP is a collaboration between educators and Lumosity researchers to advance the intersection of education and cognitive neuroscience research. Preliminary results found that students who trained with Lumosity had improved their cognitive abilities (Hardy et al; : 2009).

According to an article by Sternberg (2013), it is important for educators to better understand the impact that cognitive training may have on a students' academic performance as a whole. Related to the above, the objective of this study is to examine the effect of such cognitive training on the students' general ability to pay attention and memorise content related to a group of third year Travel and Tourism students.

2. Description of problem

Elam, Stratton and Gibson (2007) state that millennial students routinely participate in multi-tasking, enabled by the availability of technology, and that this has shortened their attention span. Students in multi-media classrooms often need to be able to hold information in a mental workspace whilst being mentally engaged in other activities, e.g. when a lecturer speaks whilst showing Powerpoint slides and students need to make notes. This requires the student to read, listen, remember and write/summarise at the same time. Working memory is required to be able to accomplish this (Gathercole; Alloway: 2007). In 2009, the graduation rate for South African Universities was 22% (Mouton, et al: 2013). Millennium students also lack skills which are necessary to become critical thinkers and to be able to participate in fluid reasoning (Murray: 1997). Although many of these problems can be partly solved by innovative, interactive and collaborative teaching practices, it should be investigated whether an improvement in cognitive skills such as working memory, attention and speed of processing may enhance examination results and overall student performance.

In order to seek clarification on whether cognitive training can enhance the academic achievement of a group of third year travel and tourism students, the following research question will be explored:

- In what way do students perceive improvement in relation to their ability to concentrate and expand long and short-term memory capacity after completing a month's training on a web-based cognitive development programme such as the Lumosity programme?

The objective is to seek to determine whether exposure to a web-based cognitive development programme can increase the ability of students to improve their attention span as well as short and long-term memory capacity.

3. Literature review/Theoretical Background

3.1 Key definitions:

Some of the key definitions used in this article include:

Cognitive skills:

These abilities are brain-based skills that need to be carried out before the simplest of tasks can be completed. Cognition has to do with how we learn, how we remember, how we solve problems and how we pay attention rather than actual knowledge (Michelon:2006).

Cognitive training:

Participating in a training activity that provides practice on tasks relevant to cognitive functioning such as memory, attention and problem-solving skills (Cochrane Library:2011)

Working memory:

The term working memory refers to a brain system that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language comprehension, learning, and reasoning (Baddeley:2011).

3.2 Literature Review

The core areas of cognitive skills are processing speed, auditory processing, visual processing, long-term memory, short-term memory, logic and reasoning and attention skills. Processing speed is the speed at which your brain processes information. Faster processing

speed means more efficient thinking and learning. Visual Processing is the ability to perceive, analyse and think in visual images. Visual processing is imperative for reading, remembering, walking, driving, playing sports and literally thousands of other tasks you do every day (Gathercole:2007; Alloway:2007).

In relation to the above long-Term Memory is the "library" of facts and knowledge you have accumulated in the past. Short-Term Memory is also called working memory, this skill handles the dynamic job of keeping at the forefront of your mind the information you need to complete immediate and short-term tasks. Logic and Reasoning is the ability to reason, form concepts, and solve problems using unfamiliar information or new procedures. It enables you to create correlations, solve problems, plan ahead and draw conclusions (Gathercole:2007; Alloway:2007). It is specifically related to cognitive processing and the improvement of short and long term memory for improved academic development through the use of a web-based cognitive development programme that this study is interested in.

Many studies have been done on the effects and validity of cognitive training. It has been indicated that cognitive training can be effective in a wide variety of demographically and clinically defined groups of people. In an article by Abikoff, (1985), the testing of cognitive training on children with ADHD as a singular intervention proved to show no or very little effect on the behaviour of the children. A later study by Douglas, et.al (1996) in Canada showed that the experimental group of children with ADHD who had undergone a 3-month training programme, showed significantly greater improvement on several of the measures at the time of post-testing. It was argued in this study, however, that it would be unwise to use it as a single intervention method to improve overall cognitive development.

Other studies have demonstrated the benefits of cognitive training in adult patients with Schizophrenia (Twamley, et.al. 2003) and in older adults and adults with early Alzheimers (Willis: 2006). Most indicate a definite, measured improvement in working memory, attention and general cognitive abilities. The study indicates that improvement can take place in adults' cognitive skills and shows validity of the current research.

There exists a marked gap in literature on cognitive training for young, healthy adults. This has been partly addressed by Lumos Labs in their endeavour to research the effect of their programme on students through the afore-mentioned LEAP initiative, where 14 000 students are actively participating in their web-based training programme (Kaluszka; Hardy:2013).

Current literature on the measuring of this kind of cognitive improvement is also important to indicate the validity of this study. Sternberg, et.al.(2013) presented a paper at the Society of Neuroscience Meeting in Sandiego to explain how the BPT (Brain Performance Test) which

forms part of the web-based programme, is used to measure improvement. It is a reliable, repeatable battery of cognitive assessments which are completed online by the participants. The programme prompts the participants at certain levels to do the assessments. Assessment scores are based on each participant's pre-test scores (Sternberg, et. al. 2013).

To demonstrate the effects of cognitive training on daily function, a longitudinal study was done by Willis et.al. in 2010. Participants were re-visited after 5 years. The experimental group reported significantly less difficulty in daily living activities than the control group. Testing showed that neither the speed of processing nor the reasoning ability had declined during the period of 5 years; thus indicating longevity in benefits from cognitive training.

4. Research Methodology and Design

The research design is based on quantitative research. The aim of quantitative research is to study the relationship between cause and effect. The use of deductive reasoning to find answers is part of quantitative research (Cohen et al: 2007). Standardised methods are used to collect quantitative data and results are presented as numerical data. The researcher should attempt to maximise objectivity and reliability (Harwell: 2010). Within the context of this article quantitative research aims to explore whether students perceive their participation in a web-based cognitive training programme to be beneficial to their studies.

4.1 Research paradigm and methodology

The research paradigm for this research project is post-positivism. Willis (2007) describes post-positivism as a milder form of positivism as it allows more interaction between the researcher and his/her respondents. It aims to produce generalisable knowledge, seeking to affirm the presence of universal truths amongst pre-determined variables (Taylor:n.d.). It uses methods such as survey design, and within the context of this research questionnaires will be used to survey views and opinions of respondents (Mackenzie; Knipe: 2006).

4.2 Research design and data collection method

Respondents completed at least three exercises of 15 minutes each for four weeks. The Lumosity programme uses cutting-edge science to present the user with web-based software tools. Games have been designed by scientists in an appealing and engaging format to exercise areas of cognitive skills such as attention, memory, fluid intelligence and problem-solving (Scanlon et al: 2007). After the completion of the programme, respondents completed a questionnaire to discuss their views of the value of the programme to develop cognitive skills.

The survey (Appendix A) consisted of 28 questions which were divided into the following categories: general skills; short-term memory; speed of processing; attention span; problem solving skills and their experience of the programme. Questions were designed to explore whether respondents were able to perceive an improvement in activities relating to the use of cognitive skills. A Likert Scale design was used with answers coded from 1 – 5. 1 indicated no improvement and 5 indicated major improvement.

4.3 Research population and sampling

Survey methods lend themselves to probability sampling from a large population. It is a means of developing a representative picture of the results that the larger population will produce (Sage Publications: 2014). For the purposes of this study, the student population at a single tertiary institution is too large to include in the survey, therefore cluster sampling is used. Respondents from a specific group, namely the Travel and Tourism Diploma students are chosen to participate.

The sample size is 10 students who completed the third year module Sustainable Tourism Development as part of the Travel and Tourism Management Diploma programme. Respondents will be volunteers with full knowledge of why they are participating in this study. The ages for the total sample will be between 20 and 25 years.

4.4 Limitations applicable to the research

Numerous variables influence academic performance. It is therefore imperative to be cognisant of the variables that influence academic performance when it is measured. The student's home life, social life, health and many other factors can influence academic performance. It is impossible for the purposes of this study to control all outside factors and ensure that they remain similar from the start to the end of the research. A student's emotional well-being on the day of an assessment can also have a huge influence on results. This is the major limitation on this study. Therefore respondents' views are obtained with the preposition that variables other than only participating in the web-based cognitive development programme may influence academic performance. .

The focus of the study is purely on the educational value of cognitive skills development programmes and by no means does the research try to analyse and conclude its validity and/or reliability.

4.5 Ethical considerations

Informed consent was obtained from all respondents who volunteered to participate in the research. There is an understanding between all respondents and the researcher that all information gathered will be treated as confidential. Individual opinions and views will remain anonymous as students are not required to include their names on the questionnaires. The researcher will honour all copyright and intellectual property requirements. All results will be handled with care and sensitivity to all respondents. All data included in this research will be reflected honestly and without any prejudice or bias (Sage Publications: 2014).

5. Data Analysis

The results of the survey, which were gathered from ten respondents were analysed to determine whether students perceived that they benefited from participating in the Lumosity web-based cognitive development programme.

The responses were coded with the categories on the Likert scale indicated from 1 to 5. In total the questionnaire comprises of 28 questions. For the first 21 questions (Category 1 – 5) the coding was given as follows: 1 = no improvement; 2 = not sure; 3 = minor improvement; 4=quite a bit of improvement; 5 = major improvement. For the last 7 questions (Category 6) which relate to the experience of the respondents, the coding was given as follows: 1=strongly disagree; 2= agree; 3 = neutral; 4= agree and 5 = strongly agree.

Descriptive statistics were generated on each of the 28 questions which were separated under three main headings which are the Mode, the Median and the Range.for each question. The questions relating to specific categories of cognitive skills, short-term memory; speed of processing; attention span and problem solving skills , were further analysed by grouping codes 1 and 2 – which indicate no improvement, and codes 3 – 5 which indicate some form of improvement, to identify further whether any benefits were perceived by the respondents. This was then illustrated in the form of pie-charts for each category of cognitive skill.

CATEGORY 1: GENERAL QUESTIONS

Table 1: Mode, median, range and distribution of answers by percentage for General questions 1-5

Distribution of responses by percentage:
1=No improvement

QUESTIONS	MODE	MEDIAN	RANGE	1	2	3	4	5
					2= Not sure			
					3= Minor improvement			
					4=Quite a bit of improvement			
					5= Major improvement			
1. Improvement in scores while training	4	4	2	0%	0%	30%	50%	20%
2. Better visual attention	3	4	2	0%	0%	40%	30%	30%
3. Did the training give you an emotional sense of accomplishment?	4	4	2	0%	20%	20%	60%	0%
4. Heightened focus while driving	3	4	2	0%	0%	50%	40%	0%
5. Improved sleeping patterns	1	1.5	4	50%	10%	30%	0%	10%

Table 1 above indicates the descriptive statistics for questions which were more of a general nature to ascertain whether respondents found that the training benefitted them relating to general daily activities.

Respondents indicated that their scores increased as they continued to participate in the web-based cognitive development programme The median for this question is 4, indicating that respondents are of the opinion that performance improved as they progressed through the training The distribution indicates that 100% of the respondents perceived some improvement in their performance.

The second question included in this category of general questions asked the respondents whether they found that they could focus on a specific target in a complex environment with more ease than before the web-based cognitive development interaction. The mode for this question was 3 and the median was 4, indicated that most of the respondents found a small improvement in their visual attention. The range of 2 indicates a small difference in the answers between all respondents. The distribution of responses shown in table 1 indicates that 100% of the respondents perceived some form of improvement in their visual attention.

The third question relating to the general category related to the sense of accomplishment of respondents as they progressed through the training. The mode for this question is 4, the median is 4 and the range is 2, which once again indicates that respondents felt a certain sense of accomplishment. Table 1 indicates that the distribution is lower for this question with 20% of the respondents not sure, and 60% indicating that they did feel a sense of accomplishment.

The fourth question in the general category related to the respondents' heightened focus while driving, which showed a mode of 3, a small improvement, a median of 4, which indicates quite a bit of improvement and a range of 2. This indicates a perception that there was mostly a small improvement in their focus while driving. Table 1 shows the distribution of responses as being 50% perceiving only a small improvement and 40% perceiving quite a bit of improvement.

The last question, question 5, explores whether the training affects the respondents' sleeping patterns. In contrast with the previous four questions, the respondents indicated that they did not perceive any improvement in their sleeping patterns during or after the time of the training. The mode for this question is 1 and the median 1.5 with a large range of 4.

A summary of the results for category 1: General questions:

Respondents' views indicate an improvement in their scores while playing the games in the training programme, an overall improvement in their visual attention, most respondents felt a sense of accomplishment in completing the training and a heightened focus while driving. This shows that respondents perceived a positive general result in their daily activities after their participation in the training programme.

CATEGORY 2: MEMORY SKILLS

Table 2: Mode, median, range and distribution of answers by percentage for question 6 – 9 relating to Memory Skills

Distribution of responses by percentage:

1=No improvement

2= Not sure

3= Minor improvement

4=Quite a bit of improvement

5= Major improvement

QUESTIONS	MODE	MEDIAN	RANGE	1	2	3	4	5
6. Do you remember names better?	2;5	3.5	3	0%	30%	20%	20%	30%
7. Better memory of content lectured	3	3	2	0%	0%	70%	20%	10%
8. Keeping better track of multiple pieces of information	3	3	2	0%	0%	60%	20%	20%
9.Increased memory of content studied	3	3	3	0%	10%	50%	20%	20%

The next four questions in the survey instrument related to memory skills, including remembering names better, a better memory of content lectured, keeping better track of multiple pieces of information and increased memory of content studied.

The mode for all four questions ranged between 2.5 and 3, indicating that respondents perceived that there was a small improvement in their memory skills. The median is also 3 – 3.5 for all four questions and the range is narrow indicating a consensus.

The distribution by percentage for these responses is indicated in Table 2. 70% of the respondents found that they had some improvement in remembering names. 100% of the respondents found that they could remember the content of a lecture more accurately. 100% found that they could keep better track of multiple pieces of information at once and 90% found that they could see an improvement in remembering the content they studied for an exam after the training. This is an average of 90% improvement overall for memory skills. This is indicated in the pie chart below in figure 1.
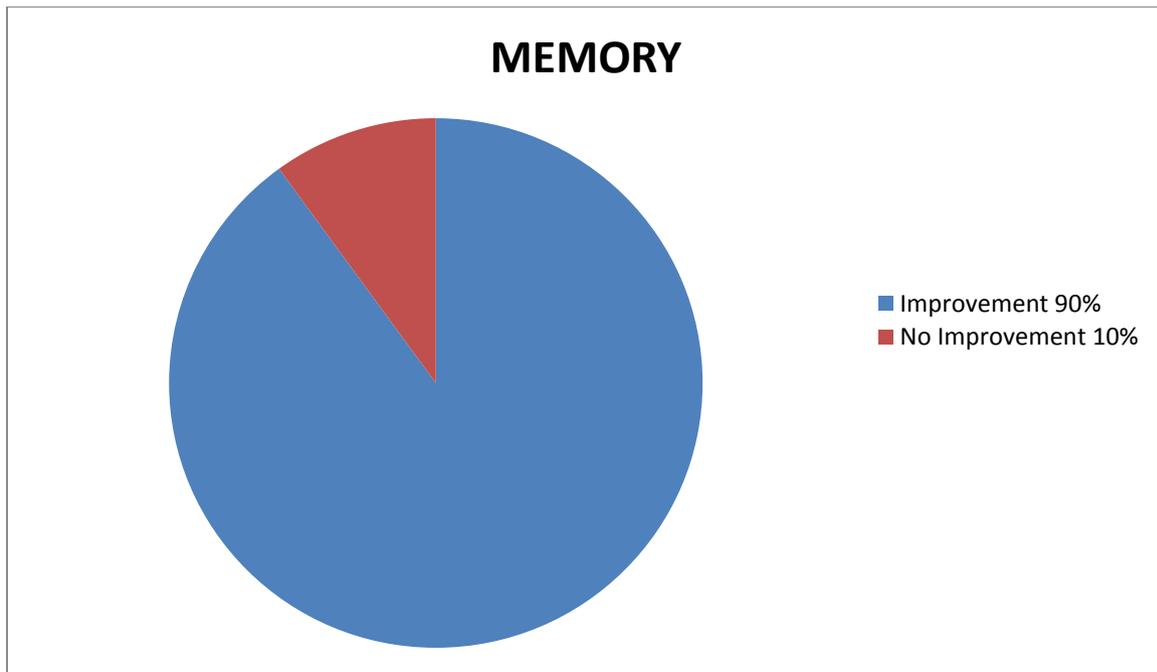
MEMORY

- ■ Improvement 90%
- ■ No Improvement 10%

Figure 1 above indicates that an average of 90% of responses chosen were in categories 3 – 5 which indicates that respondents viewed there memory skills to have shown some improvement. An average of 10% of the responses chosen were in categories 1 and 2 indicating no improvement.

A summary of the results for category 2: Memory Skills

Responses indicate that respondents found a small improvement in their memory skills, including being able to remember the content of a lecture more accurately, being able to keep better track of multiple pieces of information at once, and being able to better recall information studied for exams.

CATEGORY 3: ATTENTION SPAN

Table 3: Mode, median, range and distribution of answers by percentage for question 10 – 13 relating to the category: Attention Span.

				Distribution of responses by percentage: 1=No improvement 2= Not sure 3= Minor improvement 4=Quite a bit of improvement 5= Major improvement				
QUESTIONS	MODE	MEDIAN	RANGE	1	2	3	4	5
10. Paying better attention to more than one thing at once.	3;4	4	2	0%	0%	40%	40%	20%
11. Better attend to key information in large text	4	4	2	0%	20%	20%	50%	10%
12. Better concentration in class	4	4	3	10%	10%	20%	60%	0%
13. Less distracted by distractions while completing a task	4	3.5	3	10%	10%	30%	50%	0%

Questions 10 – 13 pertain to the cognitive skill type: Attention span. The mode for question 10 was equal indicating the same frequency of responses for minor improvement and quite a bit of improvement. The modes were 3 and 4. The median was also 4. The range indicates little difference in the answers by the respondents. This indicates that respondents feel that they are better able to pay attention to more than one thing at once, after the training.

Questions 11 – 13 all have a mode and a median of 4 indicating that respondents perceived an improvement in being able to attend to key information in a large text, that they are better able to concentrate in the classroom and that they are less distracted by outside distractions when completing a task. This is indicated in table 3.

The distribution of responses for questions pertaining to improvement in attention span as indicated in Table 3 above, indicate an 80% - 90% response ranging between option 3 – 5 which indicates and improvement perceived by the respondents in their attention span after the online training programme. This is illustrated in Figure 2 below.
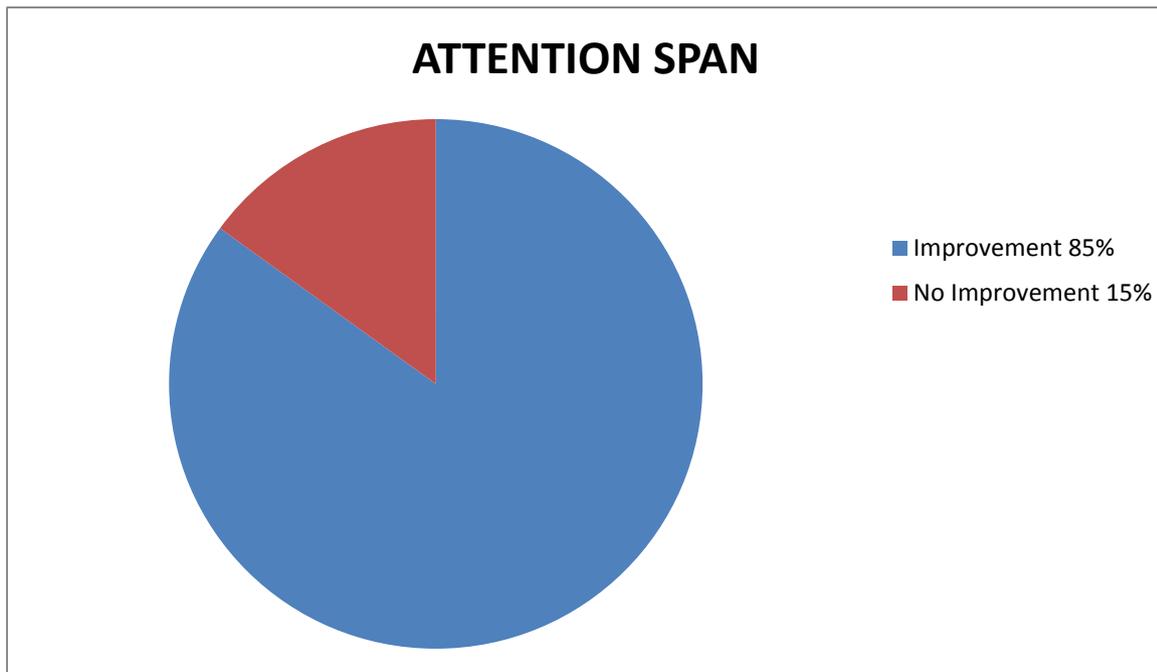

Figure 2: Distribution of responses for attention span

Figure 2 above indicates that 85% of the responses in the category: Attention Span, indicated some improvement, ranging from choice nr 3 – 5. 15% of the responses indicated no improvement, ranging from choice nr 1 – 2.

Summary of results for category 3: Attention Span

Responses indicate that respondents found an improvement in being able to concentrate in class and were less distracted by outside distractions. They were able to better attend to key information in a large text.

CATEGORY 4: SPEED OF PROCESSING

Table 4: Mode, median, range and distribution of answers by percentage for question 14 – 18 relating to the category: Speed of Processing.

				Distribution of responses by percentage: 1=No improvement 2= Not sure 3= Minor improvement 4=Quite a bit of improvement 5= Major improvement				
QUESTIONS	MODE	MEDIAN	RANGE	1	2	3	4	5
14. Making faster decisions in time-pressured situations	3	3	4	10%	10%	40%	30%	10%
15. Improvement in recalling recent information	4	4	4	0%	10%	30%	40%	20%
16. Better control in changing focus	4	4	2	0%	0%	40%	50%	10%
17. Reacting faster to questions	4	4	2	0%	0%	40%	50%	10%
18. Work faster with fewer errors.	4	4	2	0%	10%	30%	50%	10%

Questions 14 – 18 of the survey instrument pertained to speed of processing. Question 14 asked respondents to answer if they can make faster decisions in time-pressured situations after completing the training. The mode and median is 3 for this question, indicating a small improvement being perceived by the respondents. The range is big which shows responses on both sides of the scale. The mode and median for questions 14, which relates to improvement in recalling recent information, is 4, indicating that most respondents felt that there was quite an improvement. Question 16 – 18 all have a mode and median of 4 indicating that respondents perceived quite a bit of improvement in being able to reorganise themselves when their focus of attention is changed, that they can react faster to questions and work faster with fewer errors. These statistics are indicated in table 4 above.

SPEED OF PROCESSING

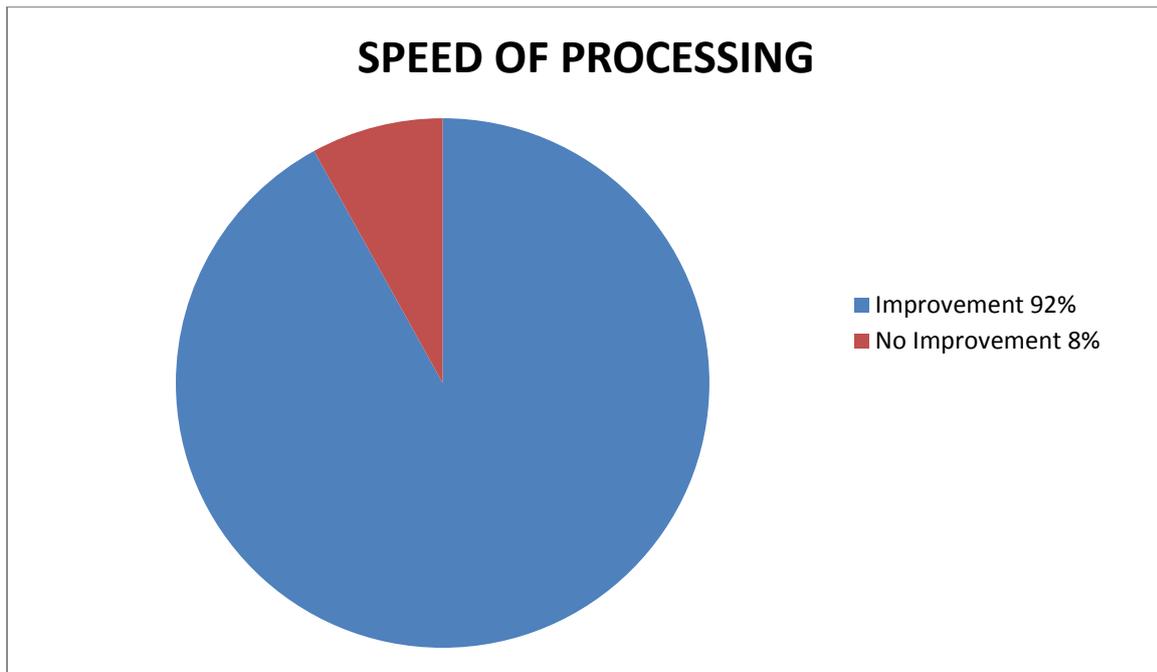Figure 3 — Pie chart: Improvement 92%, No Improvement 8%

Figure 3 above indicates that an average of 92% of responses chosen were in categories 3 – 5 which indicates that the respondents speed of processing skills have shown some improvement. An average of 8% of the responses chosen were in categories 1 and 2 indicating no improvement.

Figure 3 above indicates that respondents viewed their speed of processing skills to have improved with more than 90% of responses showing some improvement.

Summary of results for category 4: Speed of Processing

Respondents perceived quite a bit of improvement in being able to reorganise themselves when their focus of attention is changed, that they can react faster to questions and work faster with fewer errors.

CATEGORY 5: PROBLEM-SOLVING SKILLS

Table 5: Mode, median, range and distribution of answers by percentage for question 19 – 218 relating to the category: Speed of Processing

				Distribution of responses by percentage: 1=No improvement 2= Not sure 3= Minor improvement 4=Quite a bit of improvement 5= Major improvement				
QUESTIONS	MODE	MEDIAN	RANGE	1	2	3	4	5
19. Reason more logically to find a solution	4	4	3	0%	10%	30%	50%	10%
20. Were your exams easier to complete?	3	3	4	10%	10%	50%	20%	10%
21. Better mental calculation of figures	3	3	4	20%	10%	40%	10%	20%

The purpose of this category is to ascertain whether the respondents felt that they had improved in being able to do logical reasoning and mental calculations.

Questions 19 to 21 pertained to problem-solving skills. The mode and median for question 19 was 4, indicating that respondents perceived a small to relatively large improvement in being able to reason more logically to find a solution. The range is 3. The mode and median for question 20 is 3, indication a small improvement being perceived by respondents in being able to complete their exams. The mode and median for question 21 is also 3, indicating a perceived small improvement in being able to calculate figures mentally. This is indicated in table 5 above.

The distribution of responses for question 19 to 21 as indicated in table 5 show an overall average improvement of 87% of the responses if they are divided into 1-2 and 3 – 5. This is illustrated in figure 4, a pie chart below.

PROBLEM SOLVING

■ Improvement 87%
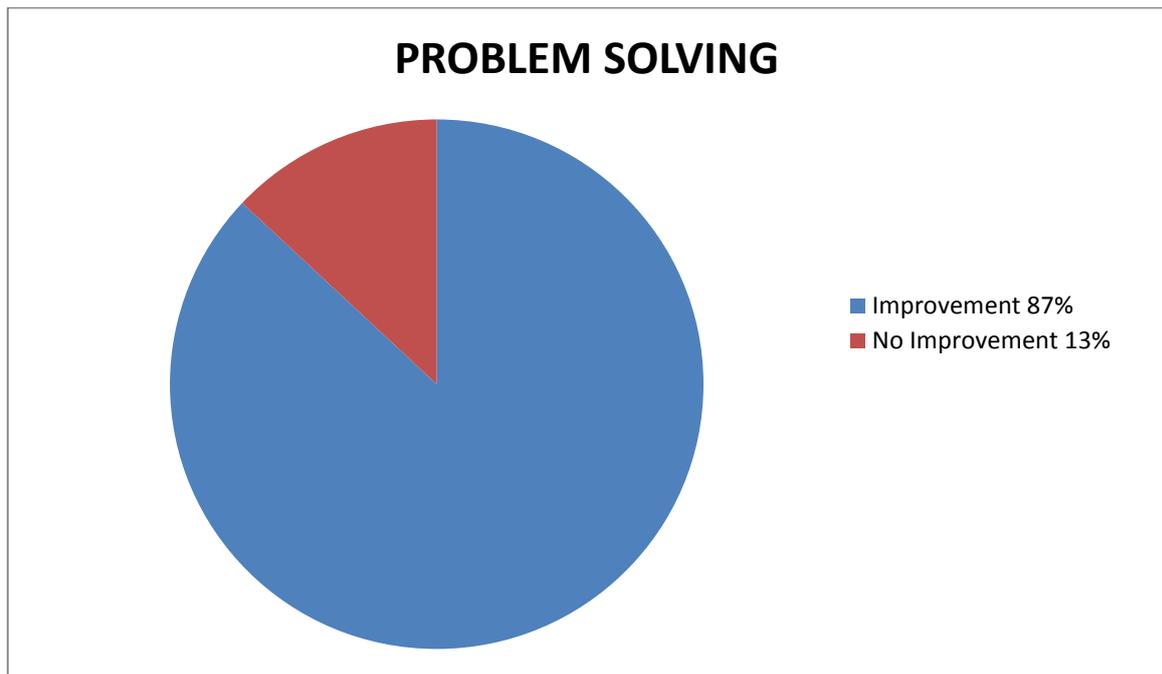■ No Improvement 13%

Figure 4 above indicates that an average of 87% of responses chosen were in categories 3 – 5 which indicates that the respondents saw an improvement in their problem-solving skills. An average of 13% of the responses chosen were in categories 1 and 2 indicating no improvement.

Figure 4 indicates that most respondents felt that their participation in the training programme improved their problem-solving skills.

Summary of results for category 5: Problem-Solving skills:

Respondents found an improvement in being able to reason logically to find a solution to a problem, as well as a slight improvement in successfully completing their examinations and being able to calculate figures mentally.

CATEGORY 6: RESPONDENTS' ENJOYMENT OF THE TRAINING PROGRAMME

Table 6: Mode, median and range and distribution of answers by percentage for questions 1 – 7 of the Lumosity experience section of the survey instrument.

				Distribution of responses by percentage 1=strongly disagree 2=Disagree 3= Neutral 4=Agree 5= Strongly agree				
QUESTIONS	MODE	MEDIAN	RANGE	1	2	3	4	5
1. Lumosity Website easy to use	5	4	3	0%	20%	10%	30%	40%
2. I enjoyed the training games.	5	5	2	0%	0%	20%	20%	60%
3. Looked forward to participating three times a week	4;5	4.5	1	0%	0%	0%	50%	50%
4. Participated more than three times a week	5	5	2	0%	0%	30%	10%	60%
5. Believe it was beneficial to my memory and attention skills	4	4	2	0%	0%	30%	40%	30%
6. Recommend programme to my friends	4;5	4	2	0%	0%	20%	40%	40%
7. Will continue training after research period	4	4	2	0%	0%	10%	50%	40%

The second set of questions related to the respondents' perceived enjoyment of the experience of training with the online brain-training program. There are 7 questions in the

survey related to this category. Responses are coded from 1 – 5, with 1= strongly disagree and 5= strongly agree.

The mode for all 7 questions ranges between 4 and 5 as well as the median for each question. The range is an average of 2. This indicates that most of the respondents felt that the Lumosity website was easy to use and enjoyed the training games. Respondents agreed that they looked forward to participating 3 times a week and even participated more than 3 times a week. Most respondents also believe that it was beneficial to their memory and attention skills to participate in the research study. They would recommend the programme to their friends and continue their training after the research period.

Descriptive statistics for the 7 questions are indicated above in table 6 with the mode, median and range of each question's responses as well as the distribution of responses by percentage.

Summary of results for category 6: Respondents enjoyment of the training programme.

Respondents showed tremendous enthusiasm for the programme. 100% of the responses were positive on whether they enjoyed the programme, 100% of the respondents indicated that they looked forward to the training exercises 3 times per week. 100% of the responsdents believed it was beneficial and would recommend the training to their friends. 100% of the respondents indicated that they would continue with the training after the research period.

6. Discussion of findings

The results of this study showed that by training on a web-based cognitive training programme, a variety of positive cognitive outcomes were perceived by the respondents.

The respondents improved on their scores as they progressed through the training. This improvement was also transferred to everyday tasks.

The findings show that respondents found a small improvement in their memory skills. Although the scoring on memory was lower than other cognitive skill types explored, the distribution of responses showed an average of 90% improvement perceived by respondents in their ability to remember names, remember the content of a lecture more accurately and remembering the content of what they studied for an exam more efficiently.

Indications are that respondents found a bigger improvement on their attention span than on their working memory. Respondents feel that they were better able to concentrate on more

than one thing at a time, as well as an improvement on being able to attend to key information in a larger text. One of the results in this group is very important to the purpose of this study as it indicates that respondents were better able to concentrate in the classroom and were less distracted by outside distractions.

Results also indicate that respondents perceived to experience quite a bit of improvement in being able to reorganise themselves when their focus of attention is changed, that they can react faster to questions and that they can work faster without errors.

An average of 80% of the responses indicated that there was a perceived improvement in being able to reason logically to find a solution, being able to complete exams easier and being able to calculate figures better mentally.

Findings are consistent with several studies performed with brain-training programmes that have achieved positive outcomes (Hardy; Scanlon: 2009).

This research indicates that there was a high level of enjoyment by the respondents. It was indicated by the results of this survey that not only did the respondents participate the requested 3 times per week, but practiced more often as it is perceived to be fun. It is also indicated that they would suggest the programme to their friends.

Results therefore indicate that this training was perceived by the respondents to be able to improve a wide variety of core cognitive skills from memory to attention, speed of processing and problem-solving skills.

7. Recommendations

Much still needs to be researched in terms of how the brain is able to change at any stage of the life-cycle. There are as many articles that prove that brain-training does not have any effect on a person's cognitive abilities as there are articles that show positive results. Therefore further exploration, especially in terms of how it can benefit higher education students and young adults, is recommended.

According to Sondlo & Subotzky (2010) a considerable number of students entering the higher education system in South Africa are academically unprepared for higher learning. The matric results of 2014 showed a 78,2% pass rate of which only 30.2% of those students received university exemption. But can those students cope with the tertiary learning environment? According to Mouton et al (2013), first year students find it difficult to adapt to the higher education environment and that one of the major challenges facing higher education institutions today is to improve pass and graduation rates, particularly noting that

language as well as reading and writing skills are a barrier to success. Sondlo and Subotzky (2010) state that this leaves the burden of responsibility and additional cost with the higher education sector, to develop and support underprepared students. There is an urgent need to develop effective success strategies and student support frameworks by higher education institutions. (Sondlo; Subotzky: 2010)

As the Lumosity program is clearly enjoyed by the students, and is available as a free application on most smart devices today, it is recommended that it could be suggested to students at the start of the academic year, as the results of this study and other studies mentioned here show that cognitive abilities, which are so important in achieving success, can be enhanced by such a programme.

8. Conclusion

According to Hardy and Scanlon (2009), cognitive abilities like attention span, working memory and fluid intelligence are critical building blocks for learning. Improving these abilities prepares and enables the mind to take in and process information. It also prepares the student by improving their ability to attend to, focus on and remember classroom activities. This research lends more proof that certain cognitive training programs can improve cognition, and have a positive effect on young people's lives and academic achievement. The research supports the view by Lumosity researchers that intelligence can be changed in adults and shows the potential of such training to help increase performance. (Lumosity Labs: 2014)

The studies mentioned in this article indicate that the way we view cognition and the brain's ability to change throughout life is changing. Could we enhance the preparedness of our matriculants by encouraging the development of these skills though such a programme and thereby ease the burden of the higher education institutions to increase pass rates and graduation rates? In South Africa, we are in need of solutions to expand the success rates of higher education and should take note of avenues such as a cognitive training programme, even if it is not conventional.

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ANNEXURE A: QUESTIONNAIRE

Dear Respondent,

This is a study conducted by a student at the Independent Institute of Education whilst completing a Post Graduate Diploma in Higher Education.   The primary goal of the study is to explore the benefits of a web-based cognitive training programme.

You will have to register on the website www.Lumosity.com. The website will ask you to do a "fitness test" on the first day of training. From then on you can train as much as you like, but a minimum of 3 times a week for a period of four weeks. The aim of the questionnaire is to obtain feedback on your experience after completing the training. The focus of the questionnaire is on determining whether the training was indeed beneficial to develop your cognitive skills.

The questionnaire is anonymous and all information will be treated as highly confidential. Thank you in advance for the taking the time to complete the questionnaire.

All questions pertain to the participation of the respondent in the Lumosity Online Cognitive Training Programme. Questions relate to Lumosity categories and results.

PLEASE ANSWER THE FOLLOWING QUESTIONS BY TICKING THE CORRECT OPTION BELOW:

A. VIEWS ON YOUR COGNITIVE SKILLS

Definition of Cognitive skills:

Cognition has to do with people's understanding of the world. It is a set of skills and abilities which are part of human actions. These abilities are brain-based skills that need to be carried out before the

simplest of tasks can be completed. Cognition has to do with how we learn, how we remember, how we solve problems and how we pay attention rather than actual knowledge(Michelon, P:2006).

Please indicate below if you experienced any of the following benefits after the completion of your online cognitive training with the Lumosity brain training programme.

Rate your perception of improvement from 1 to 5. 1 indicates no improvement and 5 indicates a big improvement.

	1 NO IMPROVEMENT	2 NOT SURE	3 MINOR IMPROVEMENT	4 QUITE A BIT OF IMPROVE-MENT	5 MAJOR IMPROVE-MENT
GENERAL					
1. Did you see an improvement in your scores after each training session?					
2. Do you find that you have better visual attention, in other words you can better locate a target in your vision amongst a complex landscape?					
3. Did the training give you an emotional sense of accomplishment?					
Did you enjoy the training?					
4. Do you find that you have a heightened focus while driving?					
5. Do you find that your sleep patterns have improved?					
MEMORY					

6. Do you find that you remember names better?					
7. Do you find that you can remember what was said in class more accurately?					
8. Do you find that you can keep track of multiple pieces of information in your head better?					
9. Do you find that you are able to remember the content of your studies better for exams?					

ATTENTION

10. Do you find that you can pay better attention to more than one thing at once?					
11. Do you find that you can attend better to key information in a large volume of text?					
12. Can you concentrate better in class and while you are studying?					
13. Do you find that you are less distracted by outside distractions while completing a task?					

SPEED

14. Are you able to make faster decisions in time-pressured situations?					
15. Is there an improvement in how quickly you can recall recent information?					
16. Can you quickly reorganise yourself when your focus of attention is changed?					
17. Can you react faster to questions?					
18. Do you find that you can work faster and with fewer errors when completing a written piece of work?					

PROBLEM-SOLVING

19. Do you find that you can reason more logically about a problem to arrive at a solution?					
20. Were your exams easier to complete after the training?					
21. Can you mentally calculate figures better?					

B. HOW DO YOU RATE THE LUMOSITY EXPERIENCE?

PLEASE RATE YOUR EXPERIENCE OF THIS TRAINING PROGRAMME BY TICKING THE APPROPRIATE BOX NUMBERED 1 TO 5.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I found the Lumosity website functional and easy to use					
2. I enjoyed the training games					
3. I looked forward to participating and did not have to force myself to do it three times a week					
4. I participated more than three times a week					
5. I believe that the training was beneficial to my memory and attention skills					
6. I would recommend the programme to my friends					
7. I will continue the training after the					

research period of 4 weeks for my own benefit					

THANK YOU FOR PARTICIPATING IN THIS RESEARCH PROJECT!