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Brain Breaks: Help or Hindrance?

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Abstract
Current trends in educational neuroscience indicate that the brain needs frequent downtime for optimal learning. One way of achieving this in the classroom is with brain breaks. Physical movement brain breaks are the most commonly used, but there is less evidence that compares different types of brain breaks and their effectiveness in promoting student refocus after the brain break is complete. This investigation, in one primary classroom, mapped three different types of brain breaks against student enjoyment/engagement, and the time it took students to refocus on their work. Differences were noted in students' enjoyment levels of the types of brain breaks and the time it took students to refocus on their work following the activity.

Keywords: brain breaks, student focus, on-task behaviour

Introduction
This investigation centred on one Grade 3 Mathematics classroom. It was based on the premise that students need regular downtime throughout the day in the form of brain breaks to allow for refocusing the brain on learning concepts and retention of factual information (Jensen, 2008). Mathematics was chosen as the sample subject due to its high profile in the curriculum and daily lesson length.

Mathematics is an important part of the Australian Curriculum where it features both as a subject (Mathematics) and as a General Capability (Numeracy). As a subject, students need to be confident with concepts and number facts, and are continually developing skills. As a General Capability, students need to be able to apply their mathematical knowledge and skills to other areas of the curriculum. In addition, the Australian Institute for Teaching and School Leadership has produced Professional Teaching Standards, one area of which covers Professional Practice (AITSL, 2011). This study focuses on Professional Practice in Mathematics, therefore making a contribution to quality teaching.

The purpose of the investigation was to identify the impact of three different types of brain breaks on two student outcomes: enjoyment /engagement in the activity, and the students' ability to refocus on their class work immediately following the brain break. The research was guided by the following question:

What effect do three types of brain break activities have on students' enjoyment/engagement and their ability to refocus during Mathematics lessons?

Background
In the past few decades educators have explored many of the findings from neuroscience research and applied them to the classroom with claims of improved learning (Spaulding, Mostert, & Beam, 2010). The number of programs based on how the brain works best continues to increase, and many teachers are welcoming these innovations and adopting them in their teaching practice (Ansari, 2008).

The brain is a highly complicated organ that thrives on movement and according to Hannaford (1995, as cited in Norman, 2003, p. 21), "movement is essential for learning". A number of theorists in education have recognized the need for teachers to incorporate movement and breaks so that optimal learning is achievable by students. Brain Gym® is one such program developed by Paul and Gail Dennison (1989). This program encourages the brain body development by stimulating a variety of muscles and parts of the brain as well as the endocrine system. Although there is some doubt that this program lives up to its claims of improved academic achievement, Stephenson (2009) concedes that "doing Brain Gym®

exercises provides a break that may increase alertness" (p. 119). There is, however, documented evidence that giving students a break during lessons using well-developed activities positively impacts on students' vision and reading comprehension (Norman, 2003; Greany & Rodd, 2003).

Sprenger (1999) supports these claims, emphasising the importance of physical and emotional involvement in learning, claiming that most learners can concentrate for approximately their age plus two minutes. She stresses that in between each of these time frames, educators should provide students with the opportunity to be physically and emotionally engaged. Research by Reilly, Buskist, and Gross (2012) claims that movement in the classroom boosts brain power; and the connection between physical activity and learning is well documented (Ratey, 2008). Despite these researched links between physical activity and academic achievement, there is limited evidence that structured physical activity is regularly incorporated into primary classrooms beyond Physical Education classes (Kibbe, Hackett, Hurley, McFarland, Godburn Schubert, Schultz, & Harris, 2011).

Brain breaks in the classroom

One way that physical activity can be incorporated into the classroom is through the use of brain breaks. Brain breaks are simple transitional physical and mental exercises designed to equip the teacher with tools to manage the physiology and attention of the class and to keep children in the most receptive state for learning. Enhanced learning through movement (educational kinesiology) increases the oxygen in the bloodstream and leads to improved concentration, which enhances children's readiness to learn. If these movements are structured then the whole mind body system is activated. This stimulates the nervous system across the whole brain (Teaching Expertise, 2004).

Brain breaks facilitate opportunities for students to breathe, relax, recharge and refocus. High concentration can cause physical and emotional tension in students and brain breaks reduce this tension, allowing students to remain in the instructional level of learning (Townsend, 2004).

Breaks during a lesson have also had a positive impact on learners' motivation and achievement (Greany & Rodd, 2003). Exercise and movements in the forms of Brain Gym®, have been proven to have a positive effect on students' enjoyment during learning, their motivation for learning and their focus (Greany & Rodd, 2003).

Several studies have been conducted involving primary school students, where regular physical activity breaks were given during the school day, and there was a proven impact on their academic performance, as well as their academic focus and behavior in the classroom (Reilly, Buskist, & Gross, 2012). Further claims are being made that brain breaks used in the classroom raise students' achievement levels (Teaching Expertise, 2004). Children successfully learn when the information they receive is given in smaller quantities, and at regular intervals. Expecting children to focus for extended periods without a break is unreasonable, which is why brain breaks are so popular. This approach keeps the brain active and alert. The Dennisons (1989) have pioneered this field with their Brain Gym® program and The Hawn Foundation (2011) has developed a similar program named the Mind Up Curriculum®, which incorporates brain focused strategies to improve learning and living. This program has been tested in classrooms and has been found to improve students' reflection and focus (Hawn Foundation, 2011). Supporting this research is Jensen (2008) who claims that shorts bursts of physical activity positively impact circulation and dopamine production therefore increasing attentional states.

While all children can benefit from brain breaks, there is also increasing evidence that children with special needs such as attention deficit disorder require downtime, as much if not more, than mainstream students. Giving them an opportunity to have a break and then refocus, allows them to perhaps improve their standard of work (Ramsay & Rostain, 2003). Silver (2004) maintains that adopting a brain break approach gives students with attention deficit disorder a fair chance to learn and achieve.

Some educators, however, subscribe to brain-based learning theories with a degree of skepticism, rising out of an alleged scarcity of empirical evidence (Spaulding, Mostert, & Beam, 2010) and advise rigorous trialling rather than unquestioned acceptance of brain-based learning strategies.

Types of brain breaks

There are a variety of brain break activities that educators have identified and these can be categorised into three groups: those based on breathing or relaxation, those based on vigorous physical activity and those which focus on mental activity, plus any combination of the three, for example standing and pretending to ride a surfboard while enjoying the feeling of skimming over the waves (Gay, 2013).

Breathing exercises have been used for at least three decades by Dennison and Dennison (2004) and generally involve some kind of deep breathing. Dent (2003) also recommends deep breathing and visualization in the classroom to maintain focus and increase student well-being. Breathing exercises are often coupled with stretching exercises such as neck rolls to relieve stress and relax students (Dennison & Dennison, 2004).

Physical brain breaks have a vigorous physical component. Incorporating a physical element into brain breaks gives students an opportunity to alleviate stress, improve physical fitness, and develop fine and gross motor skills (Teaching Expertise, 2004). Jensen (2005) presents a strong case for movement to be integrated into everyday learning, but suggests that not all breaks must be high activity as even standing up or stretching adds value to learning.

Mental brain breaks take a variety of forms and may be used to increase focus and/or improve fine motor skills (Maskell, Shapiro, & Ridley, 2004). These brain breaks may or may not involve movement and generally take the form of a learning game, or similar activity.

Brain breaks and Mathematics

Mathematics is given high priority in the primary school curriculum, yet it proves difficult for some children to master. Whether this is due to perceptions passed from parents, unfounded gender stereotyping or other reasons (Minetola, Ziegenfuss, & Kent Chrisman, 2014), the combination of mathematical concepts with skill acquisition places high cognitive loads on children which may result in heightened levels of anxiety or brain fatigue due to focused concentration for lengthy periods of time. The Board of Studies and Teaching and Educational Standards NSW (2014) mandated time for Mathematics instruction is 20% of teaching time or approximately one hour per day. Therefore it appears logical that these sessions should be broken into smaller learning chunks. Using brain breaks is one way of achieving this.

The nature of Mathematics is such that it contains specific terminology to master, and known concepts must be applied to increasingly difficult problems, requiring the use of memory and higher order thinking. By allowing students to take breaks during this period of deep level concentration and thinking, to refresh and refocus, they are given an opportunity to excel and enjoy learning (Stigler & Hiebert, 2004).

In summary, the literature is generally supportive of the concept of using brain breaks in the classroom to promote focused attention and learning. Three kinds of brain breaks: mental, physical and relaxation/breathing are identified in the relevant literature, but there is scant direction as to the best type of brain breaks for maximum focus and learning during Mathematics classes. In addition, while there is potential to use knowledge of how the brain works to improve classroom instruction, there is still plenty of scope for empirical evidence.

Method

The research design and method were tailored to provide an unbiased and trustworthy answer to the research question. The investigation took a case study approach to the topic (Lichtman, 2013) by focusing on three variables (brain breaks) and two outcomes (refocus time and enjoyment/engagement) within one Grade 3 classroom. Because it was felt that student perceptions alone would not give a clear picture of the effectiveness of the various brain breaks, three research instruments: student surveys, timed records of refocus times, and the teachers' anecdotal notes were used to provide a measure of triangulation (Cresswell & Plano Clark, 2011). All test times were conducted during Mathematics classes to provide a measure of control as it was felt that conducting the intervention across a range of subjects may introduce further variables that could skew the results.

The site was a Grade 3 classroom of 26 students in a NSW primary school. All children participated in the research activities as a part of their normal daily program but participation in the survey was voluntary, with all children choosing to participate.

Three types of brain breaks identified in the literature were chosen to be implemented over three weeks as part of this investigation. The three were:

1. Relaxation and breathing brain breaks
   These activities (Rainstorm, Breathing, Plank or Plonk, Zoom, and Spin) were designed to change the breathing pattern and facilitate oxygenation of the brain as well as calm the students.
2. Highly physical brain breaks
   These activities (Macarena, Find the Leader, Kick Boxing, Find it Fast and Tangled) were designed to get the children up and moving vigorously to facilitate oxygenation of the brain and release tense muscles.
3. Mathematics related activities
   These activities (Double Dice, Step Tag, Telephone, Swat It and Coin Toss) were designed to promote a moderate level of physical activity to oxygenate and de-stress the body. They took the form of Mathematics games that slightly shifted the direction of the lesson but kept a mathematical focus.

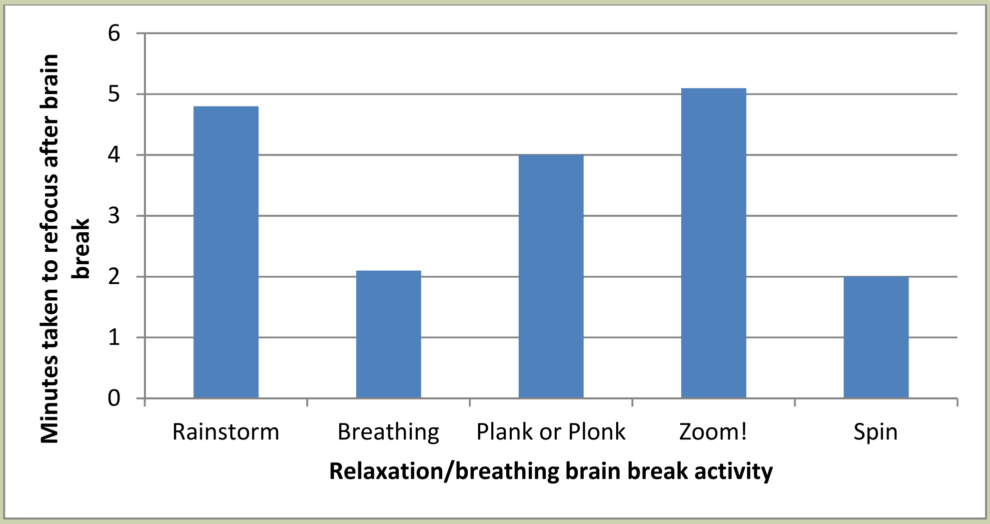
Each brain break activity type was put into practice for a period of one week. During that week a different activity of that type was implemented each day. One five-minute brain break was taken during each Mathematics lesson.

Measures were taken to ensure the order of activities was random and would not influence the results. After each brain break, the teacher-researcher timed how long it took for all class members to refocus. This was recorded along with anecdotal notes. On the last day of each week, students were invited to complete a short survey of their perception of enjoyment and ability to refocus after the brain breaks. A short comparative post-intervention survey was also administered.

Findings and Discussion

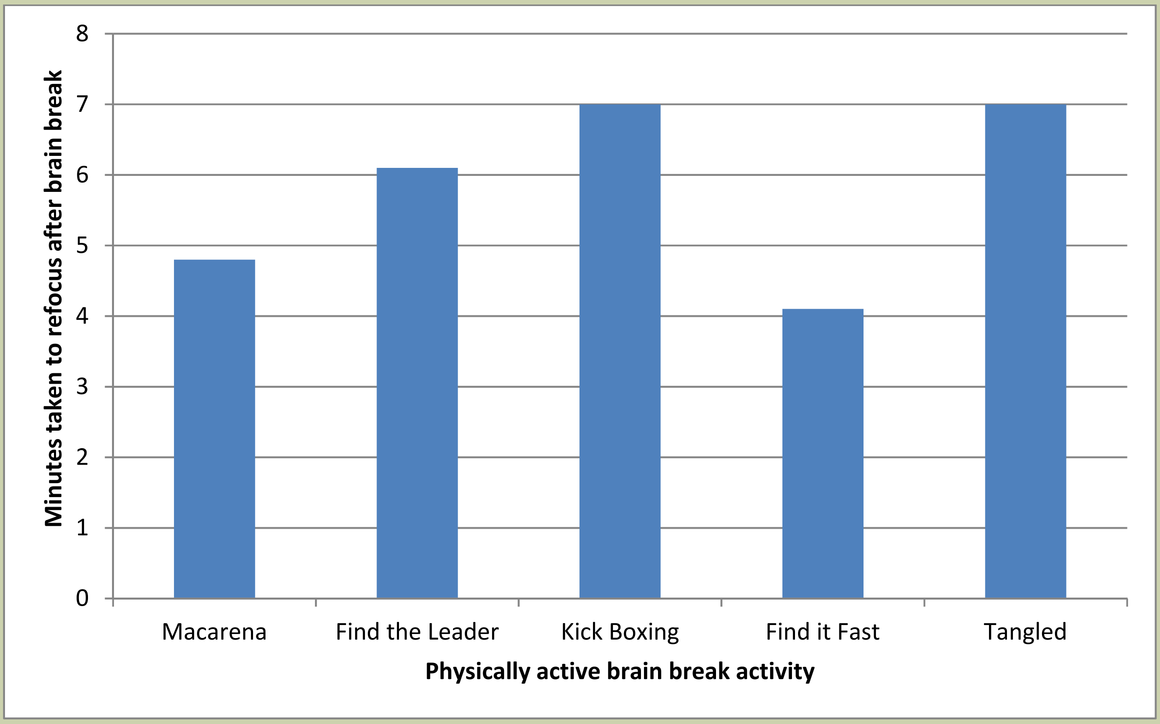
During the first week the brain break activities focused on relaxation and breathing. The majority of the students gave the activities a low enjoyment ranking with some actively resisting participation. This could indicate either a dislike for slower, quieter activities due to the students' stage of development or the fact that they were new and different activities with which they were unfamiliar. The time it took for students to refocus and return to their work ranged between two to five minutes, with a weekly average of three minutes 36 seconds (see Figure 1). Students appeared fidgety and restless for the first one to two minutes after completing the brain break, and although most of the students regained focus soon after this point, the timer was not stopped until all students were settled.

Figure 1: Refocus time for relaxation and breathing brain breaks



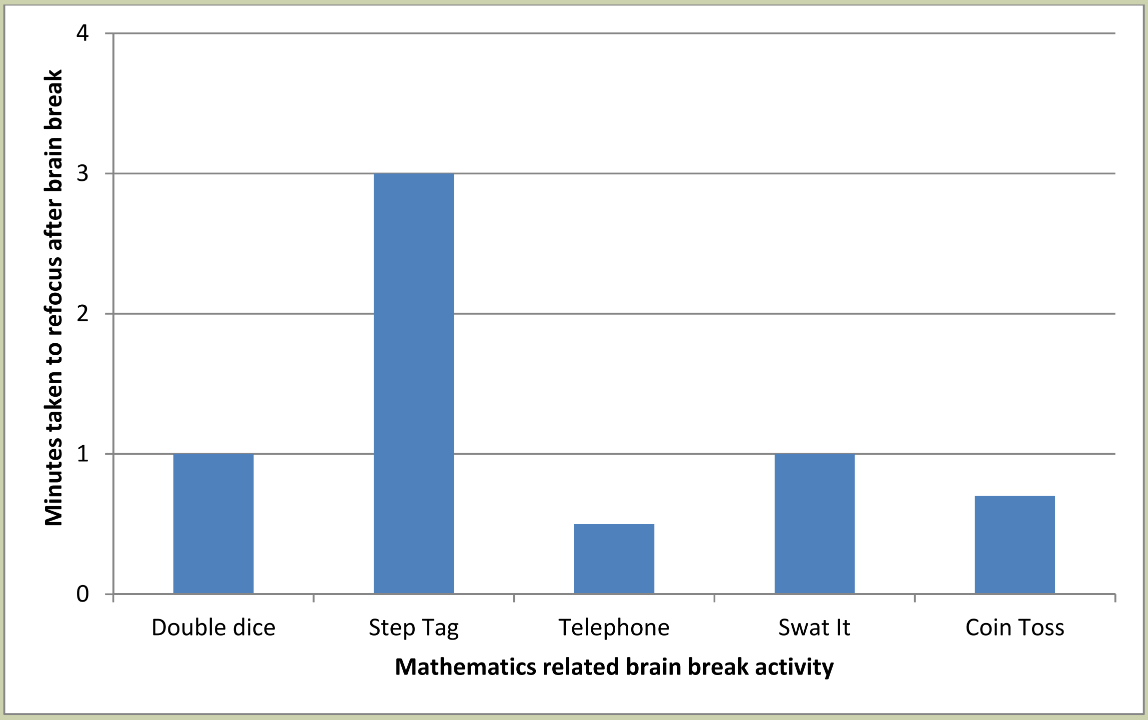
The brain break activities for the second week were all highly physical in nature. Students' engagement during the activities was a lot higher than the previous week, indicating their enjoyment. Once the brain break was completed and students returned to their work, the level of conversation and distraction was noticeably higher with more restlessness evident after the break than before it. Although the students were engaged during these breaks, the time it took to refocus on their work was considerably longer, with the average refocus time for the week being five minutes 48 seconds. After two brain breaks (Kick Boxing and Tangled), the class took seven minutes for everyone to transfer their attention back to their work (see Figure 2). This meant, including the brain break activity, a total of ten minutes of lost time or 30% of learning time for the lesson. If this data is an accurate representation for all highly physical brain breaks, then teachers may need to assess whether the chosen brain breaks are a time effective activity, or perhaps develop a regular routine to minimise distraction. Although the literature was in favour of active brain breaks (Hannaford, 2005; Reilly et al., 2012; Ratey, 2008; Jensen, 2005), this finding indicates that active movement in the classroom may lead to a state of excitability and teachers may need to put strategies in place to protect against the loss of learning time.

Figure 2: Refocus time for physically active brain breaks



During Week Three of data collection, the activities were all Mathematics related and although some physical activity was involved, it was not at the high energy levels of Week Two. Whilst all activities were game-like, some were relevant to the topic currently being taught in class and others were not. There was a definite contrast between Week Three and the previous two weeks in regard to the time it took the whole class to refocus. Students were distinctly faster at returning to their work after completing activities that were on topic, with the average time for the week being one minute 24 seconds (see Figure 3). These results are noteworthy as the average was skewed by Step Tag, after which it took the class three minutes to settle; more than double the time for any other brain break activity during that week. It was observed that this was probably due more to confusion about how to play and lack of space that resulted in animated discussion about the fairness and difficulty of the game, rather than to the mathematical concept on which it was based. From this observation, it would be fair to say that in order to foster beneficial learning during and after brain breaks, activities should be at the children's ability level and be fair, as both these factors have the potential to affect students' ability to refocus on the given tasks afterwards. It was also observed that the children were actively engaged in the Mathematics related brain breaks to the same extent as they had been engaged in the highly active ones the previous week.

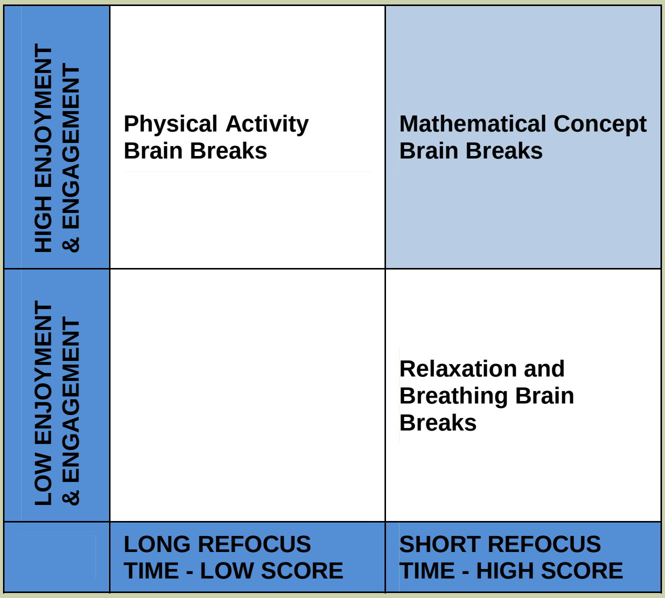
Figure 3: Refocus time for Mathematics related brain breaks



At the end of the three weeks, data for enjoyment of activities and response time to refocus were compared. When asked to indicate their preferred activity type, 8% of children chose relaxation and breathing brain breaks, 36% chose mathematical concept brain breaks, and the remaining 56% chose the physically active brain breaks as their favourite. However, when students were asked which activity type was easiest to refocus after, the order changed to 24% responding with relaxation brain breaks, 36% with physically active brain breaks and 44% with mathematical concept brain breaks. It is possible that some students misunderstood the question and ranked according to enjoyment, as the student perception results did not entirely correspond with the times recorded by the teacher, who concluded from her data that brain breaks with a high physical component had the longest refocus time. The teacher and student data did agree, however, that Mathematics related brain breaks facilitated a shorter refocus time.

Although physically active brain breaks topped the student preferences, teacher observation notes reported high levels of enjoyment and engagement during the mathematical related brain breaks, in fact, comparable levels to active brain breaks. Using both the student perception data and the teacher records, each week's activities were mapped onto a simple four quadrant grid that shows low and high levels of enjoyment and engagement against short (high) and long (low) response times (see Figure 4). Physical brain breaks scored high on enjoyment but low on length of refocus time; relaxation/breathing brain breaks ranked low on enjoyment but high on length of refocus time. Mathematically related brain breaks with a moderate level of physical activity ranked both high on enjoyment and high on length of response time, putting them into the desired quadrant for optimal engagement and refocus and therefore, hopefully, for learning.

Figure 4: Enjoyment and response time mapped against each other.



The results indicated that of the three types of brain breaks used in this classroom-based research, brain breaks that related to the subject content and used moderate amounts of movement achieved the best results in terms of combined enjoyment and refocus time. Although the highly physical brain breaks were voted the most enjoyable, the lost time factor for refocusing did not make them nearly as time effective as the other two types of brain breaks. This finding presents a slightly different perspective to most of the current literature which promotes brain breaks of a physically active nature, (Gay, 2013; Hannaford, 2005: Kibbe et. al., 2011; Jensen, 2005), instead indicating a moderate activity level to be more effective when it comes to refocus time after a brain break.

Future research directions and recommendations for practice

There are three recommendations rising out of this practitioner-based research:

1. Teachers who utilise brain breaks in their own classroom should perhaps explore a range of brain breaks to determine which is best suited to their class;
2. Teachers should weigh up the advantages and disadvantages of high enjoyment/high physical activities against the total time lost out of the lesson before implementing brain breaks of this nature; and
3. Teachers should establish a routine of brain-breaks in their classroom over an extended period of time before making judgements on their effectiveness.

This investigation highlighted some future directions for research into the use of brain breaks in classrooms. The focus of this study was Mathematics. It would be interesting to see if the results were similar for literacy and other subjects. It would also be valuable to extend the time period of a study of this nature as the novelty of brain breaks, especially high activity ones, may have contributed to the general class excitement and inability to refocus on their work. A third interesting direction would be to explore brain breaks across a wide range of year levels to determine if enjoyment and refocus time of the brain breaks changes from stage to stage or age to age.

This study focused on engagement during the brain break and refocus time after the brain break, but did not identify whether the brain break increased the focus of the students in the class once they had settled, or the duration of their on-task behaviour. This could also be the focus of further research.

Conclusion

While this was a single Mathematics class research, and therefore cannot be generalised to the total population of Grade 3 students, the results give an indication that brain breaks, although useful in the classroom setting, need to be chosen carefully and monitored closely to maximise their potential. It is acknowledged, in this case study, that the research time may not have been long enough to establish a classroom routine of brain breaks, thus impacting the results. In this investigation, however, the use of subject content related brain breaks with a moderate activity level proved to be the best option in terms of both student engagement and time taken to refocus the class.

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