Griffith UNIVERSITY

Early-years swimming

Adding Capital to Young Australians

Final Report

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Robyn Jorgensen

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Contact

For further information, please contact

Professor Robyn Jorgensen,

Faculty of Education, Griffith University,

Ph: +61 7 3735 5876

Email: r.jorgensen@griffith.edu.au

For more information

Email: earlyyearsswimming@griffith.edu.au

Web: www.griffith.edu.au/education/early-years-swimming

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Executive Summary

Background

The Early-Years Swimming Research Project has been conducted over four years. It has centred on an examination of the possible benefits that may accrue for under-5s who participate in swimming lessons.

The importance of learning to swim at a young age cannot be disputed. With accidental drowning being the leading cause of death in under-5s, it makes good sense for all young Australians to develop water safety skills from a very early age.

Further, Australia is a nation whose national psyche is based on water activities, whether enjoying the water through personal recreation or through cheering on our elite swimmers in the pool.

Participating in swimming has rewards too for health and fitness. But unlike other physical or intellectual pursuits undertaken by children in the years prior to schooling, formal swimming lessons can commence at a much earlier age than other activities. Water familiarisation activities can start soon after birth with baby's first bath and formal lessons start in many swim centres for babies as young as four months. No other baby-centred leisure activity commences at such a young age.

As a result, the learn-to-swim industry has grown dramatically in the last thirty years.

The focus of this study is to investigate whether or not young children gain more than just swimming skills if they participate in early-years swimming.

This project has used a number of research techniques to explore the benefits, if any, participation in early-years swimming offers beyond swim skills for young children.

Research Questions

(a) What, if any, are the physical and intellectual benefits of learning to swim for under-5s?

(b) What factors enhance the benefits in different learn-to-swim contexts?

Within these questions, we also sought to explore:

- Are there gender or social class differences in the achievements of early-years swimmers?
- What other factors may impact on outcomes?
- Are there factors related to pedagogy and the quality of swimming environments that need to be considered?

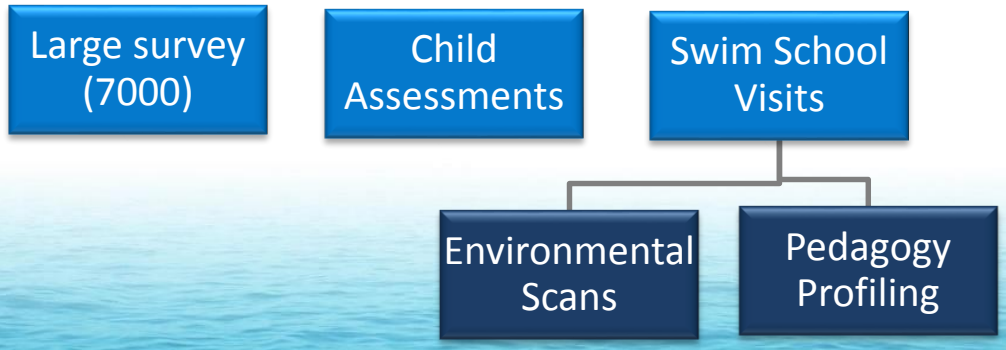
Approach

The study has utilised three main approaches:

1. A large-scale survey has been conducted over each of three years where parents identify, from a comprehensive list of international indicators (or milestones), the achievements of their children. Just under 7000 responses have been received over this period. Against these developmental measures, parents are reporting that their swimming children are achieving these milestones well before the normal expectations. A major limitation of this method, however, is that there is a risk of parental bias and results may represent parent over-estimation of their child's achievements, rather than their actual performance.

2. To address this possible bias, a study of 177 children, aged 3, 4 and 5 years from Queensland and New South Wales, has been undertaken. Using internationally- recognized tests, (Woodcock Johnson III for cognitive and language development; Peabody Developmental Motor Scales-2 for physical development), children were independently assessed.

3. Environmental and pedagogy scans of swim schools were undertaken in order to develop a sense of the swimming industry and what best practices are evident within that context. Sites in New South Wales, Victoria, South Australia, Queensland and New Zealand were visited. Using tools developed for this project, audits were taken of the school sites and how swimming was being taught. This part of the project has highlighted the diversity across swim schools and the need for some measures/discussion on what constitutes quality teaching and learning.



Results

The two stages – survey and child testing – have shown that there are considerable differences between the "normal" population (as a statistical measure) and children who participate in early-years swimming across a range of skills. These differences are related not only to physical development – as would be expected from an industry that focuses on gross motor skills – but also importantly in areas of language and cognition. It may be argued that this is hardly surprising given that the cost of swimming lessons acts as a filter – that the children of families from middle to upper socio-economic families can afford access – so that our findings are a reflection of the social strata rather than the possibilities of swimming to add capital to young children. Sampling techniques were used to ensure that the study included families from all social strata. This would ensure validity in the claims that are made. The survey has shown considerable differences between normal milestones and when swimming children are reported to achieve them. This result could be the bias of parental reporting where parents over-estimate their children's performance. To confirm the results from the survey, the intensive child testing was used to moderate the survey results. Similarly, the data from the child assessments have shown that there are significant differences between the swimming cohort and the normal population, regardless of socio-economic background or gender. The child testing has shown that swimming children are often months or years ahead of their same age peers in the normal populations of the tests that were used.

One would anticipate that children who engage in activities that develop their physical skills would perform better on measures of this type so it is unsurprising to report that the children do well in areas that require them to use their bodies for movement (such as hopping, walking, running, or climbing stairs). What is surprising, and of interest to parents, educators, and policy makers, is that the children also score significantly better on measures that related to their visual motor skills (which includes skills such as cutting paper, colouring-in and drawing lines); gross motor stationery skills (eg. standing on tiptoes, standing on one foot, imitating movement, performing sit-ups); oral expression (being able to speak and explain things, etc.); and achieving in general areas of literacy and numeracy and mathematical reasoning. It was also found that the children scored better on measures of understanding and complying with directions. Swimming children performed at levels of very high significance in relation to normal populations ($p>0.001$). Many of these skills are needed in formal education contexts so it would appear that swimming children may be better prepared for their transitions to school. This is a considerable advantage that is well beyond the swimming skills and water safety skills advocated by the swim industry.

While the data were overall encouraging, with the children participating in early-years swimming scoring better than the normal population, there were a few measures where they underperformed. Areas where the children did not display advanced learning in comparison with the normal populations, notably occurred in the manipulation of objects – these test items were based on ball handling skills.

Limitations

While these results are very promising, in such an unregulated industry care needs to be taken: practices are not necessarily consistent across all swimming schools. There is considerable variation across sites and parents selecting a swim school would be well advised to choose their schools carefully. If the child is to gain in other areas of child development, then the swim environment and swim teachers/lessons need to be of a consistently high quality. As part of this project, we have conducted site visits to audit swimming school environments and to profile the pedagogies used in swimming lessons. This will be discussed later.

Summary

- Children who participate in early-years swimming appear to be achieving many milestones earlier than the normal population – across areas of physical, cognitive and language development – regardless of social background or gender.
- Intensive testing of children using internationally-recognized tests, confirmed that swimming children often performed significantly better than the normal population across many measures of physical, cognitive, social and linguistic measures.
- Many of the skills that the early-years children are scoring well on have value in schooling and other areas of learning so they are likely to be better prepared for the transition to school.
- There is considerable variation in the programs and facilities offered by swim schools. These may influence the quality of learning offered by the swim school.

Recommendations

The swim study has shown that young children who participate in early-years swimming seem to be achieving particular milestones earlier than the normal population across physical, cognitive and linguistic domains. Many of these skills are highly valuable for the transition into other learning contexts; and will be of considerable benefit for young children as they enter preschools and school. It is widely recognised that the early years lay the foundations for learning. It would appear that early-years swimming may help develop skills beyond those of swimming, and which are of considerable value in formal education. It may be of national benefit for children who traditionally do not do well at school, particularly in the early years, to participate in learn-to-swim. This may help in the transition to school but also for the obvious benefits of water safety and general well-being.

- All parents should be encouraged to have their children participate in early-years swimming as a matter of water safety.
- Children, particularly those whose trajectory into schooling is difficult and challenging, should be provided access to swimming lessons to enhance their swimming and other skills for the transition into school.
- Subsidies should be made available for children from disadvantaged families, but the quality of the swim school must be ensured if the child is to enjoy maximum gain.

Background

Australia is a country mad about swimming. Most of the population lives within an hour's drive of a body of water. It is a major recreational activity – with swimming, boating, fishing and diving some of our favourite pastimes. More people are putting swimming pools in their backyards – there are almost one million pools at households throughout Australia (ABS: 2007), with almost 12% of homes proudly boasting pools.

But swimming isn't just for recreation. It is also used as a form of exercise and parents and families encourage children to take part in organized swimming activities. In 2009, over half a million children, aged 5-14 participated in swimming as an organized sport. In fact, it was the most popular sport across all children of school age, beating out dancing, soccer, Aussie Rules and netball (ABS, 2009).

Learning to swim is a large part of enjoying the water.

Yet with all this emphasis, there have been few studies of the impacts of participating in learn-to-swim for young children. Naturally, the focus on the limited research undertaken has been on how early swimming can enhance some motor abilities such as balance and reaching (Sigmundsson & Hopkis 2010) and motor development in neonatal babies including head holding, steady sitting, and holding items (Jun, Huang & Dan, 2005). Others have looked at the impact of swimming on children suffering respiratory difficulties such as asthma (Wang, 2009 and Font-Ribera et al, 2011). There has also been some considerable research on how water activities can enhance mobility and aerobic strength for children with physical disabilities (for example, Fragala-Pinkham, et al 2008; Hutzler et al, 2008). However, there has been little research into the impact of swimming lessons on able-bodied students other than a large German study in the late 1970s (Diem, 1982) when the learn-to-swim industry was in its infancy. Not only are the conditions in Australia different from those experienced in Europe, but in the three decades ago or so since, there have been considerable advances in swimming techniques and lessons.

In 2008, two leaders from within the swim industry, Laurie Lawrence (dual International Swimming Hall of Famer, learn-to-swim expert and leading advocate in child water safety) and Ross Gage (CEO of Swim Australia and the Australian Swim Coaches and Teachers' Association), approached Professor Robyn Jorgensen at Griffith University to conduct an independent study of the benefits for young children participating in early-years swimming. Might these children be achieving at a much quicker or earlier rate the children who do not participate in swimming? There is a strong consensus in the swim industry that young swimmers who have been in the 'game' for some time, appear to be more confident, more articulate and more intelligent, than their same age peers who do not participate in swimming. As something that was purely anecdotal but of critical importance for swimmers, parents, teachers and operators, the swim industry was keen to validate – or refute – this popular observation.

With financial support from the swim industry, this research project was established. This is the first international study undertaken of its kind – a study which comprehensively focuses on the cognitive, physical and linguistic benefits of formal swimming for young children.

Water Safety as the Catalyst for Early-Years Swimming

The swim industry had once just been the recruiting area for elite swimmers but with accidental drowning the highest cause of death in under-5s[1], Laurie Lawrence has led a national push for young children to be involved in water safety. Recognition of the importance of young children swimming is evidenced in the support of the federal government where every new mother receives a baby package on the birth of her child which now includes a water familiarization DVD authored by Lawrence. This program alone represented a commitment by the Federal Government in 2008 of $4.2million over four years (Giles, 2008), added to the $22.2 million allocated in the Budget to water safety organisations, including Surf Life Saving Australia.

The Learn-to-Swim Industry

The interest in early-years swimming has grown with Australia now boasting 934 swim schools nationwide (RLSA and AustSwim, 2010), over 600 of which are registered with Swim Australia. Almost 80% of swim schools are privately owned and a little less than a quarter are operated by local councils. The remaining swim schools operate under a management group, through a school, are community based or a combination of these.

While largely unregulated, the industry has a number of organizations which contribute to its management, regulation and education. These include ASCTA, Swim Australia[2], AustSwim and the Royal Life Saving Society – Australia (RLSSA). Even the Australian Taxation Office influences the participation and credentialing of teachers in the industry.

[1] According to National Drowning Report 2011 of Royal Life Saving Society – Australia, there were 28 drowning deaths of young children under-five years of age in 2010/11. Swimming pools remain the location with the highest number of 0-4 years drowning deaths with 12 in 2010/11.

[2] Not to be confused with Swimming Australia, the national sporting body responsible for the promotion and development of competitive swimming in Australia at all levels. Swimming Australia has almost 100,000 members and just over 1100 swimming clubs nationwide (www.swimming.org.au).

ASCTA (The Australian Swimming Coaches and Teachers Association), is the peak body for swimming and water safety teachers and swimming coaches. ASCTA (www.ascta.com) was established some forty years ago as a coaches' association but expanded to include teachers in 1996 in recognition of the growth of this sector. It is a special interest group dedicated to developing world leading practices in the education, accreditation, professional development and on-going support for swimming coaches and teachers. Swim Australia (www.swimaustralia.org.au) was launched in October 1997 as ASCTA's learn-to-swim and water safety industry development division. Its mission is to develop "learn-to-swim" in Australia to its full potential; resulting in all Australians learning swimming and water safety in an enjoyable, safe way. ASCTA registers swim schools that meet industry standards. It is a non-profit organization endorsed by Swimming Australia and currently has over 600 member swim schools. Membership is voluntary.

Royal Life Saving Society – Australia (www.royallifesaving.com.au) also works tirelessly to prevent drowning and to equip all Australians with water safety skills. As a not-for profit charitable organization, it offers a variety of education programs. Every year one million Australians participate in one of RLSSA's programs. Its key programs include Keep Watch, Swim and Survive (the program aimed at children up to the age of 14), Bronze Medallion, Junior Lifeguard Club and Grey Medallion. It is also heavily involved with education, training and research.

Parents expect that their child's learn-to-swim teacher will be "qualified" though there are no compulsory swimming teaching qualifications. Most, however, will opt to undertake training offered by AustSwim (Australian Council for the Teaching of Swimming and Water Safety). AustSwim (www.austswim.com.au) was established in 1979 in response to numerous aquatics organisations identifying the need to have one organisation that could oversee the training and accreditation of swimming and water safety teachers. AustSwim is non-profit and its council comprises members of many organisations, including YMCA Australia, Royal Life Saving Society – Australia (RLSSA), Australian Leisure Facilities Alliance, Swimming Australia, Surf Life Saving Australia (SLSA) and Water Safety New Zealand. The first AustSwim courses were offered in 1980. AustSwim teacher courses are still the most widely held qualification required of learn-to-swim teachers. According to a survey of swim school managers in 2010, teaching staff were required to have AustSwim's Teacher of Swimming and Water Safety certification (83%), followed by CPR (76%) and AustSwim's Teacher of Preschool and Infant Aquatics (58%). Other qualifications required included those from Swim Australia (32%) and ASCTA (23%)[3].

[3] Royal Life Saving Society – Australia and AustSwim conducted a comprehensive survey of swim school managers in 2010. The resulting report contains a great deal of information about swim schools and teachers and can be found at: www.royallifesaving.com.au/www/html/2808-research-reports.asp

In 2008, the Australian Taxation Office introduced new legislation whereby GST exemption was offered to those who offered courses in personal aquatic survival skills[4]. Essentially, these basic swimming skills could be used to prevent downing by letting a person survive or be safe in the water. The seven basic competencies that had to be taught in these classes were:

- sculling
- treading water
- floating
- safe entry and exit from the water
- techniques for clothed swimming survival
- use of devices to assist rescue, and
- basic swimming skills.

In order to qualify for the GST exemption, course providers (i.e. teachers) have to hold a training qualification from AustSwim, Surf Lifesaving Australia, Royal Lifesaving or another registered training organization (eg Swim Australia) that offers courses containing the seven competencies listed. This has been further incentive for teachers and swim schools to ensure those offering learn-to-swim programs meet at least the minimum standards.

Whilst the industry remains fairly unregulated, parents can select a learn-to-swim teacher who can demonstrate qualifications from AustSwim, Swim Australia or other registered training organizations. Similarly, they can choose a swim school that is registered/affiliated with Swim Australia or RLSSA. However, swim schools are not required to hold membership for either organization, and not having membership is not necessarily an indicator of poor quality.

Different swim schools will emphasise different aspects of learn-to-swim. Some may elect to offer the “Swim-and-Survive” program from RLSSA; some adapt this program to incorporate other aspects of swimming. Almost all baby classes emphasise water familiarisation and survival skills. Beyond one year of age, however, swim schools will offer any number of a variety of approaches to learn-to-swim. Most swim schools will advocate that they invoke in children a respect for the water and aquatic survival skills. Beyond this, the primary focus of some schools will be on the development of technique in young swimmers with the ultimate aim of producing (future) competitive swimmers. Others adopt more of a “general education” approach which incorporates other aspects of learning[5]. What is taught in learn-to-swim and how it is taught may impact on what children take away from their learn-to-swim classes to use in their everyday lives. Children may have very different learning experiences from the types of programs offered by the swim schools. Each of these schools offers new learnings – swimming and other – that may help children in contexts outside swimming.

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[4] Details of the Australian Taxation Office’s guidelines in relation to teaching of personal aquatic skills can be found at: http://www.ato.gov.au/businesses/content.aspx?menuid=0&doc=/content/39995.htm&page=2&H2

[5] This appears to be particularly true where swim teachers have formal tertiary qualifications, for example, in early childhood education.

"Adding Capital to Learners": Framing the research

In this project we argue that early-years swimming may be 'adding capital' to young learners (Jorgensen, 2012). When young children participate in learning activities – such as swimming lessons – there is an expectation from parents and teachers that there will be changes in what the children can do, or know, or feel. These changes are the outcome of engaging successfully with the learning activity. The skills, knowledge and/or dispositions acquired by the learner can be something that is 'added' to the child's repertoire. We have adopted the construct of 'adding capital' to describe this process since what has been learned can be of value to the child other learning contexts -- school and beyond. The use of capital as a key organizer for the study is based on two key considerations:

- First, the use of the term 'development' suggests that there is something biological, almost innate as to how children learn and acquire skills. This project explored whether or not young children may learn more if they participate in early-years swimming. As such, it is not a biological progression that is causing change. Rather, it is the case that in some ways the swimming environment is potentially enhancing how, what and when children are learning.
- Second, we see that what is possibly being added to children are skills that are above and beyond the focus of the swim lessons. This 'added' learning includes skills that, in another context, namely schools, have particular and important value. What is learnt has value beyond the swimming context and can be exchanged in this new environment. For example, what we have observed is that the safety element of early-years swimming is paramount so children learn very early to listen carefully to the teacher, to process instructions and then to conform to them. This is usually not undertaken in an authoritarian manner but the teachers are keen for the children to listen and then perform the activity in an environment that ensures their safety. While these skills have value in the swim context, within the context of formal schooling, this set of skills is key for participating effectively and productively in classrooms. Thus the skill is a form of capital that can be exchanged in another context for rewards.

Research Design

This research was not conducted using the traditional experimental design where there are control groups and experimental groups. While a control group would have been ideal, the team worked for two years to try to obtain a corpus of early-years non-swimmers that were comparable with the normal population, but met with no success. It appears that most middle-class families have their children in early-years swimming while those not in swimming tend to come from low income and migrant families. Thus a control group would have been significantly biased and produced skewed results. Another approach was needed to ensure valid comparisons. We have employed methods that allow us to compare swimming children with other populations of children who represent the 'normal' population. In this context, the research team developed two key methods for testing the research question – a large survey that relied on parent reporting which allowed a comparison of swimming children against the developmental milestones with which most parents are familiar. The second method involved the use of internationally-recognized tests of child development. The latter were carefully selected on the availability of normative data – that there would be a "normal population" against which we could compare the results of the children in our cohorts. This latter point was critical in substantiating any claims made as to whether or not the swimming children were different from the normal population.

Survey

The first method was to employ a large-scale survey that has been undertaken in Australia, New Zealand and the USA. This was a simple survey based on the normal developmental milestones that children are expected to attain by particular ages. The comprehensive list of milestones was later able to be compared to those of a more contemporary nature – from the Centers for Disease Control and Prevention (CDC) in the United States and the Department of Education, Employment and Work Relations (DEEWR) in Australia.

Over the three years, 6930 parents completed the survey:

Year	Total Responses
2009-2010	1650
2010-2011	2330
2011-2012	2950
TOTAL	**6930**

Table 1: EYS Survey responses by year

In the first year, the survey was administered as a paper-and-pen survey, mailed out to volunteer swim schools for parents to complete (usually on the pool deck). In the second and third years, while paper surveys were still distributed, an online version was made available, allowing parents to complete the survey at home. The survey was accessible through the project website which allowed parents anywhere to participate (it was not limited to the parents of selected swim schools only). This yielded a greater diversity of parents and a larger number of respondents.

The parents were presented with a series of demographic questions including their child's date of birth, the date of completion of the questionnaire and the child's age, and the duration and extent of their swimming experience, along with other activities they were undertaking. Parents were asked to check off from an extensive list of milestones, if their child was able to achieve the nominated behaviour. The milestones were presented in four categories – representing the four domains: Motor/physical (65 items), Cognitive (30 items), Socio-emotional (36 items) and Linguistic (42 items). They were ranked according to the generally expected sequence of achievement so that it was clear that there was a progression, but it was unclear to respondents as to the age at which children would be expected to reach such milestones. In the last two years, for the on-line version of the questionnaire, parents were able to scan those sections that their child could achieve – rather than being required to check off all milestones, a tedious task for the parents of older children – and then move into the sections where they were beginning to achieve some things and not others.

A copy of the paper questionnaire used in Year 3 is below:

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Early-years swimming

Next Phase Research

In the near future, we will be inviting a small number of parents and their children (aged 3-5 years) to participate in the next phase of the research.

In this phase we would like to document individual children's progress. This would involve us using internationally recognised early childhood tests to assess your child's physical, cognitive and linguistic development. This testing would take approximately one hour and be held in a venue close to your home (for example, your swim school). These tests have been developed by early childhood experts and psychologists. They are quite simple for children to complete.

We will also ask you to complete an additional questionnaire at that time (it takes approximately 10 minutes) about your child's socio-emotional development.

If you would be willing to participate in the next phase of the study – and for your child to participate also – please provide your contact details in the space below. Again, participation is entirely voluntary.

Please be assured that the responses in this survey will remain confidential. You will not be identified in the reporting of results from this survey. Your personal details will only be used in order to invite you to continue into the next phase of the study.

○ Yes, I would be willing to participate in the next phase of the study.

Parent's name: _____

Phone: _____

Email address: _____

○ No, I do not wish to participate further.

Thank you for taking the time to complete this survey!

Parent/Guardian Survey

The aim of the Early Years Swimming Project is to determine whether participation in learn-to-swim classes adds capital to young Australians.

If you have a child aged between six months and five years who is currently swimming, we invite you to participate in this research. We are very interested to find out what developmental milestones your child has reached.

As a volunteer in this project, you are asked to complete this survey that will take approximately 5 minutes. By completing the questionnaire, you are giving your consent for us to use your information for this research. Rest assured, all data collected will be treated as confidential and your responses will be combined with those of other participants to generate an overall picture of children that participate in early years swimming. Neither you nor your child will be identified in any reporting of this data.

With the information gathered from parents via this survey, we hope to determine whether participation in a swimming program has enhanced the development of children. Further, this research will identify the key factors in swimming programs that add capital to young Australians.

We appreciate your input into this highly valuable research. If you have any questions or would like further information regarding this research please contact the research team at earlyyearsswimming@griffith.edu.au

If there is more than one child in your family under the age of 5, please complete one survey per child.

Thank you!

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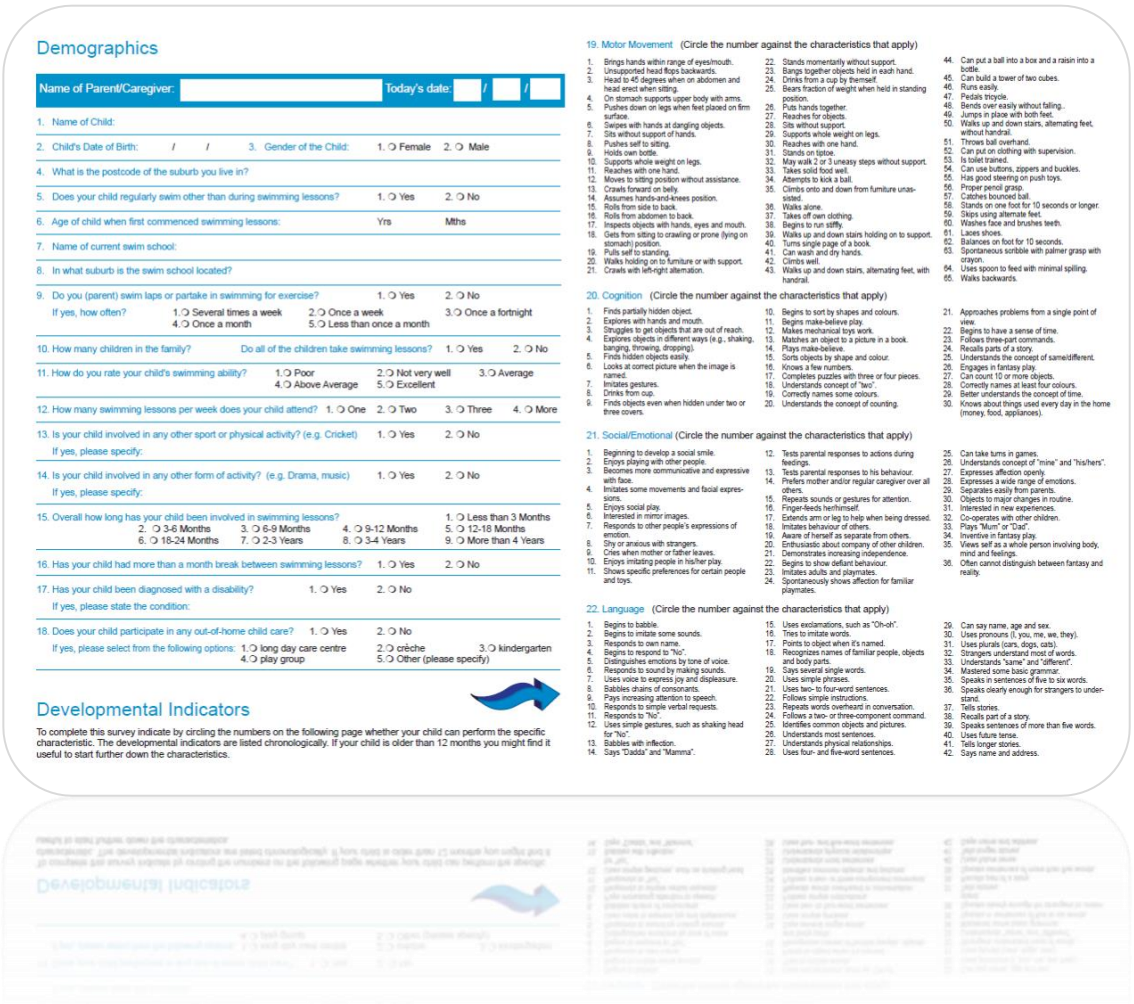
Feel free to contact us:

Email: earlyyearsswimming@griffith.edu.au
Phone: (07) 3735 5854
Fax: (07) 3735 6992
Web: www.griffith.edu.au/education/early-years-swimming

Does swimming make your child smarter?



Demographics

Name of Parent/Caregiver: _____ Today's date: ___ / ___ / ___

1. Name of Child:
2. Child's Date of Birth: / / 3. Gender of the Child: 1. ○ Female 2. ○ Male
4. What is the postcode of the suburb you live in?
5. Does your child regularly swim other than during swimming lessons? 1. ○ Yes 2. ○ No
6. Age of child when first commenced swimming lessons: Yrs Mths
7. Name of current swim school:
8. In what suburb is the swim school located?
9. Do you (parent) swim laps or partake in swimming for exercise? 1. ○ Yes 2. ○ No
   If yes, how often? 1.○ Several times a week 2.○ Once a week 3.○ Once a fortnight 4.○ Once a month 5.○ Less than once a month
10. How many children in the family? Do all of the children take swimming lessons? 1. ○ Yes 2. ○ No
11. How do you rate your child's swimming ability? 1.○ Poor 2.○ Not very well 3.○ Average 4.○ Above Average 5.○ Excellent
12. How many swimming lessons per week does your child attend? 1. ○ One 2. ○ Two 3. ○ Three 4. ○ More
13. Is your child involved in any other sport or physical activity? (e.g. Cricket) 1. ○ Yes 2. ○ No
    If yes, please specify:
14. Is your child involved in any other form of activity? (e.g. Drama, music) 1. ○ Yes 2. ○ No
    If yes, please specify:
15. Overall how long has your child been involved in swimming lessons? 1. ○ Less than 3 Months 2. ○ 3-6 Months 3. ○ 6-9 Months 4. ○ 9-12 Months 5. ○ 12-18 Months 6. ○ 18-24 Months 7. ○ 2-3 Years 8. ○ 3-4 Years 9. ○ More than 4 Years
16. Has your child had more than a month break between swimming lessons? 1. ○ Yes 2. ○ No
17. Has your child been diagnosed with a disability? 1. ○ Yes 2. ○ No
    If yes, please state the condition:
18. Does your child participate in any out-of-home child care? 1. ○ Yes 2. ○ No
    If yes, please select from the following options: 1.○ long day care centre 2.○ crèche 3.○ kindergarten 4.○ play group 5.○ Other (please specify)

Developmental Indicators

To complete this survey indicate by circling the numbers on the following page whether your child can perform the specific characteristic. The developmental indicators are listed chronologically. If your child is older than 12 months you might find it useful to start further down the characteristics.

19. Motor Movement (Circle the number against the characteristics that apply)

1. Brings hands within range of eyes/mouth.
2. Unsupported head flops backwards.
3. Head to 45 degrees when on abdomen and head erect when sitting.
4. On stomach supports upper body with arms.
5. Pushes down on legs when feet placed on firm surface.
6. Swipes with hands at dangling objects.
7. Sits without support of hands.
8. Pushes self to sitting.
9. Holds own bottle.
10. Supports whole weight on legs.
11. Reaches with one hand.
12. Moves to sitting position without assistance.
13. Crawls forward on belly.
14. Assumes hands-and-knees position.
15. Rolls from side to back.
16. Rolls from abdomen to back.
17. Inspects objects with hands, eyes and mouth.
18. Gets from sitting to crawling or prone (lying on stomach) position.
19. Pulls self to standing.
20. Walks holding on to furniture or with support.
21. Crawls with left-right alternation.
22. Stands momentarily without support.
23. Bangs together objects held in each hand.
24. Drinks from a cup by themself.
25. Bears fraction of weight when held in standing position.
26. Puts hands together.
27. Reaches for objects.
28. Sits without support.
29. Supports whole weight on legs.
30. Reaches with one hand.
31. Stands on tiptoe.
32. May walk 2 or 3 uneasy steps without support.
33. Takes solid food well.
34. Attempts to kick a ball.
35. Climbs onto and down from furniture unassisted.
36. Walks alone.
37. Takes off own clothing.
38. Begins to run stiffly.
39. Walks up and down stairs holding on to support.
40. Turns single page of a book.
41. Can wash and dry hands.
42. Climbs well.
43. Walks up and down stairs, alternating feet, with handrail.
44. Can put a ball into a box and a raisin into a bottle.
45. Can build a tower of two cubes.
46. Runs easily.
47. Pedals tricycle.
48. Bends over easily without falling..
49. Jumps in place with both feet.
50. Walks up and down stairs, alternating feet, without handrail.
51. Throws ball overhand.
52. Can put on clothing with supervision.
53. Is toilet trained.
54. Can use buttons, zippers and buckles.
55. Has good steering on push toys.
56. Proper pencil grasp.
57. Catches bounced ball.
58. Stands on one foot for 10 seconds or longer.
59. Skips using alternate feet.
60. Washes face and brushes teeth.
61. Laces shoes.
62. Balances on foot for 10 seconds.
63. Spontaneous scribble with palmer grasp with crayon.
64. Uses spoon to feed with minimal spilling.
65. Walks backwards.

20. Cognition (Circle the number against the characteristics that apply)

1. Finds partially hidden object.
2. Explores with hands and mouth.
3. Struggles to get objects that are out of reach.
4. Explores objects in different ways (e.g., shaking, banging, throwing, dropping).
5. Finds hidden objects easily.
6. Looks at correct picture when the image is named.
7. Imitates gestures.
8. Drinks from cup.
9. Finds objects even when hidden under two or three covers.
10. Begins to sort by shapes and colours.
11. Begins make-believe play.
12. Makes mechanical toys work.
13. Matches an object to a picture in a book.
14. Plays make-believe.
15. Sorts objects by shape and colour.
16. Knows a few numbers.
17. Completes puzzles with three or four pieces.
18. Understands concept of "two".
19. Correctly names some colours.
20. Understands the concept of counting.
21. Approaches problems from a single point of view.
22. Begins to have a sense of time.
23. Follows three-part commands.
24. Recalls parts of a story.
25. Understands the concept of same/different.
26. Engages in fantasy play.
27. Can count 10 or more objects.
28. Correctly names at least four colours.
29. Better understands the concept of time.
30. Knows about things used every day in the home (money, food, appliances).

21. Social/Emotional (Circle the number against the characteristics that apply)

1. Beginning to develop a social smile.
2. Enjoys playing with other people.
3. Becomes more communicative and expressive with face.
4. Imitates some movements and facial expressions.
5. Enjoys social play.
6. Interested in mirror images.
7. Responds to other people's expressions of emotion.
8. Shy or anxious with strangers.
9. Cries when mother or father leaves.
10. Enjoys imitating people in his/her play.
11. Shows specific preferences for certain people and toys.
12. Tests parental responses to actions during feedings.
13. Tests parental responses to his behaviour.
14. Prefers mother and/or regular caregiver over all others.
15. Repeats sounds or gestures for attention.
16. Finger-feeds her/himself.
17. Extends arm or leg to help when being dressed.
18. Imitates behaviour of others.
19. Aware of herself as separate from others.
20. Enthusiastic about company of other children.
21. Demonstrates increasing independence.
22. Begins to show defiant behaviour.
23. Imitates adults and playmates.
24. Spontaneously shows affection for familiar playmates.
25. Can take turns in games.
26. Understands concept of "mine" and "his/hers".
27. Expresses affection openly.
28. Expresses a wide range of emotions.
29. Separates easily from parents.
30. Objects to major changes in routine.
31. Interested in new experiences.
32. Co-operates with other children.
33. Plays "Mum" or "Dad".
34. Inventive in fantasy play.
35. Views self as a whole person involving body, mind and feelings.
36. Often cannot distinguish between fantasy and reality.

22. Language (Circle the number against the characteristics that apply)

1. Begins to babble.
2. Begins to imitate some sounds.
3. Responds to own name.
4. Begins to respond to "No".
5. Distinguishes emotions by tone of voice.
6. Responds to sound by making sounds.
7. Uses voice to express joy and displeasure.
8. Babbles chains of consonants.
9. Pays increasing attention to speech.
10. Responds to simple verbal requests.
11. Responds to "No".
12. Uses simple gestures, such as shaking head for "No".
13. Babbles with inflection.
14. Says "Dadda" and "Mamma".
15. Uses exclamations, such as "Oh-oh".
16. Tries to imitate words.
17. Points to object when it's named.
18. Recognizes names of familiar people, objects and body parts.
19. Says several single words.
20. Uses simple phrases.
21. Uses two- to four-word sentences.
22. Follows simple instructions.
23. Repeats words overheard in conversation.
24. Follows a two- or three-component command.
25. Identifies common objects and pictures.
26. Understands most sentences.
27. Understands physical relationships.
28. Uses four- and five-word sentences.
29. Can say name, age and sex.
30. Uses pronouns (I, you, me, we, they).
31. Uses plurals (cars, dogs, cats).
32. Strangers understand most of words.
33. Understands "same" and "different".
34. Mastered some basic grammar.
35. Speaks in sentences of five to six words.
36. Speaks clearly enough for strangers to understand.
37. Tells stories.
38. Recalls part of a story.
39. Speaks sentences of more than five words.
40. Uses future tense.
41. Tells longer stories.
42. Says name and address.

While such a survey of this type is a handy tool for acquiring large response rates, it was also limited. In the first instance, there is the risk for parents to over-estimate their child's performance so there is the possibility of an inbuilt bias in the reports. Secondly, there is a risk that with an on-line or paper format, that the items can be misinterpreted by the reader and hence incorrect assessments of the child might be made. Thirdly, as the paper survey was distributed solely through swim schools in its first iteration, there was the possibility of influence from swim school operators as intermediaries in the survey process. Being cognizant of these shortfalls, a more detailed analysis of particular children was undertaken.

Child Assessments

Child assessments were conducted in order to validate parental claims about their children's achievement. Drawing on widely-used child testing protocols, a series of tests were selected to be administered to children. It was planned that 200 children would be tested. As the tests require considerable input from the child, language skills needed to be well developed, and an attention span commensurate with the time of the test was required. To this end, children only of 3, 4 and 5 years were tested (boys and girls, from high, mid and low socio-economic backgrounds and with varying swim experience).

The tests employed by the Early-Years Swimming (EYS) Project were specifically selected to meet a number of criteria:

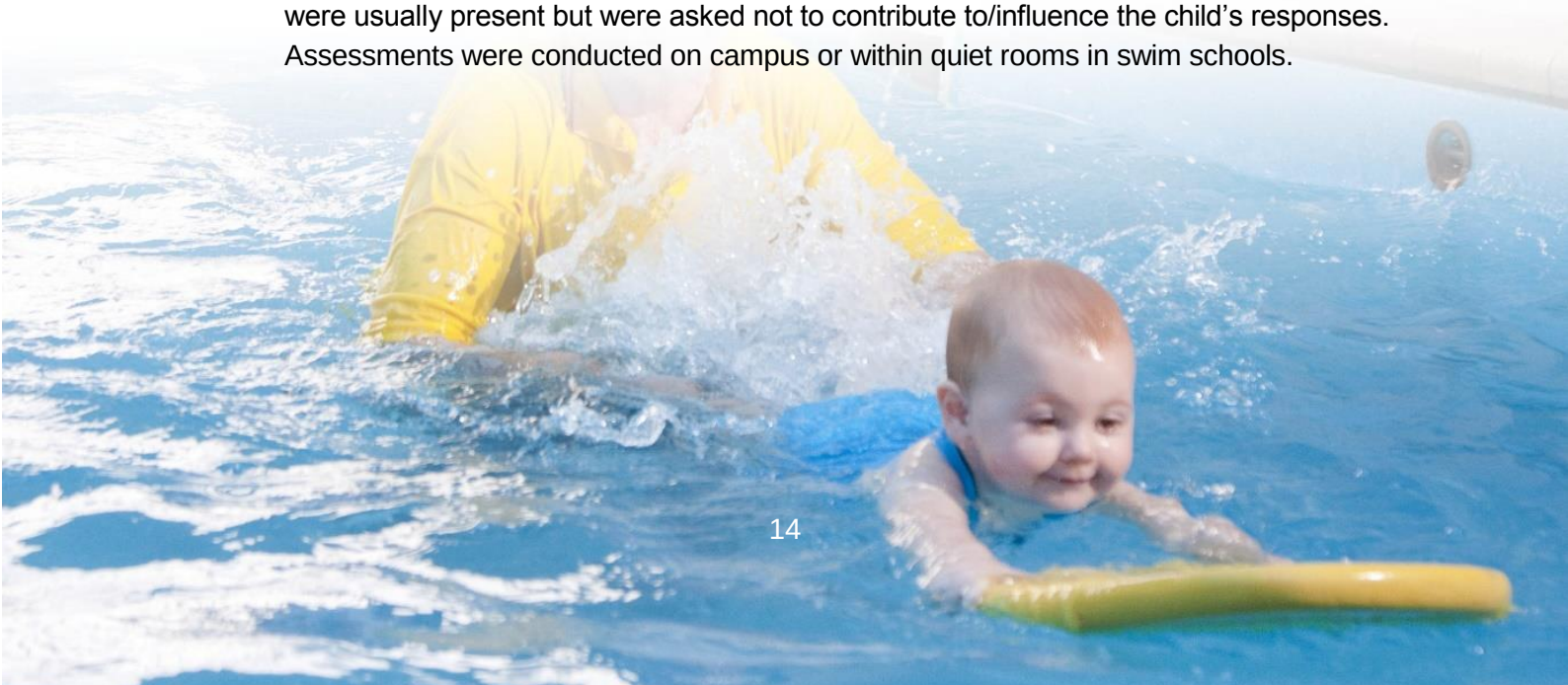
- Suitable for our purpose – to assess the physical, cognitive and linguistic development of children
- Age-appropriate – for assessing 3-5 year olds
- Could be utlilised in one session of 1-2 hours per child
- Mostly administered directly to the child without requiring input from a caregiver (or teacher)
- Could be administered by qualified teachers, but not requiring specialist qualifications (psychology, physiotherapy, occupational therapy, etc.)
- Standardised and norm-based: tests have been administered widely with a pool of previous respondents against which we could assess our participants.
- Provide “age-equivalent” measures.
- Not designed for screening purposes (eg. for identification of autism) – these tend to focus on deficits and not the achievement of milestones and beyond.

The instruments were selected in order to quickly and accurately determine each child’s progress across a number of cognitive and language areas.

Name	Domains Assessed	Brief Description
Peabody Developmental Motor Scales (PDMS-2)	Physical	Assesses both gross motor (stationery, locomotion and object manipulation) and fine motor (grasping, visual-motor).
Woodcock-Johnson III	Cognition Language	Assesses a range of cognitive areas, including: oral language, listening comprehension, maths reasoning, verbal ability, cognitive efficiency.

Table 2: Test instruments employed for EYS child assessments

Each assessment took approximately 90 minutes to implement by trained teachers. Parents were usually present but were asked not to contribute to/influence the child’s responses. Assessments were conducted on campus or within quiet rooms in swim schools.



Woodcock-Johnson III (WJIII)

The Woodcock-Johnson III (WJ-III) Tests of Achievement is a comprehensive system for measuring general intellectual ability, scholastic aptitude, oral language and achievement. It allows the assessment of a wide range of ages, reportedly 2-90 years. First developed in the United States in the late 1970s, it has been extensively tested, with a wide normative sample in 2001 of over 8000 in the United States. It has since been re-normed with an Australian sample of over 1300 in 2006-2007. Sub-tests from the WJ-III have been used in other large-scale Australian studies, for example, the Child Care Choices Study (Bowes et al, 2009).

At ages 3-5, it is difficult to assess cognitive and language skill in one brief sitting. The WJ-III allowed us to quickly and accurately gauge each child's progress. To do this, eight test items were selected from the WJ-III Tests of Achievement battery based on appropriateness for the purpose of the study (in assessing cognitive and linguistic levels), suitability for the age group and ease of implementation:

Sub-test Item	Brief Description
Item 1: Letter-Word Identification	Letter-Word Identification measures the child's word identification skills through both identifying letters by sight then progressing to pronouncing letters and words correctly. Items become increasingly difficult/less familiar.
Item 3: Story Recall	The task requires the subject to recall short, but increasingly complex stories.
Item 4: Understanding Directions	As an oral language measure, the child has to listen and follow a sequence of instructions. Items become increasingly complex linguistically as the number of tasks to perform increases.
Item 7: Spelling	Initially, the child draws on prewriting skills (drawing, tracing) and progresses to writing orally presented letters and words. For older children, the final items measure the ability to correctly spell words.
Item 9: Passage Comprehension	The child is initially asked to match symbols with pictures of objects. The items increase in complexity to matching a picture to a word or phrase and identifying a missing key word from a sentence.
Item 10: Applied Problems	Mathematics problems need to be solved by the child by listening to the problem and performing simple calculations, eliminating any extraneous information presented. Calculations become increasingly complex.
Item 14: Picture Vocabulary	Word knowledge and oral language development are assessed as the child is asked to name objects from illustrations. Single word responses are generally required but items become increasingly difficult as less familiar objects are presented.
Item 18: Quantitative Concepts	Understanding of maths concepts and symbols is assessed through counting and identifying numbers, shapes, and sequences. The child may also progress to items where they have to identify a missing number from a series.

Table 3: Items selected from Woodcock-Johnson III Tests of Achievement for EYS child assessments

The results from each of these sub-tests are recorded as “Age Equivalent” scores, sub-test scores can also be amalgamated to allow the formation of five “clusters”: Oral Language, Oral Expression, Brief Achievement, Brief Reading and Maths Reasoning. Each of these clusters is designed to provide a highly reliable prediction of future achievement in a minimum amount of testing time. As composites of individual tests, they are more reliable than individual test items.

Tests of Achievement / Clusters	Brief Reading	Oral Language	Oral Expression	Maths Reasoning	Brief Achievement
Letter-Word Identification	●				●
Story Recall		●	●		
Understanding Directions		●			
Spelling					●
Passage Comprehension	●				
Applied Problems				●	●
Picture Vocabulary			●		
Quantitative Concepts				●	

Table 4: Woodcock-Johnson III Tests of Achievement clusters assessed for EYS

As the WJ-III provided age equivalent scores for each item, this standardised test allowed us to compare the child’s actual age with the performance on each item and each cluster with a wider population of children. It also provided us with “Z” scores for each item and cluster.

Peabody Developmental Motor Scales 2 (PDMS-2)

The PDMS-2 is composed of six subtests that measure interrelated motor abilities that develop early in life. It was designed to assess the gross and fine motor skills in children from birth to five years of age. It has been proven to be both reliable and valid and draws on a normative sample of over 2000 children in the United States. It is widely used by physiotherapists, occupational therapists, psychologists and early childhood specialists in examining the motor skills of young children. It has been used in Australia, most recently in Stagnitti et al's (2011) study of disadvantaged preschool children.

We have used five of the PDMS-2 subtests. (The sixth subtest – Reflexes – is designed for babies up to 11 months only and is not used here.)

Sub-test Item	Brief Description
Locomotion (89 items)	Measures a child's ability to move from one place to another, to transport the body from one base of support to another. The actions measured include walking, running, hopping and jumping forward.
Stationary (30 items)	Measures a child's ability to sustain control of his or her body within its centre of gravity and retain balance (eg. standing on tiptoes, standing on one foot, imitating movement, performing sit-ups).
Object Manipulation (24 items)	Measures a child's ability to manipulate balls. Examples of the actions measured include catching, throwing and kicking.
Grasping (26 items)	Measures a child's ability to use his or her hands and fingers. It begins with the ability to hold an object with one hand and progresses to actions involving the controlled use of the fingers of both hands (eg. using a pen, buttoning).
Visual-Motor Integration (72 items)	Measures a child's ability to integrate and use his or her visual perceptual skills to perform complex eye-hand coordination tasks, such as building with blocks, and copying designs.

Table 5: Components of Peabody Developmental Motor Scales 2 (PDMS-2)

Only items relevant to the age group were administered by establishing basal and ceiling levels. PDMS-2 then allowed the progression of raw scores to standardised scores, percentile ranks and age-equivalent results.

Swim School Environmental Scan

Based on the literature on early childhood environments, a comprehensive audit tool was developed that incorporated the principles of quality early childhood education environments relevant to the swim school industry. The focus for 2010-2011 was the development, trialing/refinement of the tool and then the implementation of that tool took place from late 2011-2013. A total of 41 schools were visited throughout the formal data collection phase of the project:

State	No of schools (Individual sites)
NSW	16
QLD	14
VIC	6
SA	4
NZ	1
TOTAL	**41**

Table 6: EYS Research Team Swim School Site Visits

Pedagogy Profiling

It is well recognised in education that after socioeconomic status, the teacher is the most important factor in children's success in school. With this in mind, the project also sought to profile the teaching practices in the swim industry. A tool was developed, trialed, and refined throughout 2010-2011. The tool profiles the teaching practice (not the teacher) and how the practices of the teachers may be fostering skills (adding capital) to the child – including within the physical, intellectual, social and linguistic domains.

The final model that was developed for the profiling of early-years swimming pedagogy focused on the following five dimensions, each of which was then broken into a number of key elements. These can be seen in the table below:

Dimension	Elements	
1. Orientation	• Water familiarisation • Water survival skills	• Swim technique skills
2. Physical Capital	• Coordination • Differentiated activities • Participation/flow	• Activity progression • Corrective evaluations • Integrated communication strategies
3. Social capital	• Social support • Child engagement • Parent/caregiver engagement	• Confidence building, emotional well being • Self-regulation
4. Intellectual capital	• Literacy • Numeracy	• Other curriculum areas
5. Language Capital	• Rich Language	• Instructional discourse

Table 7: Dimensions and Elements from Swim Pedagogies Profiling

A total of 122 lessons were observed across the four states in 41 swim schools:

State	No of schools (Individual sites)	No of lessons observed
NSW	16	55
QLD	14	38
VIC	6	14
SA	4	12
NZ	1	3
TOTAL	**41**	**122**

Table 8: Number of Swim Schools visited and lessons profiled

Two observers scored each lesson independent of the other. At the conclusion of the lesson, scores were discussed and a common score negotiated. This process ensured that team members all gained a common understanding of the scoring rubric so that across the team there was consistency in scoring. Using two scores also helped to establish reliability among the team and ensure a consistency across the project as to the meaning of the items. The inter-rater reliability was a key process in ensuring the validity of the tool.

Analysing the Data

As with any large study, analysis of the various data sets requires specific techniques. These will be discussed in detail in the section below.

Survey

The survey that is foundational to this research has been created around widely-recognised developmental milestones. The analysis of the survey data was conducted using two major positions. In the first round of analysis, the dataset from our second year was analysed using the internationally-recognized milestones from the Centers for Disease Control and Prevention (United States) as the benchmark. In the second and final round of analysis, data from across the years of our survey were amalgamated and DEEWR's Australian milestones were used as the benchmark (DEEWR, 2012). These contemporary measures reflected recent changes in environmental factors contributing to changes in development. Both systems provided strong comparative basis for the analysis and produced very similar outcomes. This similarity in outcomes was positive for the analysis as it indicated a consistency across the two different measures and confirmed the general trends that were appearing in the swim data set.

The survey instrument contained a total of 173 milestones against which thousands of parents rated their children. These had to be effectively managed in order for analysis to occur.

We adopted a number of processes to ensure that the data was of a suitable form from which relations could be established between milestones in early swimming and capitals. Some cases had to be eliminated and some milestones were removed from the data set as they were clearly non-discriminatory so a systematic approach to cleaning the data was developed before the data were analysed.

Eliminating cases

The objective of the analysis was to consider possible and probable effects of the active participation of young children in swimming against a range of aspects of child development. Basic information essential for such consideration was the age of child and also an assessment of their performance on relevant milestones. Thus the first step was the elimination of cases where this basic information was either not available or not usable. In some cases data were missing – either in the child's demographics or in survey responses. These responses were eliminated from the data set. In other cases, parents may have incorrectly entered data making the information void. For example, with regard to the child's age, date of birth was requested; however, some parents entered the current year rather than the year of their child's birth. There were also cases where there were clear inaccuracies apparent when considered against milestones. For example, a child of 12 months whom the parent identified as being able to "jump in place with both feet", "throw ball overhead" and "toilet trained" was considered unrealistic and such cases were

excluded. In some such cases, it may have been the case that parents misinterpreted some of the milestones as the completion of the questionnaire took place without administrator supervision and with no opportunity for clarification. Finally, where clear outliers were identified, box-plots were used to make decisions on their inclusion or exclusion from the analysis.

Eliminating non-discriminatory items: Rasch modelling

In this second stage a more detailed assessment, using Rasch modelling, was undertaken to identify items that could be included on a unidimensional scale. Two statisticians undertook independent Rasch modeling to confirm the viability of the data set.

While there are quite high levels of expected variation in the achievement of the milestones assessed, there were also challenges as some items were clearly non-discriminatory. For example, items that typically were achieved by children of all ages (eg early milestones such as “brings hands within range of eyes and mouth” or “imitates some movements and facial expressions”) did not provide any discrimination. The use of Rasch modelling was to facilitate the identification of items appropriate for inclusion in scales assessing each of the four domains.

WINSTEPS (Linacre, 2012) software was used to undertake this analysis. For each item, fit statistics were calculated (i.e. infit value, with this transformed as a standardised t value). Additionally, the data were analysed indicating the level of difficulty of each item, thus suggesting the relative sequence of development of the milestones included. Using this approach the data could be more clearly reported within the limitations of the model – the Rasch Modelling process eliminated those items where there was statistically considerable variation within the item, thus rendering it invalid.

Making sense of the data

After Rasch modelling had taken place, the remaining milestones were then compared to those of both the CDC and DEEWR. Any milestones that could not be compared to either of these were eliminated from the study. Two different analyses were undertaken by two independent statisticians. As each of these sets of milestones reported ages of expected achievement differently, separate systems for analysis were developed.

Comparison with CDC Milestones

Each test item that was accepted in the final analysis was mapped for each age group and plotted against the CDC milestones. An example of the process through which mapping occurred is evidenced in Figure 1 which graphically shows the percentage of children whose parents identified them as having successfully achieved the milestone “Climbs Well”.

Age for each child was calculated by determining the difference between the date of birth and the date of completion of the survey, measured in months. For the initial assessment, ages were classified into groups – by 6 month increments up to 2 years,

then yearly for those above two years. Thus, as well as individual variation within children (i.e. the natural range in the achievement of milestones) there also is, within age groups, a level of variation for those that are at the lower or upper level of each age range. While such variation will occur within groups, this process also allows a consideration of the general level of achievement of individual milestones.

For “Climbs well”, the international (CDC) benchmark for this skill is 3 years – as indicated by the downward arrow between columns 2-3 and 3-4.

Figure 1: How Parental Survey Milestones are mapped against those of the CDC: Example “Climbs Well”: (percentage of achievement by age grou)p

Here parents indicated that all children above four years of age were able to “climb well”. What is of interest to this research is the percentage of children younger than the benchmark who were able to complete the skill. More than 90% of children between 2 and 3 years were able to complete the task as were 87% of 1-2 year olds. Also notable was the small percentage of parents reporting that their 6-12 month old child was able to undertake this activity. As the hypothesis foundational to the research was that participating in early-years swimming would add capital to young children, the most significant interest in the data were those achievements prior to the nominated age for the particular milestone. Those children who met the milestone prior to the nominated age could be achieving this milestone as a consequence of their involvement in early-years swimming. That is, within our framework, early-years swimming may be adding various forms of capital to young swimmers.

Comparison with DEEWR Milestones

The focus of the DEEWR milestones is to promote awareness among parents as to their child's development. If a child is not achieving such milestones by nominated ages then parents are encouraged to 'act early'. Hence, milestones are presented as diagnostic tools for child development and provide a useful benchmark for describing the ages at which children usually achieve particular behaviours. Using such internationally-recognised criteria as the basis for the survey, it was possible to see if participating in early-years swimming may progress learning in key areas of children's growth.

As the age of expected achievement for DEEWR milestones is expressed as a range, a different approach had to be taken to the analysis of our data. The DEEWR milestones are organised chronologically for birth to 4 months, 4-8 months, 8 months to 1 year, 1-2 years, 2-3 years, 3-4 years and 4-5 years. Each chronological group is then divided into a number of key areas – social and emotional; language/communication; cognitive (learning, thinking, problem solving); and movement/physical development, very closely matched to our four domain areas in our survey.

To be able to effectively compare our data with the DEEWR milestones, a number of processes were followed. First, composites were created where the DEEWR milestones matched our survey milestones for each of the four domains: DM (Motor), DC (Cognitive), DS (Socio-Emotional) and DL (Language). These were then broken down for each of the age groups. For example, 11 matches occurred within the motor domain (DM) for the 8-12 month age group. Second, to determine the child's nominal age from this data, an analysis was undertaken in relation to their achievement of each of the milestones within this composite. In our example, if the child had successfully demonstrated competence in all eleven matched milestones, they were given the nominal age at the top end of the scale, in this instance their age would be given as 12 months. If none of the milestones had been met, the age allocated would be the bottom end of the scale (here, for example, eight months). If a child met fewer than half, their nominal age was also rounded down. If they scored one less than the total number of milestones, their age was rounded down to the mid-range age (in this instance, 10 months). This process resulted in a conservative estimate of the child's age in part to address the possibility of over-reporting by parents. These scale scores, however, are meaningless if the child's biological or actual age is not incorporated within the measure. So, thirdly, the child's actual age was then subtracted from this nominal age – what we have then is the difference between the child's developmentally inferred age (from the parent's reporting of their achievement via the questionnaire) and their actual age (calculated from their date of birth and the time of the survey). In our example then, the ten month old child who successfully demonstrated competence in all eleven matched milestones would have been given the nominal age of twelve months; the difference between the nominal age and the biological age then is two months.

The mean scores for each of these DEEWR composites could then be calculated for each age band to determine the rate at which swimming children exceeded – or fell short of – the DEEWR milestones.

Child Assessments

As noted earlier in this report, tests were selected that had national or international norm-referenced populations against which we could compare the results of the child assessments. The results for each of the sub-tests in both the Woodcock-Johnson III Tests of Achievement and the Peabody Developmental Motor Scales 2 were reported as age equivalents (in months) allowing straightforward comparisons to each child's chronological age in months.

Environmental Scan and Pedagogy Profiling

At this point, the data have been reported using simple descriptive statistics to provide illustrations of the environments and pedagogies used within the swim industry observed to date.

Environmental Scan

Many of the items on the environmental scan were either yes/no responses or rating. Scores were scaled and then adjusted so that each dimension was given a score out of ten. This enabled easy comparisons to be made across the four dimensions. The four dimensions included external factors; the centre itself; the facilities; and the pool.

Pedagogical Profiling

The pedagogical profiling was analysed using simple descriptive statistics and mean scores are reported on for the national sample.

Key Findings

Survey: Developmental Milestones

Over the three years, 6930 parents completed the survey. Each questionnaire related to one child who participated in formal learn-to-swim only so where there were more than one child in each family aged five and under, the parent completed a separate survey for each.

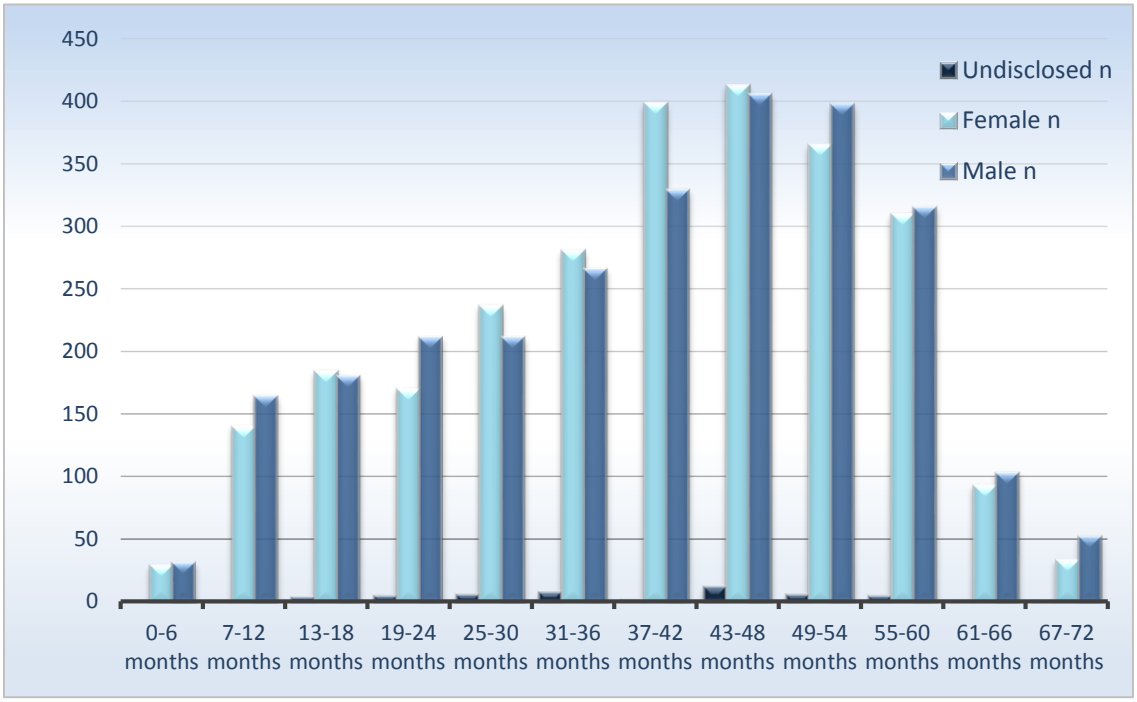


Figure 2: EYS Parent Survey: Child subject demographics: by age and gender

Stage 1 Analysis: CDC Milestones

In the first stage of analysis, the Centers for Disease Control and Prevention (CDC) milestones were used for comparison purposes with data from the parent survey. This analysis has been presented in early reports and is best summarized here. The CDC has identified the age at which children should be successfully achieving the milestone. For each of those listed, this is at the start of the light blue zone (see Table 10). For example, for “Stands on tiptoe”, children are expected to be able to perform this by the age of two years. Within the light blue zones, then all children should be achieving the milestone. The mid blue cells show the two prior age bands in which, according to their parents, at least 50% of all swimming children have already achieved the milestone (up to 95% are achieving this). In some instances, swimming children have almost met the 50% benchmark but fallen short by just a few percentage points. These cases have been marked with dark blue cells. Further, swimming children have achieved some milestones three age bands earlier than the CDC target, at a rate of at least 50%. These milestones have been highlighted.

Milestone		0-6 months	7-12 months	13-18 months	19-24 months	25-36 months	37-48 months	49-60 months	61-72 months
Stands on tiptoe	Physical								
Climbs up and down furniture unassisted									
Walks up and down stairs holding on to support									
Climbs well									
Runs easily									
Stands on one leg for 10 seconds or longer									
Correctly names some colours									
Understands the concept of counting	Cognitive								
Begins to have a sense of time									
Recalls parts of a story									
Understands the concept of same/different									
Can count 10 or more objects									
Correctly names at least four colours									
Enthusiastic in the company of other children	Socio-emotional								
Demonstrates increasing independence									
Begins to show defiant behaviour									
Imitates adults and playmates									
Spontaneously shows affection for familiar playmates									
Separates easily from parents									
Interested in new experiences									
Cooperates with other children									
Plays mum and dad									
Says several single words	Linguistic								
Follows simple instructions									
Follows a two- or three- word command									
Identifies common objects and pictures									
Understands physical relationships (in, on under)									
Mastered some basic grammar									
Speaks clearly enough for strangers to understand									
Tells stories									
Uses future tense									

Key	
	Almost 50% of swimming children are already achieving this milestone.
	Age groups in which at least 50% of swimming children are achieving.
	CDC target for milestone to be achieved.

Table 10: CDC milestones for which swimming children achieved at a rate of 50% for two bands ahead of the nominated age group.

What these data indicate is that parents are reporting that their swimming children are reaching many developmental milestones ahead of the "normal" or expected time. The above table shows those milestones that appear to be acquired considerably ahead of the expected time for that particular milestone. There are some milestones (in bold) that appear to be acquired considerably earlier than would be anticipated. Similarly, there were some milestones that were just outside our nominal cutoff point of 50%. These have been marked by the darker blue. As a nominal scale, these items could have been included if a rounding process had been adopted.

It appears from this analysis of the survey data, that swim children may be achieving many milestones in all areas of this study (physical, social, cognitive and linguistic) at an earlier age than expected. As the CDC milestones were based on very large data sets from American children, it was also important to compare our data against Australian milestones as most responses were from Australian children. To this end, the DEEWR milestones were also used to compare the early swimming cohort against. Similar results were found for many of the milestones.

Stage 1 Analysis: DEEWR Milestones

As mentioned previously, composites of the DEEWR milestones that matched our survey milestones were created for each age bracket – a different technique from the CDC analysis. Here, children's nominal ages were assessed using these composites and the difference between that and their biological age calculated (in months).

The results from Phases 2 and 3 of the survey are presented below[6]:

Phase 2				
Composite Domain	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
DM (Motor)	-26	50	7.34	10.28
DC (Cognitive)	-38	53	9.73	10.55
DS (Socio-Emotional)	-33	53	15.19	13.45
DL (Language)	-31	50	10.26	11.08
Phase 3				
Composite Domain	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
DM (Motor)	-42	46	7.6	10.68
DC (Cognitive)	-40	56	10.69	10.42
DS (Socio-Emotional)	-44	56	15.77	13.33
DL (Language)	-45	56	10.62	11.56

Phase 2: n = 2401, Phase 3: n = 2980

Table 11: Difference of Surveyed Swimming Children against DEEWR composites for domain milestones

[6] The iteration of the survey utilised in the first year lacked the complexity to allow analysis of this type to be conducted.

What can be seen from these tables is a wide spread of results recorded across the two-year cohorts. The minimum scores here (all expressed as negative scores) show that at the bottom end of the achievement range, there were children performing many months below the DEEWR achievement levels for each composite. At the other end of the scale, some children were performing up to 56 months ahead of the expected achievement on the composite milestones.

What should be noted here:

- The mean result for each of the DEEWR composite domains is consistently above expectations. Parents reported that their swimming children were, on average, over seven months ahead in motor achievement and around 10 months ahead cognitively and linguistically. In both years, parents reported that their swimming children were on average 15 months ahead of the DEEWR composite milestones in the socio-emotional domain.
- Results across both year levels are consistent for each of the composite domains.

These results can be further broken down into age groups where the results become even more interesting. Again, there is a high level of consistency between the two years, suggesting good reliability:

Age group	0-6 months	7-12 months	13-18 months	19-24 months	25-30 months	31-36 months	37-42 months	43-48 months	49-54 months	55-60 months
Phase 2										
DM (Motor)	5	5.1	14.9	19.6	17	14.1	9.5	5.6	2.3	-1.1
DC (Cognitive)	7	10.8	10.8	10	14.8	17.8	16.4	12.3	6.5	1.1
DS (Socio-Emotion)	10.9	23.8	30.2	27.7	27.1	23.5	18.9	13.1	6.4	0.3
DL (Language)	3	2.2	9.3	18.3	21	20	16.8	12	6.2	0
Phase 3										
DM (Motor)	4.7	4.9	14.3	19.4	17.1	13.5	10.4	5.8	2	-2.1
DC (Cognitive)	10.7	8	10.2	11.3	16.8	17.7	16	12.1	7.7	2.2
DS (Socio-Emotion)	11.8	23.2	30.2	29.7	27.4	22.4	18	12.9	7	1.2
DL (Language)	3.3	2.1	8.5	18.7	21.2	19.7	16.4	11.3	5.8	0.2

Table 12: Difference (in months) of Surveyed Swimming Children against DEEWR composites for domain milestones, by age group

A clear pattern of achievement against DEEWR composite milestones has emerged. In the earlier age groups the rate of achievement over the DEEWR composites is quite moderate but as the age of the child groups increases, so too does the difference. This achievement peaks at around 25-30 months where children are outperforming DEEWR milestones by 17 months (motor domain), almost 15 months cognitively, 27 months on the socio-emotional scale and 20 months linguistically (Phase 2 results used here though the results are similar for Phase 3). The principal reason for the results topping out at this age bracket is that the survey instrument used for milestones measured only up to 5 years of age. This is a clear limiting factor in measuring development of the older children. To be more specific, as the developmental scale only went to 60 months in age if and the child was already 60 months old, then there is no capacity in the current study to determine just how advanced that child might be (but it could measure if the child is underperforming for his/her age). If the scale was able to assess to 120 months for children aged 60 months then it might have been possible to see the same level of advancement for children aged 5 years. In short, children in that grouping were maxing out the scale indicating that they may have been more advanced than the scale could measure.

This scale ceiling effect is likely to have caused lower means across the two-year cohorts than those shown in Table 12 above. Whilst parents may be overstating the development of their children – a principal criticism of utilising parental reporting for a measure of child achievement – the results are still strong despite the inability of the developmental scale instrument utilised here being able to effectively measure the achievement for older children.

Both analyses employed in this study – utilising both the CDC and DEEWR milestones – are are confirmatory in terms of swimming children's achievements as reported by parents.

Child Assessments

The data collected for this part of the study were compared against larger populations – the tests were selected on the basis that normative data were available to which we could compare our swimming children. In most cases, these were Australian norm-referenced populations making it possible to undertake comparisons between the swimming children and a normal population. The test items did not necessarily align with the developmental milestones in the first part of the study but offered similar reference points.

One hundred and seventy-seven (n=177) children were assessed, 95 were female and 82 male. They were aged between 36-71 months with the mean age of 49.46 months. For the purposes of our analysis, the children were split into three groups, based on tercile age. The ages were converted to years by taking age in months at time of testing and dividing by 12 and then rounding to the nearest year. The rounding is very important because it means that .5 is rounded up and .4 is rounded down. The result is a group of years that will be based on children around the whole year but might average slightly lower or higher. The alternative – to select those children aged between 3 years and 4 years – would provide an analysis of a mean age closer to half-years (eg. 3.5 years), making comparisons difficult.

Once split into the three terciles, the gender groupings per age were then identified:

Age	F	M	Total
Group 1: mean age 40.5 months	30	30	60
Group 2: mean age 48.8 months	36	26	62
Group 3: mean age 60.2 months	29	25	54
TOTAL	95	81*	176*

*Age data missing for one child

Table 13: Overview of ages and gender of swimming children assessed

All of the children who took part in child assessments were actively engaged in learn-to-swim classes. They have participated for varying lengths of time, from 6 months to 61 months.

The children represent a variety of socioeconomic backgrounds. Parents were asked for the postcode of their residential suburb and data was analysed using the Australian Bureau of Statistics Index of Relative Socio-economic Disadvantage (IRSD). This is a general socio-economic index that summarises a range of information about the economic and social conditions of people and households within an area. A low score indicates relatively greater disadvantage in general, a high score indicates a relative lack of disadvantage.

The index is based on a number of measures, including scores for the percentages of people:

- aged 15 years and over who have no educational attainment or whose highest level of education is Year 11 or lower
- aged 15 years and over who are separated or divorced
- living in one-parent families with dependent offspring
- living in families with children under 15 years of age and a jobless parent
- who are unemployed or are employed:
    - in low skill Community and Personal Service occupations
    - as Machinery Operators and Drivers
    - as Labourers
- stated household income between less than $20,800 per year
- living in occupied private dwellings:
    - requiring one or more extra bedrooms
    - with no cars
    - paying rent less than $166 per week
    - no internet connection
- aged under 70 who have a long-term health condition or disability
- who do not speak English well.

(http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/2033.0.55.001main+features100052011)

Of the children assessed for this project, 82 represent residential areas that score in the lowest half of areas on the ABS's Index of Relative Socio-economic Disadvantage.

Age Group	Female				Male			
	Low SES	Med SES	High SES	Total	Low SES	Med SES	High SES	Total
Group 1: mean age 40.5 months	3	14	13	30	11	10	9	30
Group 2: mean age 48.8 months	10	12	14	36	6	10	10	26
Group 3: mean age 60.2 months	10	10	8	28	12	7	6	25
TOTAL	**23**	**36**	**35**	**94**	**29**	**27**	**25**	**81**

(Residential postcode was not provided for 2 children)

Table 14: Overview of ages, gender and socioeconomic status of swimming children

Physical Capital

It would be reasonable to anticipate that an activity, such as swimming, would have a strong emphasis on gross motor skills as these are central to being able to propel through the water. It is also reasonable to expect that children who participate in formal learn-to-swim would perform well in assessments of physical skill.

The physical domain has been measured using the PDMS-2. Children were assessed on each of the five domains and their age equivalent scores were determined. Comparisons were then drawn between each child's actual age (represented in months) and the PDMS-2 age equivalent. The mean difference for each grouping was determined. Using a two-tailed t-test, it was found that there were significant differences between the swimming cohort and the normal population against which it was compared.

Age Groupings:

The children were clustered into terciles, according to age so that comparisons could be made to gauge whether some groups had more gains than others and also enable age-group comparisons.

For Tercile 1 (the youngest age group, mean age: 40.5 months), swimming children performed at a higher level on four of the five physical areas:

PDMS-2 Sub-test Item	Mean Achievement (in months)	Sig. (2-tailed)	Mean Difference
Stationary Standing on tip toes, balancing, standing on one leg	42.81	.105	2.314
Locomotion Walking, hopping, running, climbing stairs	42.42	.104	1.917
Object Manipulation Kicking, throwing, catching balls	39.42	.409	-1.076
Grasping Holding objects, controlled use of fingers of both hands (eg. using a pen, buttoning).	44.92	.026*	4.417
Visual Motor Integration Eye-hand coordination – drawing, copying objects, building towers	41.22	.558	.717

* p < .05, ** p < .01[7]

Table 15: Performance of Tercile Age 1 (mean age 40.5 months, n=60) on PDMS-2 Assessments

[7] One asterisk denotes that p < .05 and two asterisks shows that p < .01. This is a measure of statistical significance. At these two levels, results are statistically significant.

At a mean age of 40.5 months, the swimming cohort of children performed on average two months above the normal population for Stationary and Locomotion subtests, a little under one month for Visual Motor Integration and almost 4½ months for Grasping (which was statistically significant).

Similar results were found for Tercile 2 (the middle age group with a mean age of 48.8 months). There were 63 children in this group:

PDMS-2 Sub-test Item	Mean Achievement (in months)	Sig. (2-tailed)	Mean Difference
Stationary Standing on tip toes, balancing, standing on one leg	49.97	.411	1.168
Locomotion Walking, hopping, running, climbing stairs	52.22	.012*	3.422
Object Manipulation Kicking, throwing, catching balls	45.48	.013*	-3.324
Grasping Holding objects, controlled use of fingers of both hands (eg. using a pen, buttoning).	55.65	.004**	6.851
Visual Motor Integration Eye-hand coordination – drawing, copying objects, building towers	51.75	.087	2.946

* p < .05, ** p < .01

Table 16: Performance of Tercile Age 2 (mean age 48.8 months, n=63) on PDMS-2 Assessments

Again, the swimming children have underperformed in Object Manipulation tasks with a mean age of 48.8 months this tercile is performing these tasks at an average of over three months later than the normal population. In all other physical sub-tests, however, they are performing well above the normal population. Of most importance here, the second tercile is performing almost 3½ months ahead in the area of Locomotion and almost 7 months (6.851 months) above the general population on grasping. These results are statistically significant.

For the Tercile 3, a group of 54 children (mean age 60.2 months), the following results were recorded:

PDMS-2 Sub-test Item	Mean Achievement (in months)	Sig. (2-tailed)	Mean Difference
Stationary Standing on tip toes, balancing, standing on one leg	61.44	.289	1.244
Locomotion Walking, hopping, running, climbing stairs	65.24	.000**	5.041
Object Manipulation Kicking, throwing, catching balls	56.57	.031*	-3.626
Grasping Holding objects, controlled use of fingers of both hands (eg. using a pen, buttoning).	65.83	.000**	5.633
Visual Motor Integration Eye-hand coordination – drawing, copying objects, building towers	65.41	.001**	5.207

* p < .05, ** p < .01

Table 17: Performance of Tercile Age 3 (mean age 6.02 months, n=54) on PDMS-2 Assessments

Results for this third group were even more impressive. While still underperforming in Object Manipulation – by over 3½ months – these children were outperforming the normal population on all other physical areas. Most impressive are the results for Locomotion, Grasping and Visual Motor Integration where these children are performing on average over 5 months ahead of their peers in the normal population. Table 18 (below) shows a summary of all three age terciles:

Sub-test	Group 1 (40.5 months) 60 children			Group 2 (48.8 months) n=63			Group 3 (60.2 months) n=54		
	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff
Stationary	42.81	.105	2.314	49.97	.411	1.168	61.44	.289	1.244
Locomotion	42.42	.104	1.917	52.22	.012*	3.422	65.24	.000**	5.041
Object Manipulation	39.42	.409	-1.076	45.48	.013*	-3.324	56.57	.031*	-3.626
Grasping	44.92	.026*	4.417	55.65	.004**	6.851	65.83	.000**	5.633
Visual Motor Integration	41.22	.558	.717	51.75	.087	2.946	65.41	.001**	5.207

* p < .05, ** p < .01

Table 18: Performance of the Whole Swimming Cohort by Tercile Age on PDMS-2 Assessments

In summary, across the 177 children who participated in the child assessments, we found:

- There are no statistically significant differences between the swimming children and the normal population for the Stationary subtest.
- Swimming children performed significantly below the general population in Object Manipulation (kicking, throwing and catching balls), more than three months below their same-aged peers. This difference increased as the age of the swimming groups increased.
- There was a positive increase across groups in the area of Locomotion – considerable gains were experienced in comparison to same-aged peers. These gains increased with the age of the tercile group.
- Across all age groups there were considerable gains made by swimming children in grasping physical skills (from 4 to 6 months) and these results are statistically significant.
- The oldest tercile exhibited statistically significant gains – of 5 months – in comparison to the normal population in Visual Motor Integration.

Gender:

While the swimming boys in this study did not outperform their peers in any statistically significant manner, there were some notable differences between female swimmers and the normal population. (The mean age of children who participated in this study was 49.46 months.)

Sub-test	Males n=81			Females n=95			Whole Cohort n=176		
	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff
Stationary	51.28	.253	1.675	51.28	.133	1.884	51.09	.091	1.631
Locomotion	51.57	.168	1.968	54.19	.001**	4.789	52.87	.001**	3.410
Object Manipulation	48.31	.393	-1.291	45.86	.005**	-3.538	46.85	.007**	-2.608
Grasping	50.04	.824	.437	59.88	.000**	10.484	55.12	.000**	5.659
Visual Motor Integration	50.35	.644	.746	54.31	.002**	4.905	52.34	.011*	2.885

* p < .05, ** p < .01

Table 19: Performance of the Swimming Cohort by Gender on PDMS-2 Assessments

Girls in this study out-performed their peers in four of the five sub-tests and this was statistically significant. Within Grasping, for example, girls were some 10½ months ahead, Visual Motor Integration and Locomotion were both over 4½ months ahead of the normal population. Girls were, however, over 3.5 months behind the normal population on Object Manipulation.

Socioeconomic Status (SES):

While performance patterns were not dissimilar across socioeconomic groupings, the differences from the normal population are noteworthy.

Sub-test	Group 1 Low SES (n=52)			Group 2 Med SES (n=64)			Group 3 High SES (n=60)		
	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff
Stationary	52.37	.926	.173	48.25	.934	.150	52.87	.000**	4.667
Locomotion	54.90	.171	2.704	51.09	.101	2.994	53.00	.001**	4.800
Object Manipulation	49.63	.186	-2.565	44.69	.055	-3.413	46.66	.239	-1.539
Grasping	56.75	.053	4.550	50.75	.270	2.650	58.10	.000**	9.900
Visual Motor Integration	54.48	.285	2.281	48.81	.716	.712	53.93	.001**	5.733

* p < .05, ** p < .01

Table 20: Performance of the Swimming Cohort by SES Groupings on PDMS-2 Assessments

The most statistically significant results based on socioeconomic status (SES) were for the high-SES grouping (n=60). These children performed better at a statistically significant level than the normal population on four of the five physical sub-tests. With the exception of Object Manipulation (-1.5 months), these children achieved results over 4½ months ahead of their “normal” peers – with Visual Motor Integration scoring 5.7 months above and Grasping almost 10 months ahead.

While the other two groupings followed similar patterns, the gains were far more moderate. Low-SES children were at least two months ahead for Locomotion (2.7) and Visual Motor Integration (2.2) but were more than 4½ months ahead for Grasping. They were 2½ months below the normal population for Object Manipulation. There were no distinct patterns of achievement moving from low-SES to mid-SES. Children in the middle group were outperformed by the low-SES children on all measures (most notably by almost two months for Grasping).

Cognitive and Linguistic Capitals

The basis for this aspect of the child testing was the Woodcock-Johnson III tests. Using a two-tailed T-test, a number of factors were found to be very highly significant. The Woodcock-Johnson III battery assesses children on a number of items, some of which can be aggregated into clusters to provide quick and accurate measures of performance for general skills.

The general skills that had statistical significance can be seen in Table 21 below:

Cluster	Indicative items included in General Skill	Mean	Significance	Mean Difference
Oral Language	Ability to recall short, but increasingly complex stories and to listen and follow a sequence of instructions.	59.68	.000**	10.216
Oral expression	Ability to name objects from illustrations and to recall short, but increasingly complex stories.	60.51	.000**	11.049
Brief achievement	Letter and word identification skills, prewriting skills, simple mathematical calculations.	52.38	.003**	2.922
Brief reading	Letter-word recognition and pre-reading passage comprehension skills (the ability to match symbols with pictures).	51.71	.015*	2.245
Mathematics reasoning	Simple mathematical calculations and counting and identifying numbers, shapes, and sequences	56.06	.000**	6.597

Table 21: Intellectual/Cognitive Capital: WJIII clusters in which independently assessed swimming children performed significantly better than normal population

Results across all five clusters assessed were statistically significant across the swimming cohort. As a group they were particularly strong in areas of Oral Language (over 10 months ahead) Oral Expression (11 months) and in Mathematical Reasoning (6½ months). Given the mean age of the swimming children assessed was just under 50 months (49.46), these results are impressive. They also scored almost three months ahead of the normal population on the cluster for Brief Achievement and two months for Brief Reading.

These results were further examined by looking at individual subtests and by breaking down the cohort into a number of subgroups (by age, gender and socioeconomic status).

Age Groupings:

The 177 children assessed for this research have been broken down into terciles according to age. In **Tercile 1** – the youngest of the age groupings – there are sixty children.

Sub-test	Mean	Sig. (2-tailed)	Mean Difference
Letter-Word Identification	40.88	.832	.383
Story Recall	42.52	.678	2.017
Understanding Directions	56.38	.000**	15.883
Spelling	37.40	.051	-3.100
Passage Comprehension	47.90	.000**	7.398
Applied Problems	49.58	.000**	9.083
Picture Vocabulary	56.02	.000**	15.517
Quantitative Concepts	44.73	.001**	4.233

* p < .05, ** p < .01

Table 22: Performance of the Swimming Tercile Age Group 1 (mean age 40.5 months, n=60) on WJIII Assessments

With a mean age of 40.5 months, children in this tercile are performing above the normal population in a number of areas within the cognitive and language domains. For example, they are outperforming the normal population by over 15½ months in both Understanding Directions and Picture Vocabulary. Further, they are outperforming at phenomenal rates for Applied Problems and Passage Comprehension. Not insignificant is their performance with Quantitative Concepts – over four months ahead. These results are statistically significant. On only one measure did the youngest group not meet the levels achieved by the normal population – in Spelling – where their mean result was 3 months behind.

Similar results were recorded for **Tercile 2.** There were 63 children in this group:

Sub-test	Mean	Sig. (2-tailed)	Mean Difference
Letter-Word Identification	49.02	.904	.216
Story Recall	55.03	.326	6.232
Understanding Directions	64.16	.000**	15.359
Spelling	51.00	.187	2.200
Passage Comprehension	52.41	.015*	3.613
Applied Problems	57.13	.000**	8.327
Picture Vocabulary	65.30	.000**	16.502
Quantitative Concepts	56.57	.000**	7.771

* p < .05, ** p < .01

Table 23: Performance of the Swimming Tercile Age Group 2 (mean age 48.8 months, n=63) on WJIII Assessments

With a mean age of 48.8 months, this group also outperformed the normal population in many statistically significant ways: in Picture Vocabulary (16 ½ months), Understanding Directions (over 15 months), Applied problems (8.3 months), Quantitative Concepts (7.7 months) and Passage Comprehension (3.6 months). On none of the WJIII subtests within the cognitive and language domains did this middle tercile perform at a mean level lower than the normal population.

The 54 children in **Tercile 3** have a mean age of 60.2 months. Their results are reported as follows:

Sub-test	Mean	Sig. (2-tailed)	Mean Difference
Letter-Word Identification	61.83	.334	1.630
Story Recall	70.89	.022*	10.689
Understanding Directions	78.06	.000**	17.857
Spelling	63.27	.012*	3.069
Passage Comprehension	57.44	.086	-2.758
Applied Problems	65.85	.000**	5.646
Picture Vocabulary	81.17	.000**	20.973
Quantitative Concepts	64.10	.001**	3.896

* p < .05, ** p < .01

Table 24: Performance of the Swimming Tercile Age Group 3 (mean age 60.2 months, n=54) on WJIII Assessments

The oldest tercile also performed extraordinarily well on a number of cognitive and linguistic measures. Statistically significant results were recorded for Picture Vocabulary (almost 21 months), Understanding Directions (over 17½ months), Story Recall (10.7 months) and both mathematical measures – Applied Problems (5.6) and Quantitative Concepts (3.9). Their spelling was also advanced by three months.

Summary by Age Groupings

Sub-Test Item	Group 1 Mean Age: 40.5 months	Group 2 Mean Age: 48.8 months	Group 3 Mean Age: 60.2 months
Letter-Word Identification	.383	.216	1.630
Spelling	2.017	6.232	10.689*
Story Recall	15.883**	15.359**	17.857**
Passage Comprehension	-3.100	2.200	3.069*
Quantitative Concepts	7.398**	3.613*	-2.758
Applied Problems	9.083**	8.327**	5.646**
Understanding Directions	15.517**	16.502**	20.973**
Picture Vocabulary	4.233**	7.771**	3.896**

* p < .05, ** p < .01

Table 25: Overview of the Performance of the Swimming Cohort by Tercile Age Groups on WJIII Assessments

To summarise, across all age groups then, when considering the mean age differences in the cognitive and linguistic domains, it can be seen in Table 25 above, that there are consistent and considerable cognitive differences between the swimming children and the normal population. These data suggest that swimming children in this study appear to be many months ahead of their same-age peers. Of particular note are mean differences to the normal population for Understanding Directions which has a positive relationship to age (as does Spelling, but to a lesser degree) and Quantitative Concepts which would appear to have a negative relationship.

Gender:

Gender was analysed to see if there were any difference in cognitive and linguistic performance between boys and girls. These are summarised in Table 26:

Sub-test/Cluster	Males n=81			Females n=95			Whole Cohort n=176		
	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff
Letter-Word Identification	48.19	.434	-1.410	51.99	.106	2.589	50.11	.589	.649
Story Recall	45.46	.190	-4.143	64.64	.004**	15.242	55.63	.056	6.167
Understanding Directions	65.20	.000**	15.600	66.56	.000**	17.158	65.69	.000**	16.233
Spelling	46.63	.088	-2.967	53.07	.019*	3.674	49.98	.659	.517
Passage Comprehension	52.48	.011*	2.875	52.62	.012*	3.224	52.39	.001**	2.925
Applied Problems	55.11	.000**	5.512	59.21	.000**	9.813	57.13	.000**	7.671
Picture Vocabulary	68.58	.000**	18.975	65.82	.000**	16.419	66.83	.000**	17.374
Quantitative Concepts	52.91	.022*	3.313	56.65	.000**	7.249	54.75	.000**	5.289

* p < .05, ** p < .01

Table 26: Overview of the Performance of the Swimming Cohort by Gender on WJIII Assessments

There are some notable differences in results between boys and girls. Within the linguistic and cognitive domains, boys outperformed girls by 2-½ months on Picture Vocabulary – though the results for both genders were excellent. Boys were a staggering 19 months ahead of the normal population and girls 16½. On almost all of the other subtests within these domains, the girls performed at a higher level than boys. For example, girls performed better in Understanding Directions (17.2 to 15.6 months), Passage Comprehension (3.2 to 2.9 months) and within the two mathematical measures: Applied Problems (9.8 months to 5.5 months) and Quantitative Concepts (7.2 to 3.3 months). These were statistically significant differences. The only results whereby swimming children performed at a lower level than the normal population were recorded by boys.

Socioeconomic Status (SES):

One of the criticisms of a study such as this is that, as participation in formal swimming lessons can be expensive, swimming children are not representative of all children as they enjoy a higher socioeconomic status. The results then could be a reflection of this elevated SES at the expense of other variables. Mindful of how some may be excluded from swimming, this research was designed to include a cross-section of children, representative of all social strata. The research design incorporated children from varying socioeconomic backgrounds, residing in suburbs where postcodes reflect the wide variety of social strata.

The results by SES tercile are reported in Table 27:

Sub-test/Cluster	Group 1 Low SES (n=52)			Group 2 Med SES (n=64)			Group 3 High SES (n=60)		
	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff	Mean	Sig. (2-tailed)	Mean Diff
Letter-Word Identification	51.19	.658	-1.008	47.30	.698	-.798	51.71	.070	3.512
Story Recall	59.83	.210	7.627	45.36	.464	-2.741	61.87	.043*	13.667
Understanding Directions	65.56	.000**	13.358	62.16	.000**	14.059	69.08	.000**	20.883
Spelling	51.55	.758	-.651	46.84	.564	-1.261	51.57	.059	3.367
Passage Comprehension	53.49	.439	1.290	51.37	.036*	3.265	52.19	.003**	3.986
Applied Problems	59.16	.000**	6.957	54.22	.000**	6.122	58.18	.000**	9.983
Picture Vocabulary	70.14	.000**	17.937	62.44	.000**	14.344	68.30	.000**	20.100
Quantitative Concepts	55.71	.061	3.506	52.11	.013*	4.011	56.35	.000**	8.150

* p < .05, ** p < .01

Table 27: Overview of the Performance of the Swimming Cohort by SES on WJIII Assessments

There are some identifiable differences between SES groups in relation to the cognitive and linguistic domains. What can be seen in Table 27 is that differences in scores increased across a number of domains with the increasing SES status of the student. Low-SES swimmers performed better on three areas of testing (Understanding Directions, Applied Problems and Picture Vocabulary) while mid SES swimmers performed better on five areas of testing, and high SES performed better on six measures. Collectively these positive differences suggest that regardless of SES, swimming children were scoring better than the normal population in a number of areas. This finding helps to ameliorate concerns that the differences being observed in this study were due to social differences.

The high-SES group performs very well compared to both the normal population and to the other SES groupings. Their results include means of over 20 months on both Understanding Directions (compared to 13+ months and 14 months for the other two groups) and Picture Vocabulary (compared to almost 18 months for low-SES and 14.3 months for mid-SES) and almost 10 months for Applied Problems (compared to 7 months and 6 months for the other groupings). The higher SES group also performed extraordinarily well for Story Recall (13.7 months above the normal population) and 8 months for Quantitative Concepts where the other groups either did not perform as well or did not perform at a level that could be considered statistically significant.

While it could be expected that children from the high-SES might outperform both the normal population and children from lower SES groupings, it is of interest to note that on some measures (for example, Applied Problems and Picture Vocabulary) that mean results for children from low-SES suburbs were actually higher than those from the mid-SES grouping.

What is apparent in Table 27 above is that children from lower-SES areas do display more cognitive capital than the normal population and that in some areas such as picture vocabulary and understanding directions, this is very substantial – 18 months and 13 months respectively. There is an increasing trend as children come from increasing social strata. This trend confirms the original hypothesis that we were mindful of, that SES may moderate outcomes, However, it can be said with some confidence that regardless of social background, swimming children display greater cognitive capital than the normal population.

But as indicated early on in this report, it was critical for the research to be able to confidently separate any possible outcomes from swimming and social background. The children were classified by residential postcode. The sampling method ensured that there were families from all sectors of the community. The Australian Bureau of Statistics Index of Relative Socio-economic Disadvantage (IRSD) is an index based on residential postcodes and summarises a range of information about the economic and social conditions of people and households within an area. While the Index is relatively robust, it is noted that there is no surety that because a family lives in a high or low postcode area that they are low- or high-SES. At best, what can be assumed is that there is a strong likelihood that because of their location within a particular postcode zone that they share some characteristics of others located in the same area. It is the most reliable measure available to researchers without being personally invasive in family status.

Summary of Findings from Parent Survey and Child Assessments

The data from the survey, while needing to be viewed with some caution due to the possible parental bias of over-estimating children's skills, was generally confirmed by the individual child assessments. This suggests that there is some validity in gains noted by the survey data. It appears that there is a synergy between the two data sets. In summary, it appears from both data sets that children who participate in swimming are achieving milestones earlier than the normal population.

Environmental Audits

The completed audits for all sites visited can be seen in the figures below.

External Factors

Before accessing a site, the external factors were assessed in terms of their visibility, practical access and safety for parents. Parents or carers would have at least one child in their care, possibly more, so ensuring that the site was easily and safely identifiable and allowed safe carriage into the site were prioritized.

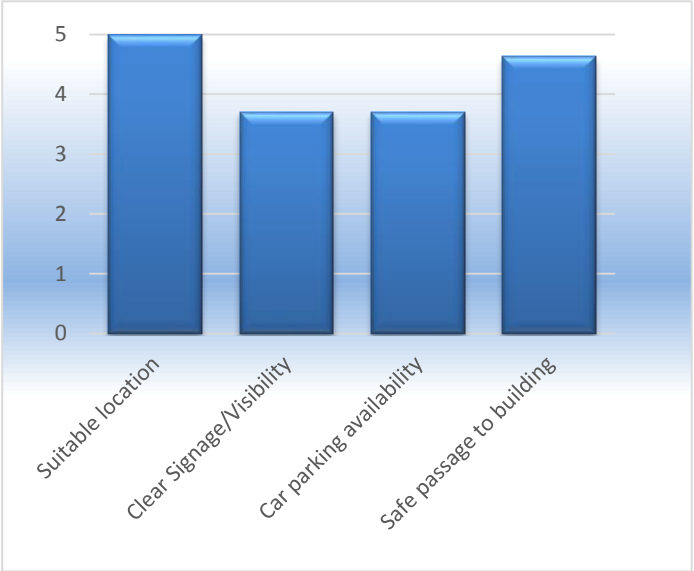


Figure 2: External factors of swim schools, summative data

As can be seen, across the board swim schools were rated very positively on the four elements within this dimension. The schools where signage or visibility was not scored highly were generally contained within facilities that provided other services.

The Centre/School

There was considerable variation in the physical layout of the schools ranging from purpose built to cater for early-years swimming, through to pools that operated from council facilities with minimal modifications. There was a range of swim schools operating from commercial/council pools which use temporary constructs (such as resting benches/islands) placed in the pool.

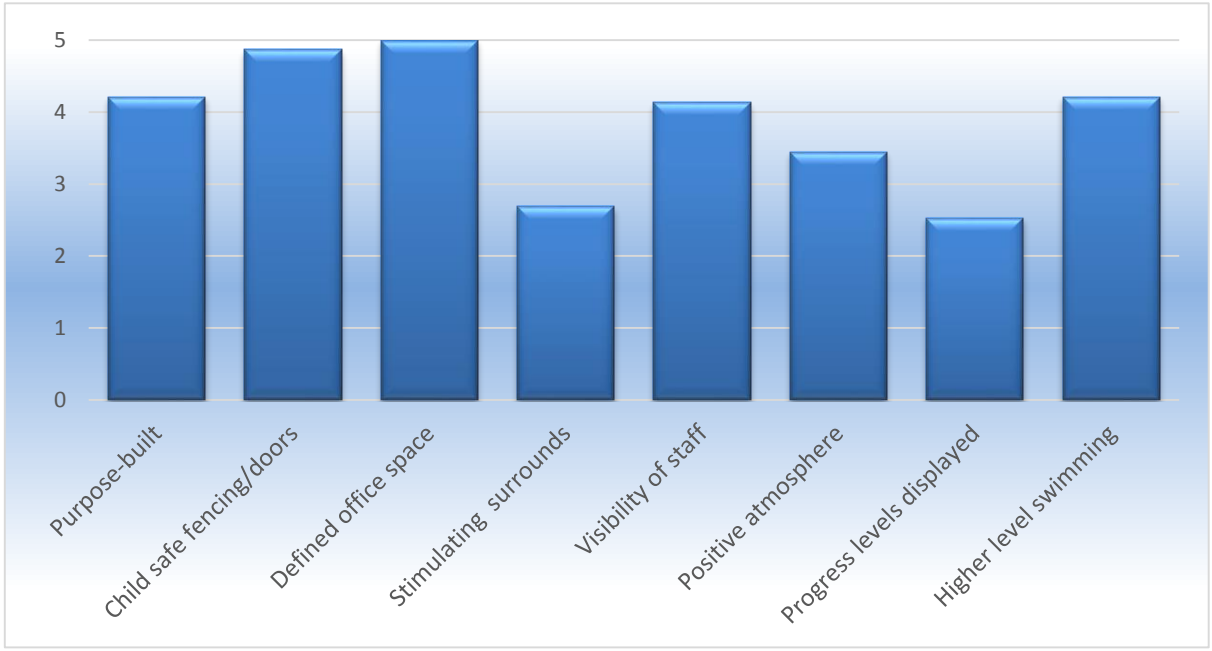


Figure 3: Assessment of swim school centres, summative data

Some swim schools located within shared facilities (eg. council pools) had limited opportunity for adapting the environment, even for the display of levels within the swim program. Most of the variation in this dimension was in the elements of stimulating surrounds and positive atmosphere

Facilities

In this dimension, the range of facilities available at swim schools was the focus of the profiling. This included toilets and change facilities; baby change facilities; storage facilities for parents to safely store their possessions while participating in swim lessons; access to the pool deck for non-participating parents; adequate seating for parents as they watched their children; play facilities for siblings or children not involved in swim lessons; availability of refreshments (such as food, coffee, drinks) and tables/chairs for families while they waited for their lessons.

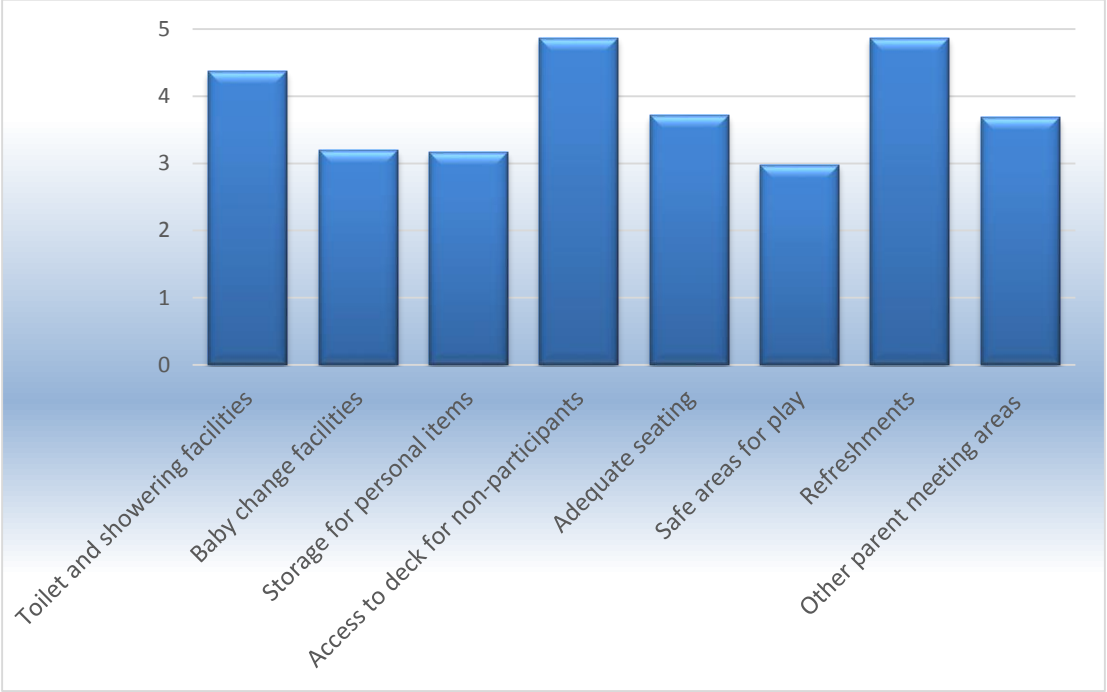


Figure 4: Assessment of swim school facilities, summative data

The areas of most variation in this dimension were the provision of a safe place for children to play and the provision of baby change facilities which is again a reflection of the purpose of the facility in which the swim school is housed.

The Pool

As the pool is the centerpiece for swimming lessons, this is an integral aspect of the swim environment audit. This included whether or not the pool was purpose built; the comfort level (usually heat and ventilation); lighting; sunsafe (particularly relevant for outdoor pools); noise levels; depth of the pool appropriate for the swimmers; ease of entry; destination swim points; availability of teaching resources for the teachers and children.

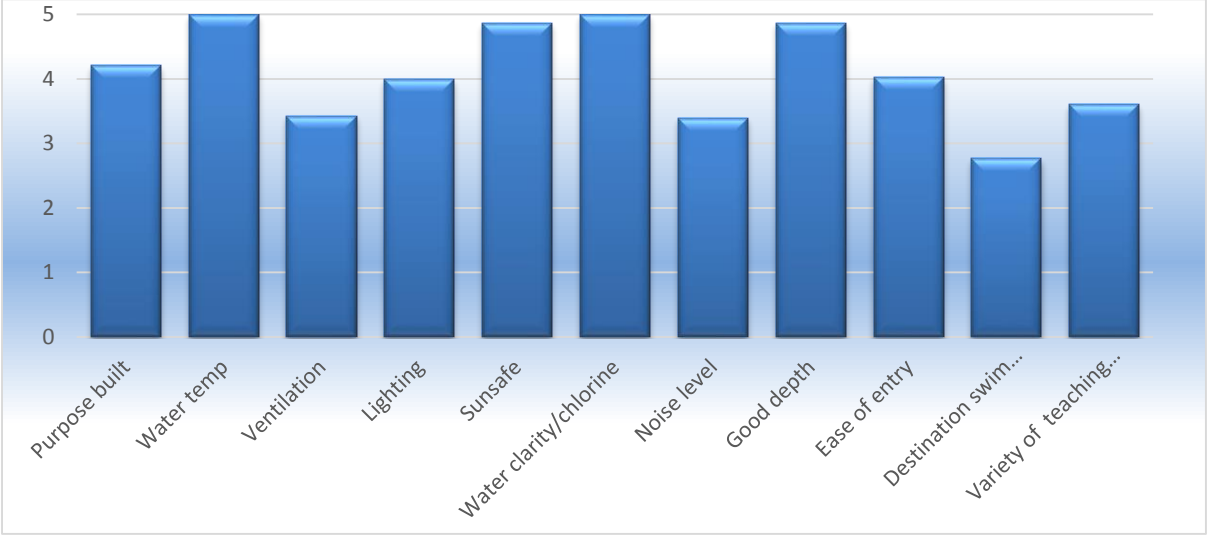


Figure 5: Assessment of swim school pools, summative data

The overall data here suggest that there are positive swim school environments across the board. It should be noted though that there was considerable variation across the sites in terms of noise levels. Again, this was dependent on the location and constraints of the environment. In many schools it was impossible to hear what the teacher was saying to young children from the poolside. Water temperature is a key factor in the comfort of young children in learn-to-swim. Some swim schools cannot offer baby swim classes because they do not have control over the water temperature in their pool as this may be controlled by owners/facility managers who operate independent of the school.

Swim Pedagogies

One hundred and twenty-two lessons were observed across the swim sites visited. The lessons included all age groups. There is a marked difference in the lessons for babies/parents than those where the child is in the pool without the parent/caregiver. With this in mind, we have separated these two types of lessons as they are markedly different in terms of what can be undertaken and achieved by the teacher. We provide an analysis on the lessons with/without parents and then an aggregated score for that dimension.

Dimension One: Orientation

The early lessons focus on ensuring the child is familiar with the water and various activities are undertaken, including basic familiarisation, submersions, early safety (turning to grab the edge of the pool). These lessons are undertaken with parents or carers in the pool. As the child ages and their physical development improves, later lessons begin to adapt for the gross and fine motor skills of the child. Some schools have a very strong emphasis on water safety whereas others focus on swim technique. These two categories are not mutually exclusive and elements of both are found in lessons/programs. However, the ethos of the swim school may prioritise one over the other.

The results have been reported in three groupings. The first grouping shows the average rating for lessons for all children aged 5 years and under. The second grouping has been labeled “Baby Swim” and this represents all children, generally under the ages of 2½ years, who are participating in a swimming lesson accompanied by a parent/carer. Some swim schools do not require parents in the water from when the child turns two, others require parents to actively participate until the child turns four. The principal determinant here is the presence of the parent. The third grouping, labeled “Preschoolers” represents children, generally aged over 2½ years who are participating in a lesson without a parent. These children could be aged up to 5. The separation of babies from preschoolers was made in order to recognise the significant differences in approaches used.

The three components that make up the Orientation dimension: water familiarisation; water survival skills; and swim technique skills for each of the groupings are displayed in Figure 6 below.

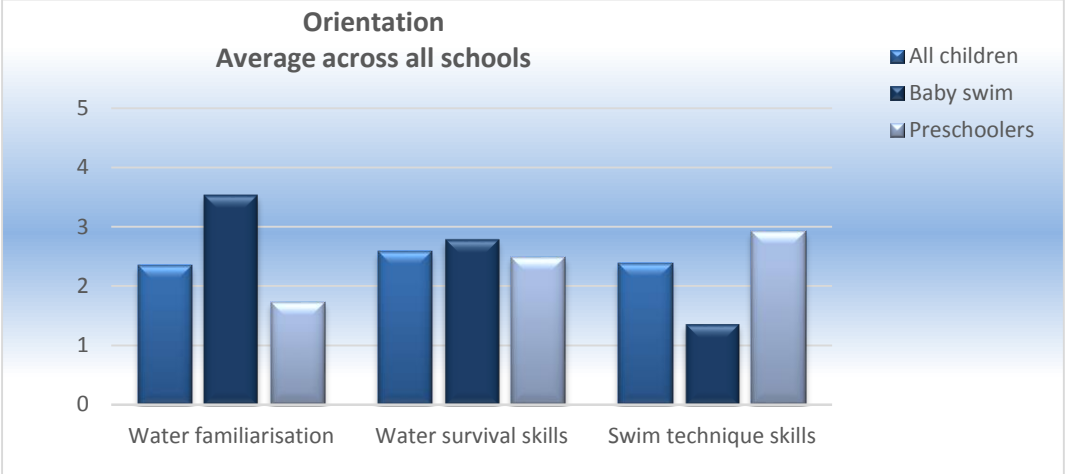
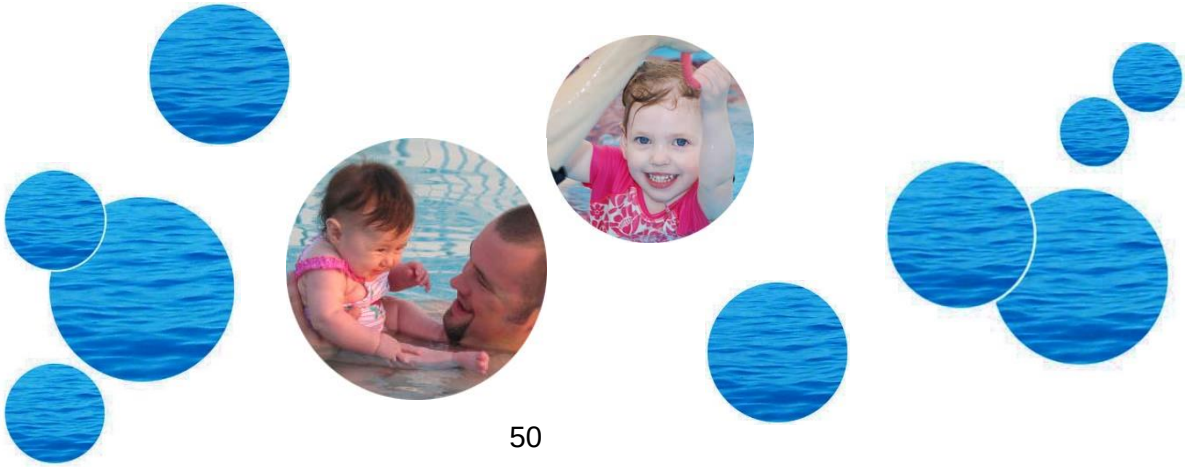


Figure 6: Profile of orientation of learn-to-swim lessons, summative data

The data here are not surprising – in baby swimming there is a considerably higher profile for water familiarisation. This tends to reduce over time so that as children age, there is little or no water familiarisation as the emphasis has shifted to the teaching of technique. In terms of safety, there is a good score for both categories of lessons.



Dimension Two: Physical Capital

This dimension of the profiling is the core business of swimming – one would anticipate that swimming lessons are building on the physical capital of children. In terms of the data, the elements of this dimension focused on aspects of what is taught as part of swimming. This dimension comprises:

- **Co-ordination** where there is an expectation that the child will exercise a number of physical movements concurrently.
- **Differentiated activities:** where variation of children's skills/abilities/ages is evident, a number of activities are used to cater for this variance.
- **Participation/flow:** Teacher maintains constant flow of the activities presented in the lesson so children are continually engaged in some form of specified activity with limited down time.
- **Activity progression:** Teacher has designed the lesson so that activities progressively build on each other.
- **Integrated communication strategies:** Teacher uses a range of communication strategies: talking, singing, demonstrating, using visual aids (eg. toys/pool aids).

Figure 7 below depicts the results for observed lessons on each of the physical capital elements:

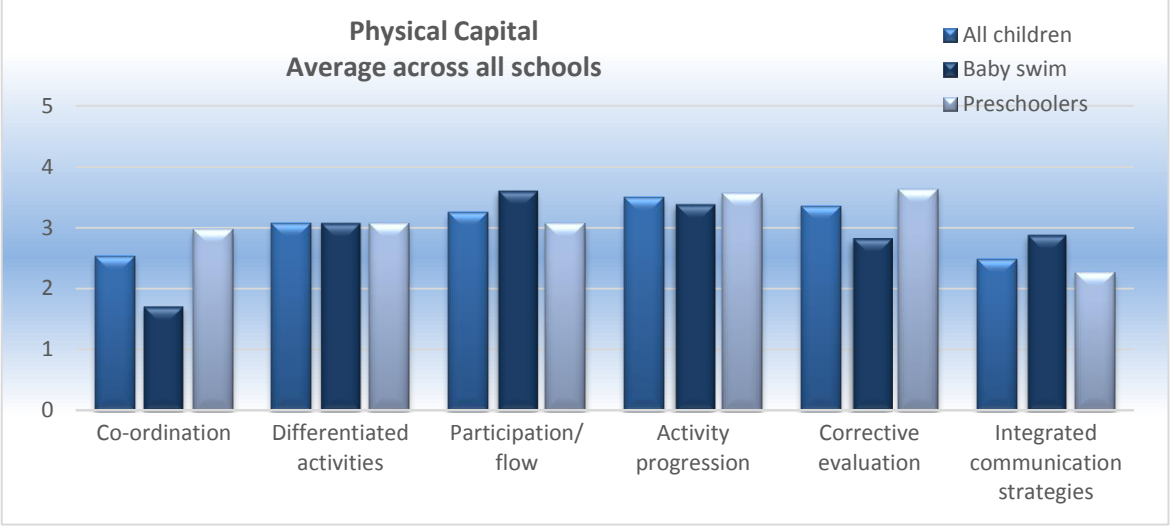


Figure 7: Profile of "physical capital" within observed learn-to-swim lessons, summative data

Unsurprising in these data is that there is a strong link with the physical development of the child and how the lessons are structured. What is of interest however, is the variation among schools on some of the elements. Particularly, the participation/flow element has the most variation. This is most likely a reflection of the ethos of the school where some schools allow children to either sit on the edge of the pool while others swim (so that they are only actively participating in perhaps 25% of the lesson), some schools allow children to play in the water while the teacher focuses on particular children so that there is some water activity happening albeit unstructured, while other schools endeavour to have children actively involved in the majority of the lesson.

Dimension Three: Social Capital

Lessons were also assessed for how the pedagogies employed may contribute to the social capital of child participants.

- **Social support:** Teacher exhibits behaviours, comments and actions that encourage effort, participation and taking risks to learn.
- **Child engagement:** Children exhibit on-task behaviours that signal involvement/satisfaction with the swimming lesson, including attentiveness, doing the assigned activities, anticipating lesson structure, showing enthusiasm.
- **Parent/carer engagement:** Teacher engages parents/carers in lesson activities. (Parents/carers exhibit behaviours that show an investment, including attentiveness to the child/teacher, interaction with the child, anticipation of lesson structure, enthusiasm.)
- **Confidence building, emotional well-being:** Teacher employs strategies to build confidence and emotional well-being in children. The approach is consistent and dependable. The positive sense of self and copying skills of children.
- **Self-regulation:** Teacher encourages self-regulation of students. This is demonstrated by both implicit behaviour management techniques (where little time is aimed at disciplining children's behaviour and children are demonstrating high self-regulation) and, where children are not demonstrating high self-regulation, instructional techniques that gently remind/reinforce good behavior.

The results for the dimension of social capital are:

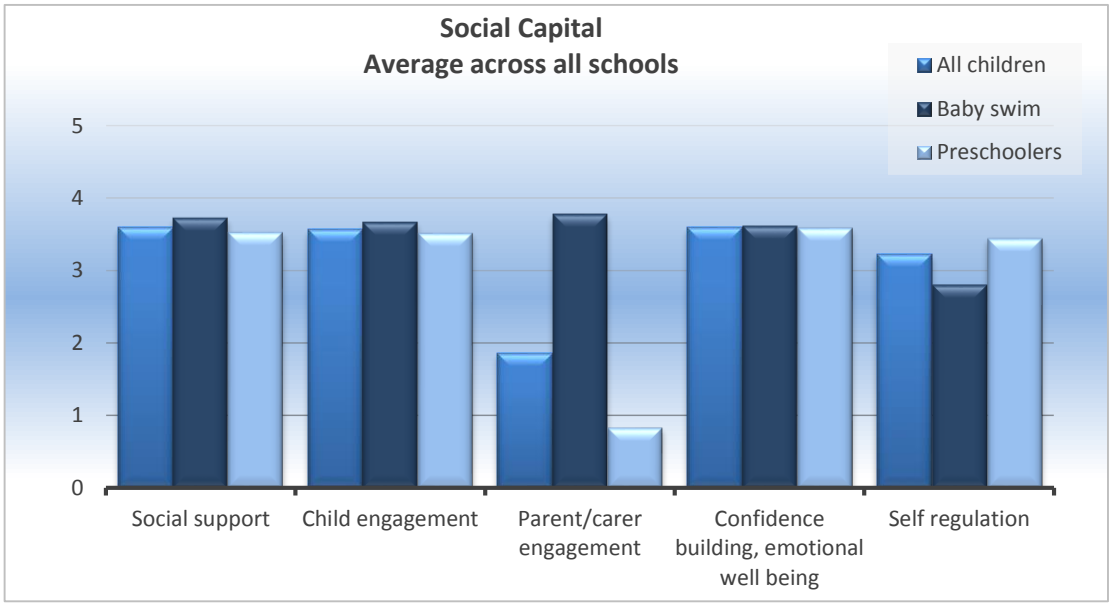


Figure 8: Profile of "social capital" within observed learn-to-swim lessons, summative data

The scores for social capital are quite strong and there is a strong sense of the swim pedagogy creating a positive learning environment. Encouragingly, there is very little variation across schools on these elements suggesting that there is a strong sense overall of creating very positive learning environments for the swimming children.

Dimension Four: Intellectual capital

The observed lessons were also profiled as to the contributions they made to intellectual capital in children. Pedagogies were observed on literacy, numeracy and "other" curriculum areas.

- **Literacy:** Teacher incorporates instructional techniques and/or activities in the class that develop literacy. (eg. explicit instructional techniques, the development of listening skills, the use of rhyming in songs, letter formations on instruction cards.)
- **Numeracy:** Teacher uses instructional techniques and/or activities in the class that develop numeracy. (eg. the use of counting while instructing, using visual cues with number representations.)
- **Other curriculum areas:** Teacher incorporates instructional techniques and/or activities in the class that develop other areas of the curriculum. (eg. music).

Figure 9 outlines the observational findings for intellectual capital:

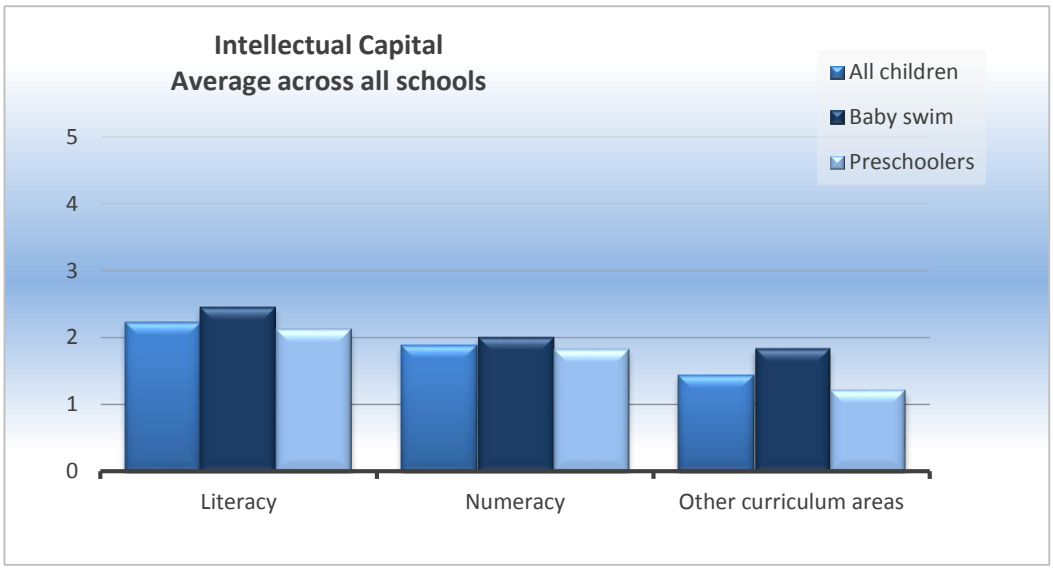


Figure 9: Profile of "intellectual capital" within observed learn-to-swim lessons, summative data

While this dimension is not a strong feature in the lessons, there is still evidence that the teachers are working on elements of literacy and numeracy learning. The babies' lessons have scored higher on the "other curriculum areas" due to the number of songs that are often part of the swimming lesson. This dimension, along with language, is an important factor in school readiness.

Dimension Five: Language Capital

Lessons were also profiled as to how the linguistic capital of children may be enhanced. Specifically, they were profiled by the "rich" language employed and the instructional discourse used.

- **Rich language:** Teacher incorporates instructional techniques or activities that endeavour to link with the understandings of the child to the world outside the aquatic environment.
- **Instructional discourse:** Teacher incorporates instructional techniques that develop a range of skills in children that will benefit them in the school environment.

Figure 10 below outlines the results for each of the elements within the Language Capital dimension:

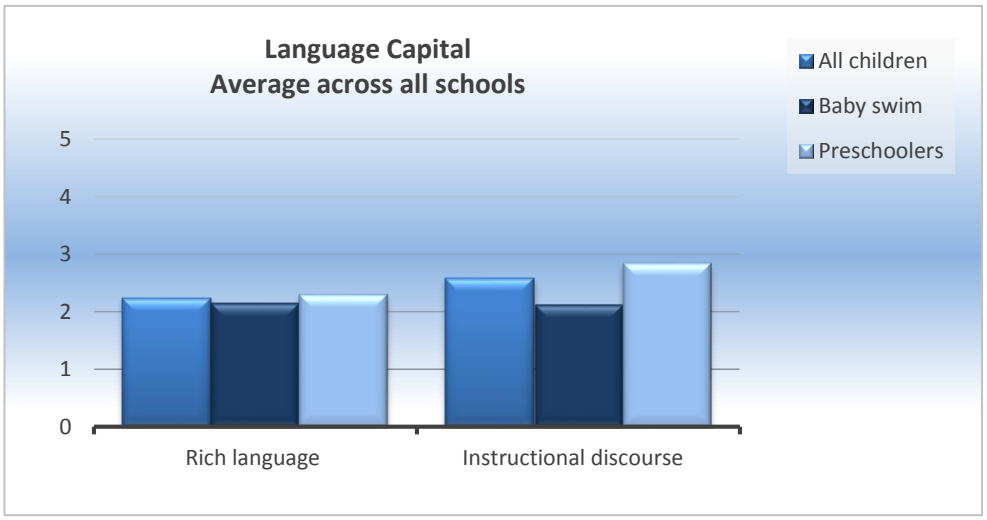


Figure 10: Profile of "language capital" within observed learn-to-swim lessons, summative data

This dimension is not quite as rich as the other dimensions, in part due to the repetitive nature of the swimming instructions. The richness of the language is perhaps constrained by the ways of teaching, but the instructional discourse used by teachers is stronger for children than the baby classes. We contend that this difference may be due to the stronger play environment of the baby class and having parental involvement. Whereas, with the older children, the teachers do need to focus more on how they deliver instructions but in a context where there is a lot of coordination between body movement and language (e.g. "kick, kick, kick"). Here the language is not rich as the co-ordination between movement and language appears to have a stronger emphasis in the pedagogy.

Project Conclusions and Recommendations

Conclusions

From this study, it does appear that children who participate in swimming are achieving a range of milestones earlier than normal populations. This has been supported strongly from the parent survey as well as the child testing. The child testing, as a much more robust and reliable measure of child achievement, indicates considerable gains being displayed by the swimming children in comparison to the normal population.

It is reasonable to anticipate that swimming may enhance physical capital due to the physical focus of swimming, particularly in gross motor skills. Many of the skills, dispositions and knowledge that swimming children are displaying in both the survey and the child testing are those that one would expect from intense training in swimming – namely their physical capital. However, we also note that swimming children, as reported by their parents and through child tests, are also performing better than normal populations in other areas – their language and intellectual capital. In some areas, there are significant differences between the swimming cohort and the normal populations upon which the tests have been based.

Many of the skills that swimming children are displaying earlier than the normal population are in areas that are valued in contexts outside swimming. For example, the survey showed that young swimmers are reported by their parents to be counting to 10 much earlier than is expected on developmental milestones. Many of the parental reports in the survey have been confirmed by the child testing. We note that the child testing confirmed many aspects of the parent reporting (survey) but not as strongly. As such, there is triangulation in the data but with a need to moderate some of the parental reporting. Collectively, the two sources suggest that children who participate in swimming achieve a range of milestones (skills, knowledge and dispositions) earlier than the normal population.

It was also found that there were some areas where swimming children were not performing as well as the normal population, particularly in the area of object manipulation – namely ball handling skills.

One of the most salient variables in the analysis of the swim survey was that of the swim school. This suggests that a considerable amount of the variability across the study was related to the swim schools.

Our observations of quality swim lessons suggest that swim lessons can offer considerable potential to add capital to young children. In early swimming lessons young learners are exposed to new experiences that extend their repertoire of skills, knowledges and dispositions. The analysis of the swim environment and the teaching approaches adopted by the schools varied considerably. The small numbers of observations at each site along with the diversity among the survey responses mean that any direct correlation could not be undertaken but this may be an area of value in the future. However, it is reasonable to assume that the quality of the swim school

is an important factor in the capacity to build various forms of capital among young swimmers. We have noted the strong mathematical experiences in early swimming (counting to three, counting to ten, one-to-one correspondence between counts and actions; rich language around colours and shapes, rich language of mathematics in general) (Jorgensen, 2013). All of these experiences enrich and enhance children's learning and the results may be shaped by these experiences.

It appears that there are advantages for young children who participate in early-years swimming. There is clearly the water safety focus and the physical benefits for participating in any activity, but this research suggests that there are many areas of positive difference between swimming children and the normal population. Many of these differences will be of advantage to children as they transition into school or preschool settings. They have developed many of the skills needed for school – academic, social and personal.

Caveats

We cannot conclusively claim that swimming is responsible for the differences we have identified in this study. Simply, we can say that children who participate in swimming lessons achieve a wide range of milestones (survey) and skill, knowledge and dispositions (child testing) earlier than the normal population.

We cannot conclusively claim that more lessons or time per week would have an even more significant difference – the number of children in this study who participated in more than one lesson per week was too small to draw any firm conclusions.

Recommendations

As the early years of life are so critical to later successes, there is now a strong emphasis on these early years of learning and the transition into schooling. Many of the children who participate in early-years swimming are those who come from families able to afford swimming lessons. The cost of lessons can vary considerably. While the swim schools the Early-Years Swimming Research team visited in 2011-2012 charged between $11 and $24 per lesson, RLSSA's Swim School Managers Report (2010) showed that across Australia, the average thirty-minute swimming lesson was just under the $30 mark for children up to 5 years of age. For many families, this cost is beyond their budget and are disadvantaged by not being able to participate in swimming lessons and the possible benefits to be gained for children beyond those of swimming and safety.

- All children should be encouraged to participate in swimming for safety and overall wellbeing.
- Quality swimming lessons are rich in opportunities for learning beyond swimming skills so there is the potential for children to extend their learning which may help in the transition to school. It would be prudent for at-risk children to be able to access early-years swimming, but many of these children are less likely to participate in swimming due to the high cost of lessons. Subsidizing lessons may be a way forward for disadvantaged families to enable better access to school.
- Recommendations for determining what constitutes quality swimming programs should be developed to help parents in the selection of swim schools which may enhance skills, knowledges and dispositions to support the transition to school.

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