Back to Urth Article

by Elize Janse Van Rensburg

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TITLE

Promoting the development of foundation phase learners in under-resourced environments using Ayres Sensory Integration® principles and custom-designed, low-cost playgrounds

ABSTRACT

Introduction: Children from under-resourced environments often lack opportunities to engage in sensory experiences that support developmental abilities and scholastic performance. "Back to Urth" playgrounds were designed to address the developmental needs of foundation phase learners in under-resourced communities. A 12-week sensory-motor program, based on Ayres Sensory Integration® (ASI) principles, was developed, and educators were trained to present this program on a "Back to Urth" playground at a rural school in the Free State. This study aimed to determine the effect of the program, on the development of Grade R and Grade 1 learners.

Method: Learners from two comparable, no-fee schools were included in this experimental non-randomised pre-test-post-test control group design study. Learners from one school participated in the sensory-motor program on the "Back to Urth" playground (n=40), and learners from the other school served as the control group (n=41). The effect of the program was measured with the Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition (Short Form), Revised Ayres-based Clinical Observations, and the Optima School Readiness Assessment.

Results: An improvement in scores for both groups, with the experimental group showing statistically greater improvement in their Revised Ayres-based Clinical Observations and Optima School Readiness Assessment total scores were indicated.

Conclusion: This research provides evidence that sensory-motor components subserving learning can be improved when learners are exposed to a sensory-motor program designed within the framework of ASI®, presented by educators on a low cost "Back to Urth" playground.

KEYWORDS

Sensory-motor, development, low-cost sustainable playground, sensory integration, educators

INTRODUCTION

> *Children are the foundation of sustainable development. The early years of life are crucial not only for individual health and physical development but also for cognitive and social-emotional development. Events in the first few years of life are formative and play a vital role in building human capital, breaking the cycle of poverty, promoting economic productivity, and eliminating social disparities and inequities*[1].

Involvement of the researchers (including two occupational therapists and an educationalist) in rural communities in the Xhariep district, Free State, South Africa, not only led to the awareness of the developmental needs of children in the foundation phase of education but also the outcry of educators for support with developmental stimulation programs for children from under-resourced communities, attending rural schools.

One of the efforts to address these needs was the design and construction of sustainable, low cost "Back to Urth" playgrounds. The concept of the "Back to Urth" Playgrounds was developed by one of the researchers based on research done at the Department of Occupational Therapy, University of the Free State (UFS). This research indicated that children from under-resourced environments in South Africa experience developmental delays and consequent functional problems, which in turn has an impact on their performance in school and other occupations[2]. These problems result in barriers to learning which can seldom be fully remediated.

"Back to Urth" playgrounds are designed to provide sensory-rich experiences, with an emphasis on the tactile-, vestibular- and proprioceptive, systems, that support sensory integration and thus function. The uniqueness of these playgrounds is that each part of the playground is designed using principles based on Ayres Sensory Integration® (ASI), as well as results from research done at the Occupational Therapy Department, UFS[3]. This ensures that definite balanced sensory experiences are provided that support specific developmental abilities needed for successful scholastic performance.

The playgrounds are designed to allow children from under-resourced communities to access play apparatus which provides them with balanced sensory-rich experiences that support development[4]. Main sections of the playgrounds are constructed with a low-cost, eco-friendly building method, making it a sustainable solution for communities lacking in resources and infrastructure. The building of the playgrounds was initially done in collaboration with the

Department of Development Studies, UFS and Qala Phelang Tala (QPT), a non-profit company working towards sustainable human settlements[5]. Venter[5] introduced this sustainable building method to one of the researchers in 2014 who then recognised it as a possibility for the construction of "Back to Urth" playgrounds. The building process works on the principle of community participation and collaboration between different stakeholders, where skill transfer is prioritised, and the relevant community's/school's involvement is a priority. This whole initiative forms part of a collaborative training platform of the Faculty of Health Sciences, UFS, where students, community members, existing private, public and third sector organisations/structures and volunteers come together to create pathways, partnerships and initiatives that enables skill development and service delivery to marginalised communities.

Each playground is uniquely designed depending on the space available, needs of the school/community, materials obtainable, human resources and finances available. After completion of a playground at a school, the educators receive training on the optimal use of the playgrounds.

Considering the given information the question that existed was whether opportunities for exposure to a sensory-motor program, based on ASI® principles, presented on a "Back to Urth" playground by educators, would enhance the development of skills and functions needed for the learning process in a mainstream school.

LITERATURE REVIEW

Leading to the research question some of the latest research[1], on brain development in children indicates that 700 to 1,000 new neural connections are formed every second in a child's brain. This emphasises the importance of "the formative influence of early childhood experience"[1] especially if the fact that the pace of brain development slows down with age, is taken into consideration. This also confirms what Jean Ayres hypothesised on, and as stated by Ayres[6:1-2]: "...early (brain) connections set the foundation on which later connections are built". According to UNICEF[1] "early childhood care, protection and stimulation can jumpstart brain development, strengthen children's ability to learn, help them develop psychological resilience and allow them to adapt to change".

Statistics on the performance of learners in primary education in South Africa confirms that educators' concerns and need for help are not unfounded. A report on the annual national

assessment of 2014 indicated that Grade 3 learners in South Africa obtained an average of only 56% for both literacy and numeracy[7].

Looking at school assessment criteria (National Curriculum and Assessment Policy Statement (CAPS)), definite standards are set for learners to achieve by the end of the Grade R year. It is expected that a Grade 1 learner should be physically, cognitively, affectively, normatively, sociocultural and linguistically prepared for functioning on a certain standard when starting his/her school career[8]. In the September 2016 monthly report of the Xhariep District Based Support Team (DSBT) it was indicated that 39 referrals were received from the foundation phase of one school in this district of which 32 were from learners who by far did not meet the basic standards for their grades due to suspected developmental delays[9].

The reality is that children who are raised in poverty or under-resourced environments often lack opportunity for environmental stimulation and exploration as well as social interaction, collectively impacting on their development. The functional difficulties these children experience include poor use of their body in three-dimensional space, which can functionally be seen in their poor gross- and fine motor performance[2]. These children fail to develop the abilities that support their writing- and reading skills and result in poor school performance and school failure resulting in the perpetuating cycle of poverty.

Important abilities such as postural control, bilateral coordination, fine and gross motor coordination, the planning of new movements and visual perception are all basic performance components. These components, amongst others, support reading and writing and depend heavily on sensory integration which contributes to a child's capacity to learn and function successfully[6]. Sensory integration is a framework constructed by Dr Jean Ayres and is based on her work on patterns of perceptual-motor dysfunctions. According to Ayres[6], sensory integration can be defined as a neurological process that organizes sensations from one's body and the environment and makes it possible to use the body effectively in the environment. Ayres strongly felt that "behaviour is linked to neurological processes, and that brainstem-level sensory processing enables higher neural centres' to develop and specialise"[6:2], thus influencing development and successful participation in daily activities.

Many sensory-motor stimulation programs exist. Sensory-motor programs, designed within the framework of ASI® and implemented in under-resourced communities where the Occupational Therapy Department of the UFS are involved, are compiled using the 'The Wall Model Adapted Version'[10]. The Wall Model Adapted Version is designed according to Ayres theory that "a child's

development unfolds in a sequence and is influenced by the experiences a person has during development"[11:7]. The Wall Model Adapted Version includes the important sensory-motor components that subserve function and that are dependent on the integration of sensory information. The developmental components are theoretically arranged and indicate an approximated developmental trajectory and the dependence of one component on the other[10]. This model was designed for the use of intervention planning. It supports the fact that a child's development is dependent on participation in activities of daily life inclusive of exposure to sensory-motor activities impacting on movement skills, cognitive, emotional and social development[12]. This model allows for clinical reasoning during intervention planning as well as for grading and was thus an important guiding model, together with the pre-test results, in the compilation of the activities for the sensory-motor program that was implemented.

Sensory integration is regarded as a specialist field within the profession of occupational therapy. However, the researchers argued that due to realities within the South African context the majority of children growing up in under-resourced environments will very rarely be exposed to specialist occupational therapy services. A real-world problem of developmental challenges due to poor sensory integration existed. Building low-cost playgrounds, allowing for sensory-rich experiences, together with the development of balanced sensory enriched programs to be implemented by educators could result in addressing this problem.

AIM

The study aimed to determine the effect of a 12-week sensory-motor program designed within the framework of ASI, presented by educators on a low cost "Back to Urth" playground, on the development of Grade R and Grade 1 learners attending a rural, mainstream school in the Free State.

METHODOLOGY

The researchers valued research as a way in which pragmatic knowledge could be created. A classic quantitative research methodology was implemented, using formal assessments and controlling variables leading to new knowledge in the fields of occupational therapy and education. The study employed a classic experimental non-randomised pre-test-post-test control group design. A pilot study was conducted to ensure the feasibility of the use of the identified measuring instruments before the main study to test and refine the measurement procedures. The learners involved in the pilot study were from another town and results were thus not included in this study.

Participants

Two comparable schools were included in the study – one school served as the experimental school and the other as the control school. The schools are situated 10km apart in two adjacent rural towns in the Free State. Both schools are classified as no-fee schools and had feeding schemes in place for learners, the schools had a similar number of learners and educator-learner ratio, and both schools used Afrikaans as their language of teaching and learning. The demographic profile of the learners in both schools was similar concerning gender, race, socio-economic background and home language. A "Back to Urth" playground had been built at the experimental school in the year before the research. The playground was enclosed with a fence and learners of the school did not have access to the playground until the study commenced. The control school did not have access to a "Back to Urth" playground.

Learners of the schools were included in the study, in either the experimental or the control group, if they were enrolled in Grade R or Grade 1 for the first time in the year of the study. Their parents or legal guardians provided informed consent and the learner gave assent in an age-appropriate manner to participate in the research. Learners with diagnosed mental or physical disabilities and learners who were ill or absent from school at the time of the execution of the assessments were excluded from the study. In the experimental group, an exclusion criterion was set for learners who had not participated in at least 80% of the intervention sessions. At the control school, the relevant criteria were applied and testers continued testing until a similar number of participants in each grade and gender group were achieved, as for the experimental school.

Measurement instruments

Learners from both the experimental and the control groups were assessed at the respective schools before the implementation of the sensory-motor program, and again after the 12-week intervention period. Two measurement instruments assessing sensory-motor performance and one assessing school performance were used. The two sensory-motor tests were the Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition, Short Form (BOT-2 SF)[13] and the Revised Ayres-based Clinical Observations[14]. The school performance test used was the Optima School Readiness Assessment[15].

The BOT-2 SF assesses motor proficiency and consists of 14 items drawn from the eight subtests of the complete Bruiniks-Oseretsky Test of Motor Proficiency 2nd Edition (BOT-2)[13] representing a broad range of motor abilities. The BOT-2 SF provides a single, sufficiently reliable score of

overall motor proficiency. Raw scores achieved by a learner on the 14 items are converted to point scores and then to a norm-referenced composite standard score. Since this norm-referenced test was standardized in North-America, standard scores achieved would not necessarily reflect the abilities of South African children in comparison to their peers, but rather to a contextually diverse normative sample. However, despite this limitation, the test did allow for reliable comparison of pre- and post-test scores of the experimental and control groups to one another. The BOT-2 SF has demonstrated good test-retest reliability (r=0.86 for ages 4-7) and excellent interrater reliability (r=0.98 for ages 4-7)[13]. The reliability of the BOT-2 SF was also investigated in rural communities in Australia, demonstrating acceptable reliability for use in rural communities[16].

Twelve sets of the Revised Ayres-based Clinical Observations that have been part of Ayres' original work in sensory integration[17] were included for this study. These clinical observations have assisted occupational therapists over many years to distinguish typical sensory-motor developmental patterns from immature/delayed developmental patterns. The items included in the Revised Ayres-based Clinical Observations for this study were: asymmetrical tonic neck reflex, symmetrical tonic neck reflex, eye movements, forearm rotations, thumb-finger touching, finger to nose test, supine flexion posture, prone extension posture, equilibrium reactions, gaze stability, arm extension and trunk rotation, and midline crossing. Some observations contained more than one item (such as testing the left hand and right hand separately, and then bilaterally on the forearm rotation observation), resulting in a total of 30 sub-items that were rated for each learner. A five-point rating scale was used to rate each learner's performance according to the following classification:

1 – totally unable to perform the action
2 – attempts but only achieves partially
3 – able to perform, poor control / not well integrated
4 – good performance, slight inconsistencies and lacks some integration
5 – executes with ease, good control / well integrated

The Optima School Readiness Assessment was developed by Le Roux[15] to assist educators of foundation phase learners to obtain a "differentiated view of the level of school readiness of learners in [their] class"[15:1]. The Optima School Readiness Assessment, developed specifically for the South African context, is widely used by educators in the Xhariep District, including the Inclusive Education unit where one of the authors are employed. The results of this test can be

used diagnostically by the educator to ascertain a learner's level of learning readiness and to assist those learners who experience learning challenges. The test consists of five subtests assessing the following functions: visual perception, spatial/number concept, auditory perception, socio-emotional development and fine/gross motor development. Most of the test items can be administered in small groups.

Measurement procedures

Parental informed consent forms were distributed by school staff, on behalf of the researchers, and returned to relevant educators. The same procedure was followed for the pre-test and the post-test at both the experimental and the control schools. The sensory-motor tests (BOT-2 SF and Revised Ayres-based Clinical Observations) were administered by qualified occupational therapists who had received additional research-specific training by the authors. The Optima School Readiness Assessment was conducted by an educational specialist trained in the use of the Optima School Readiness Assessment. To limit rater bias, pre-intervention assessments results were not available to the test administrators when they did the post-tests. Additionally, pre- and post-tests were done at least 12 weeks apart making it difficult to remember the performance of a learner and limiting rater bias. The nature of the study did not allow for blind testing of children of the experimental and control groups, as the location of their school determined group allocation.

Testing of learners was done during school hours. Prior arrangements with the schools ensured that participation in the study did not result in any loss of learning opportunities for learners in the classroom. Learners were tested in a pre-arranged, suitable venue at their relevant schools. The relevant test administrator collected learners and established a rapport before they were individually tested. For the Optima School Readiness assessment, test items were presented in small groups except for the auditory memory and gross motor which were presented to learners individually.

Description of intervention

The experimental group participated in the sensory-motor program that was presented by educators on the "Back to Urth" playground situated at the school. The intervention program was compiled by the researcher who was responsible for the design and development of the "Back to Urth" playground. The educators of the Grade R and Grade 1 classes received training in the presentation of the program. A third educator was also included in the training to allow for substitution in the case of absence of one of the two other educators. The researcher responsible

for the design of the playground and intervention program was available for support/consultation throughout the intervention period.

The intervention program consisted of sensory-motor activities designed using ASI® principles and specifically for use on a “Back to Urth” playground. The pre-test results were also considered in the design of the intervention program. The playground at the experimental school consisted of ten constructed apparatus. Activities included crawling up- and rolling down a “mountain”, walking over a tyre bridge constructed from recycled tyres, balancing on a 4x4 see-saw, and swinging on swings in different positions and directions. The program was graded twice during the intervention period. Grading allowed for variation in sensory experiences and also requiring different and more advanced abilities as learners progressed through the program.

Learners of the Grade R and Grade 1 classes at the experimental school participated in the intervention program for one or two sessions a week for twelve weeks, depending on the school program. The educators provided the children with instructions on what to do on the different pieces of equipment and also determined the time spent on each piece of equipment. This was done to ensure that all the children played on all the different apparatus according to the program, during a session. To ensure that all learners in the study participated in at least 80% of the intervention program sessions, the educators were requested to keep a record of attendance and absenteeism.

Learners at the control school continued with their normal educational program at their school for the duration of the 12 weeks following pre-testing. After completion of the intervention, program post-testing was done in the same manner as the pre-testing.

Data management and analysis

Demographic information and all the pre-test and post-test results were captured electronically on an Excel Spreadsheet by the test administrators, where after one of the researchers checked the transfer of data systematically for transfer errors. Continuous variables were summarised by medians, minimum, maximum or percentiles. Categorical variables were summarised by frequencies and percentages. Within-group changes were evaluated using the Singed Rank for paired data. Differences between groups were evaluated using the Wilcoxon Two-Sample test for unpaired data. The analysis was done by the Department of Biostatistics at the UFS, using Statistical Analyses Software (SAS 9.4).

Ethical considerations

The study was approved by the Health Sciences Research Ethics Committee (HSREC), University of the Free State (HSREC 167/2016) and permission for the study to be conducted at public schools was obtained from the Free State Department of Education, as well as the respective school principals. Participation in the study was voluntary. Learners' parents/guardians provided written informed consent, and learners gave assent. There was no remuneration involved in participation in the study. Information collected during the study was dealt with confidentially and participants' identities were protected by using participant numbers and storing documents with personal information such as consent forms separate from research data.

The educators of both schools received general feedback on the performance of the children, as a group, after the study was completed. In cases where a learner's test results were indicative of serious developmental- or functional skill problems that could result in poor school performance more specific feedback was provided to the educators, as was agreed to in the parental consent form. Recommendations regarding possible support for these learners in the classroom were provided and arrangements with different stakeholders e.g. the Department of Health were initiated.

The school acting as the control school was provided with a workshop for the foundation phase educators once the post-testing had been completed. The workshop aimed to provide them with knowledge on sensory-motor development of Grade R and Grade 1 learners. They did not have access to a "Back to Urth" playground like the one at the experimental school, thus an adapted program was presented, with limitations due to the absence of a playground. This action was

taken for the learners at the control school to also benefit from participation in sensory-rich motor activities.

RESULTS

Table I depicts the final number of participants in each grade and gender group for both the experimental and control schools. For both the two sensory-motor tests, the results of 40 learners from the experimental school and 41 for the control school were included and calculated. All the learners of the experimental school attended more than 80% of the sessions. One of the learners of the experimental school relocated during the research period and had to be excluded.

Insert Table I: Number of participants in the final sample

The distribution of Grade R learners to Grade 1 learners, as well as the distribution of male to female learners, were similar for the experimental and control groups. The samples in both schools included more Grade 1 learners than Grade R learners, and more male than female learners.

Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition Short Form

When administering the BOT-2 SF, a total point score is obtained, and a standard score is calculated by comparing the child's total point score to normative data of the test for children of the same age. The BOT-2 SF standard score has a mean of 50 and a standard deviation of 10. The median score obtained by the experimental and control groups on pre- and post-testing with the BOT-2 SF are reported in Table II.

Insert Table II: BOT-2 SF standard scores

The difference between the experimental and control groups on pre-testing was not significant ($p=0.81$), demonstrating similarity and thus comparability of the two groups before the intervention commenced. Following intervention, both the experimental group and the control group showed an improvement in their median standard score from pre-testing to post-testing.

Comparison of the difference in median standard score from pre- to post testing shows an improvement of 8 points for the experimental group and only 4 points for the control group. However, the difference between the scores of the two groups was not significant (p=0.59).

Revised Ayres' Clinical Observations

Twelve observations, consisting of a total of thirty sub-items, were scored for each learner using the described five-point rating scale. Each learner could obtain a total rating score between 30 and 150. The median, minimum and maximum total rating score for the experimental and control groups on pre- and post-testing are depicted in Table III.

Insert Table III: Revised Ayres' Clinical Observations total rating scores

The median total rating score for the experimental and control groups was similar and thus comparable before the intervention. The experimental group's median total rating scale improved from 112 to 125 post-intervention, while the control group improved slightly from 113 to 118.

To ascertain whether the improvement in the experimental group was significantly greater than that of the control group, the difference between the total rating score for each learner on pre- and post-testing was calculated by subtracting the pre-test score from the post-test score. A positive value would thus indicate improvement, and a negative value would indicate a decline in performance. The difference for the experimental and control groups was then compared, and a 95% confidence interval was calculated to determine the significance of the difference. The results are depicted in Table IV.

Insert Table IV: Revised Ayres Clinical Observations difference between total rating scores

Both groups showed improvement in the median difference between the pre-test and post-test total rating scores. The improvement in the experimental group was, however, significantly more than that of the control group ($p<0.0001$).

Optima School Readiness Test

The Optima School Readiness Test was conducted on different days than the motor tests (BOT-2 SF and Revised Ayres' Clinical Observations). As a result, some learners were not included in the results for the Optima School Readiness Test due to absenteeism. There were complete test results for 36 learners in the experimental group and 34 learners in the control group. Table V depicts the median scores obtained by the experimental and the control groups on pre- and post-testing respectively, for each subtest of the Optima School Readiness Test (subtest name and maximum possible score indicated in the left-hand column). The p-value, calculated by means of the signed-rank test for paired non-parametric data, for the difference between the median pre- and post-test scores for each group is also indicated.

Insert Table V: Optima School Readiness Test median scores obtained

Results indicate that the experimental group obtained significantly better results on 15 of the 21 subtests, as well as on the total score after the intervention. Although the control group also obtained significantly better results on the total score on post-testing, their subtests scores only showed significant improvement in six of the 21 subtests. Both groups performed better in these six tests on post-testing, namely Gestalt perception, visual memory, discrimination, memory, number concepts and fine motor skills. Subtests in which the experimental group improved significantly, but not the control group, were perception of shapes, incomplete man, visual sequencing, auditory analysis, picture riddles, sense of direction, midline crossing, life skills and gross motor skills.

The difference between the pre- and post-test scores for the two groups on the OPTIMA was calculated to evaluate whether the experimental group showed significantly more improvement in their pre- and post- difference of the total test score. The p-value was [$p<0.00$], indicating that the experimental group showed a significantly greater improvement in performance than the control group

DISCUSSION

The study aimed to investigate the effect of a sensory-motor program, designed within the framework of ASI®, presented by educators on a sustainable, low-cost playground, on the development and performance of foundation phase learners. The post-test results of the BOT2-SF did not indicate a significant difference in the sub-test scores or the total test scores. Clinically, the experimental group did appear to improve more than the control group. However, this change was not large enough to demonstrate significance as was the case in the other assessment instruments used.

The Revised Ayres' Clinical Observations' results showed an improvement for both groups. Although both groups showed improvement in the median difference between the pre-test and post-test total rating scores, the difference for the experimental group was significantly more than for the control group, providing definite evidence of the effect of the intervention. It is noteworthy to report that the breakdown of scores, items related to functions supported by the vestibular system and specifically balance, showed the most significant improvements. The vestibular system is stimulated by moving through three-dimensional space in different planes and for the activities included in the program, this was a requirement.

The results of the Revised Ayres' Clinical Observations are promising and in support of the positive effect of a sensory-motor stimulation program, designed within the framework of ASI®, and presented by educators on a sustainable, low-cost playground, can have on foundation phase learners, attending a rural school's, sensory-motor development.

Results of the Optima School Readiness Test showed an improvement for both groups on six tests during post-testing. The test items for Gestalt perception, visual memory, discrimination, memory, number concepts and fine motor skills are all targeted abilities that receive attention in the classroom and could, therefore, explain why both groups performed better. The test items for sense of direction, midline crossing, and gross motor skills, where the experimental school performed significantly better can directly be attributed to the intervention as it were abilities that were addressed in the program. Perception of shapes, incomplete man, visual sequencing, auditory analysis, picture riddles, and life skills are amongst the test items commonly linked to higher cognitive functions. Ayres already hypothesized in the 1960s that higher cognitive functions are dependent on lower brain function and then specifically sensory integration[6] and more and more evidence is currently mounting, supporting this hypothesis[12]. Results of this

research support evidence for improved sensory integration in learners of the experimental group which could have contributed to improved performance on these test items.

LIMITATIONS

The study had a limited number of participants and results of bigger samples of learners are needed. This study only investigated the short-term impact as the intervention was conducted over three months. Blinding of fieldworkers conducting the pre- and post-assessments were not possible, as the experimental and control groups were from two different schools.

CONCLUSION

Sensory integration theory allows for the explanation of function, the planning of intervention (using knowledge from an ASI® framework, sensory-rich activities to be engaged in on a specific playground was designed), and it was predicted that function could change due to the intervention (knowing that exposure to purposeful, enriched foundational body-centred sensory activities can impact on learning)[12,18]. This research provides evidence that sensory-motor components subserving learning can be improved when learners are exposed to a sensory-motor program designed within the framework of ASI®, presented by educators on a low cost "Back to Urth" playground. Learning barriers can, therefore, be prevented with consistent exposure to the playground.

This research contributed to the knowledge and practice field of sensory integration in occupational therapy. It contributed to the real-world challenge of a scarcity of occupational therapy services in under-resourced communities in South Africa where the majority of children are growing up. Building low-cost playgrounds, allowing for sensory enriched experiences, together with the knowledge and skill transfer to educators to implement programs, such as the one used in this study, can assist in addressing the developmental challenges experienced, due to poor sensory integration, and have a positive impact on school performance.

Research investigating the difference between a program as implemented in this study versus individual ASI® intervention is also recommended. Evidence exists that individual ASI® intervention does impact positively on the development of toddlers from a low socio-economic setting that was born prematurely[19] but we do not know what the difference in impact will be when individual ASI® intervention is compared to intervention that is only based on ASI® principles and presented by educators to a group of learners.

A longitudinal study on the longterm impact of such a program on a Back to Urth playground is needed as this study was done under controlled conditions and we need to know what the impact will be if a program is presented within the normal realities of a school program and over a prolonged time.

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