Eyes on Our World:
An Interdisciplinary Approach

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There has been a worldwide trend recently for universities to reduce their traditional focus on separate disciplines and to encourage interdisciplinary research and teaching. This interdisciplinary collaboration tends to be highlighted in the physical and medical sciences (e.g., bioinformatics, molecular bioscience), but students with special needs often require medical and therapy support, so special education has a history of collaboration with professionals in other disciplines. However, this collaboration has taken place most often in professional practice rather than in pre-service course work or in research programs. This paper describes current research projects that are being undertaken with links between special education and another discipline, communication and information technology. The projects are concerned with the development of learning experiences for young, vision impaired children. They recognise the value of interdisciplinary approaches in tackling complex problems and the value to students of crossing disciplinary boundaries and participating in team research.

Background

Effective collaboration between different disciplines has become a high priority in science and interdisciplinary research has been described as a mantra of science policy (Metzger & Zare, 1999). This has been sparked partly by recognition of the need for graduates to have cross-discipline capabilities, and has led universities to initiate interdisciplinary experiences in research and teaching in a variety of fields. To actualise the priority will be a challenge for academics accustomed to working and teaching within their own specialised areas of interest.

In the past, special education has tended to be an exception to limited collaboration between disciplines, as students with special needs can require support from both health and education professionals and staff have needed to actively seek it. However, this collaboration has most often taken place in education’s professional practice settings at primary and secondary levels, or medicine’s in hospitals or therapy rooms rather than in universities with accommodations in teaching or in research programs. The mode of operating as a transdisciplinary team in intervention programs with children with disabilities is of interest, as there have been determined efforts by allied health teams to distinguish transdisciplinary practice from the hierarchical operations of multidisciplinary teams in hospital settings. It is emphasised that professionals in the team do not operate independently from one another but exchange ideas and learn from one another.
In addition to the transdisciplinary model, there are two other common models of team structure in collaborative research and teaching: multidisciplinary and interdisciplinary. The main difference across the three models is the degree to which professional boundaries coalesce (Bruce, Lyall, Tait, & Williams, 2004; Magill-Evans, Hodge, & Darrah, 2002). In the multidisciplinary model, each discipline provides an independent contribution. A team leader sets goals and recruits team members to provide specialised skills. There is more co-ordination between professional team members and transfer of tools in the interdisciplinary model but usually, each remains responsible for a particular aspect of the project. In the transdisciplinary model there is more sharing of knowledge by team members, more blending of responsibilities and more cross-skilling.

This latter model is well-recognised in the nursing and allied health literature (Magill-Evans et al., 2002) and centres for transdisciplinary research have been established in France since 1973 (Ramadier, 2004). CIRET (the Centre International de Recherches et Etudes Transdisciplinaires) offers a multilingual forum, with an electronic journal and international colloquia sponsored by UNESCO. Advocates of transdisciplinary research believe that the complex and heterogeneous problems of modern society cannot be solved in terms of disciplinary boundaries (Klein, 2004). However, interdisciplinary teams are more common, especially in the technology and science fields where there has been rapid growth in universities and in industry.

The importance attached to structuring research away from disciplinary boundaries is reflected in the strong focus on interdisciplinary collaboration in the European Union's (EU) centralised research activities and in recent funding decisions by the National Institute of Health (NIH) in the USA. The objectives of the EU are to direct research into areas that will increase industrial competitiveness and improve the quality of life for citizens (Bruce, Lyall, Tait, & Williams, 2004). In the USA, the NIH committed $9 million for the development of interdisciplinary research strategies to solve significant biomedical and/or behavioural research problems, and $5 million for interdisciplinary research training programs and curriculum development. The encouragement of new teaching and training programs is interesting because it recognises the need to extend the knowledge and competencies of future graduates beyond the confines of specialised disciplines.

Although these initiatives are recent, 40 years ago Piaget (1973) noted the need for interdisciplinary collaboration and the Centre for Genetic Epistemology was designed so that psychologists, logicians, and mathematicians could collaborate in furthering his research (Piaget, 1962, 1973). In Piaget's view, the main obstacle to interdisciplinary research was the university division into disciplines and perhaps it is not surprising that concern about loss of autonomy is currently a common problem in establishing interdisciplinary research teams (Jones, 2001).

The mechanics of setting up the team, what is learned from the process, its benefits and problems, have recently been recognised as worthy of investigation. Robertson, Marten and Singer (2003) recommended that the process of collaboration should be made transparent if other researchers are to assess the data collection and its inferences, and plan follow-up studies. These writers could find only one group, still in the early
stages, that was examining their method of collaboration. Several others, however, have described aspects of team building and summarised what they believe to be critical aspects of interdisciplinary collaboration (Jones, 2001; Morreale & Howery, 2003). Common “how to do” principles start with the identification of the critical problem that needs attention and then the choice of collaborators matched to the project. These reports stress the importance of negotiating roles and responsibilities. The recommended strategies can be summarised as follows:

- clarify who has control over the agenda, the aims and the objectives
- clearly state the plan of action and define tasks, timelines and goals
- determine the procedure regarding publication and sharing of authorship
- schedule regular team meetings during the course of the research
- minimise competition
- ensure that every participant feels some sense of ownership.

The benefits reported include:

- impact on problem-solving through exchange of ideas
- gains in resources and information
- recognition of diverse skills
- expansion of personal development and interests of individual team members
- value to students of crossing disciplinary boundaries and participating in team research.

As noted in the “how to do” principles, a vital precursor to team functioning is the negotiation of roles and responsibilities with a subsequent need for regular team meetings. These initial negotiations may be frustrating and time consuming but the ultimate success of the project depends on the commitment of individual team members. Other challenges include:

- concern about loss of autonomy
- difficulty in establishing unambiguous agreements between team members
- building trust between team members
- the language of each discipline may be different (the same term may have different meanings or implications), adding to difficulties in communication
- it can be more difficult to get institutional or external funding
- organization structures may not be flexible enough with potential bureaucratic barrier
- senior management may be unwilling to risk perceived loss of control
- staff may be uncomfortable with new ways of working.

This paper describes current interdisciplinary research projects being undertaken within the Eyes on Our World program at Griffith University. The projects link special
Eyes on Our World's interdisciplinary projects
The aims of these projects are to use information technology to encourage young vision impaired children to engage in learning activities. The research literature about applications of information technology to learning in early childhood is predominantly about typical, sighted children. These research reports have indicated that although teachers may prefer the drill and practice type of computer games, young children seem to prefer more challenging puzzles. However, it has been found that maths games and puzzles do not always support the development of mathematical concepts and if teacher support is needed but not available, children move on to easier tasks (Yelland, 2001). Drill and practice can help children to develop skills in counting and sorting but this may be of most benefit after children understand the concepts involved (Sarama & Clements, 2001). In contrast to the drill and practice approach, there are reports that programmed "toys" (e.g., the Logo turtle) can provide effective environments for learning mathematics and problem-solving (See Sarama & Clements, 2001 for review). These programs are based on the premise that children's learning can be extended if they are engaged and interested in a problem solving activity. This engagement and interest is a major basis for children's involvement in any activity. It is especially important for children with vision impairment because their learning environments are restricted by the lack of incentives usually provided by the sight of interesting objects or events.

Procedure
Process of collaboration
The origin of the interdisciplinary collaboration can be traced to the support given by Ray Charles for the vision impairment program at Griffith University. After visiting the Vision Impairment Lab, he provided publicity on Australian TV channels and on the Griffith University home page web site. As a result of this publicity, several approaches were made to the director of the Vision Impairment Lab about the possibility for interdisciplinary research.

The director sought suggestions for suitable projects from specialist teachers of vision impairment in early childhood, primary, and secondary school settings. A number of ideas were offered. A team consisting of the Head of the School of Cognition, Language and Special Education, the Director of the Vision Impairment Lab and the Head of the School of Computer and Information Technology considered these. The team collaboratively developed its set of "how to" principles and selected three projects:
(a) An interactive dynamic electronic educational toy (IDEET).
(b) Indoor computer enhanced environment
(c) Tactile computer maths game

These were then included on the list of research topics offered to final-year
information technology students. Three groups were formed consisting of four students in each group and assisted to negotiate its own set of "how to's". The first of the projects (IDEET) is nearing completion and the others are underway.

The students meet on a weekly basis for the first three months of their project. The meetings are then reduced to once a month or on request. They are responsible for designing the software and selecting the most suitable material for the hardware. They then must test trial their design with children who are blind or with severe low vision under the supervision of the Director of the Vision Impairment Lab. As a result of the observations made during these trials, adjustments are made to both the software and hardware. Details of IDEET follow, as it is the project closest to completion.

The IDEET project

From design to test trials
A Sony robotic dog toy that could kick as in a soccer game was used as the basis for an interactive toy. The students modified its body by gluing four different textures to various parts of its body. In this way, it was considered that children who were blind or had low vision would use touch to identify parts of the dog's body. Sensory systems for robots in children's learning situations are usually designed to detect either light or audible sounds. Because touch is an important modality for blind children to compensate for their lack of vision, the sensory system for the robot in this project detected patterns of pressure. The students also modified the software so that the dog not only had the ability to kick but also it could dance. Music was added to the toy by inclusion of a small chip.

When the start button is pressed the dog moves from a sitting position to a standing position and a child can feel this movement by having both hands on the toy. The dog then introduces itself by saying "Hello, I am Miranda". (The student working on the modifications and adaptations from the school of CIT named it after his girlfriend). A pause, and the dog continues, "If you want to hear music touch my head", pause. "If you want me to play with the ball, touch my back", pause "If you want me to kick the ball with my head, touch my head again", pause "If you want me to kick the ball with my foot, touch my back", pause. "If you want me to dance …etc".

Two groups of young children participated in test trials of the robot, one group of five sighted children and one of four children who are congenitally blind. The age range in both groups was from 2 to 5 years.

Interactions between the toy and both groups of children were active and enthusiastic. Especially after their initial experiences with the toy, children listened attentively to the instructions and then chose their preferred activity. Choices are important in active learning. When one of the blind children selected dancing, he was observed feeling the movements of the dog as it positioned itself on its hind legs and stretched forward its forelegs, moving them up and down alternately, and swaying to the music. When the child perceived that the dog was swaying, he swayed too. As well as contributing to the learning experiences of individual children, the robot encouraged interaction with others. When the choice was made for singing, the dog started singing a popular song known by the children, and they started singing, too.
Obvious signs of pleasure were common. One child elected for the Miranda to kick the ball, and while sitting on the floor, placed the dog between his legs, facing towards him. The ball was placed touching Miranda's forelegs. The child then touched the dog on the back and it kicked the ball. The child burst out laughing when the ball came to his body, providing strong evidence of action feedback. The experience also gave the child practice in the spatial location of the ball with respect to the dog's legs and his own body. Development of spatial knowledge is vital for the orientation and mobility skills that lead to independence for a blind child. For a sighted child, this kind of information is readily available through vision.

In other observations, it was noted that children, including those who were blind, spent sustained periods of time exploring the toy, its various parts, batteries and chips. This exploration provided interactive opportunities for the teacher and University students to name the IDEET's parts and to discuss with the children the function of each component.

**Discussion**

As suggested in the literature (Jones, 2001; Morreale & Howery, 2003), there were benefits from the application of diverse skills. The robot is in the prototype stage of development but observations suggest it can have a positive impact on the learning experiences of young children who are blind or have low vision. Criteria for extending its capabilities in areas of child learning are now under consideration, e.g., by providing more experience with the language of spatial concepts in touch instructions.

The design of the robot needed specialised IT skills but gained from an educator's knowledge of conditions favourable to child learning and of individual differences in children who are blind or have low vision. These differences may be related to the nature of each child's vision impairment and whether there are additional disabilities. The decision to use touch as a major source of sensory information was based on knowledge of sensory compensation in the development of blind children.

Young children who are congenitally blind do not have as many opportunities as sighted children for play and other experiences that promote independence. They can press a button to listen to music or stories through media that is static in nature, e.g., tape recorder, wireless, TV, so they have some experience of action-outcome learning but they have fewer opportunities for dynamic interactive learning with a multifunctional object. The robot provided an environment to promote active self-directed learning through stimulating attention, motivating exploration in a playful context, and providing systematic action-outcome feedback.

The university students reported the personal encounters with the children who are blind or with severe low vision enriched their experience and gave direct purpose to their work. Because of the commitment of team members to the project, initial difficulties in understanding each other's terminology were easily overcome and organisational hurdles at this stage were minimal.

Another interdisciplinary project is being planned currently between Education and the School of Medicine. Academics can become involved in a variety of interdisciplinary research projects that are not restricted to the same disciplines. The principles for
successful collaboration may be more dependent on good team building than on the nature of the disciplines involved.

References