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Leveraging 3D Technology for Students with Autism

An innovative university-community collaboration for skill development and vocational exploration

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The transition to adulthood is identified as a crucial period for individuals with ASD (Chen et al. 2015; Chen, Sung & Pi 2015; Hendricks & Wehman 2009; Levy & Perry 2011; Schall, Wehman & McDonough 2012; Taylor et al. 2012; Wehman et al. 2014b). Given the limited services, resources and opportunities that specifically address the needs of young adults with ASD, the transition after high school can be difficult, especially in terms of postsecondary education and meaningful employment (Migliore, Butterworth & Zalewska 2014; Wehman et al. 2014c; Wei et al. 2015). Partnerships across a wide range of agencies, including universities and the business and corporate sectors, are crucial to addressing this transition (Chappel & Somers 2010; Wilczynski, Trammell & Clarke 2013). While the role of universities as professional intermediaries in community development has been examined (Fehren 2010), here the focus is on how university-based professionals coordinated with community organisations and business entities to address an aspect of habilitation services for youth with ASD in relation to vocational readiness. As Shattuck and Roux (2014, p. 698) contend, there is a critical need to begin a new conversation on both innovation and investment in the context of autism across the life course. They state:

> *This new perspective recognizes people on the autism spectrum and their families as valuable members of our communities – with roles to play, dreams to achieve, and contributions to make.*

There is also the need to document how programs integrate services, research, training and policy to create better outcomes, and this requires convergence of best practice in research and in public and private sector innovations (Doehring & Volkmar 2016). It is with this perspective that we engaged in the development and implementation of a unique educational curriculum that leverages 3D technologies as a pathway to learning computer-

DECLARATION OF CONFLICTING INTEREST
Cheryl Wright and Scott Wright have a financial interest in the social enterprise NeuroVersity.

based skill sets, social competency, vocational exploration and self-determination. This educational program is built on a collaborative model, working with families and individuals with ASD, school systems, non-profit agencies, businesses and communities, with corporate support.

The partnerships involved in this project are ongoing and have evolved over the past five years, engaging undergraduates, graduate students and faculty from five colleges (Nursing, Social and Behavioral Sciences, Education, Health, and Business) in partnership with non-profit organisations, schools and private businesses. The binding mission of this diverse group was to work together to offer a 3D technology program for youth with ASD to enable skill development and vocational exploration.

CHALLENGE OF EMPLOYMENT

There are many issues that make this a critical topic today. Employment is a major part of an adult's identity and greatly impacts quality of life (Roux et al. 2015; Sung et al. 2015). The application of acquired skills to a meaningful job translates to an enhanced perception of quality of life and subjective wellbeing for young adults with ASD (Gal et al. 2015). Some 50,000 people with ASD turn 18 every year in the United States and represent the largest group seeking employment in the autism population (Sung et al. 2015). The literature indicates that adults with ASD are reported to be among the least successful groups of individuals in terms of community integration, post-secondary education and employment outcomes, even when compared to populations with other disabilities (Burgess & Cimera 2014; Neary, Gilmore & Ashburner 2015). This is most likely due to social difficulties and social anxiety in young adults with ASD (Fortuna 2014).

Most young people with ASD are not only unemployed but live in their family home and have jobs considered low wage and 'unskilled' (Neary, Gilmore & Ashburner 2015; Roux et al. 2013). Specifically, for those young individuals with ASD who had exited high school, fewer than 50 per cent had participated in post-secondary education or employment, and six years after high school only 55 per cent of participants had paid employment during this time (Shattuck et al. 2012). Furthermore, individuals who found employment were often under-employed and had difficulty remaining employed (Shattuck et al. 2012).

Adults with ASD do wish to be employed, yet there are limited opportunities for employment in competitive markets (Jacob et al. 2015). One reason for these low employment rates is that many individuals with ASD have difficulty interpreting and navigating social situations and this can create challenges in the workplace (Jacob et al. 2015). One challenge is their difficulty in understanding and communicating with supervisors, which can be a primary hindrance to job performance and often lead to their being terminated from the workplace (Wehman et al. 2014a). Some may also find the social skills necessary during the job application and interview process difficult to navigate (Hendricks 2010).

Individuals with ASD have unique vocational needs, and the support services available to this population are often limited and less than optimal (Jacob et al. 2015). Compared to services for other people with disabilities, services for individuals with ASD are more expensive and often do not provide sufficient support (Burgess & Cimera 2014). People with ASD are also more likely to be denied services as their disability is regarded as too severe (Hendricks 2010). In examining transition services for youth with ASD, those aged 18 and younger represented the largest group, and only 47 per cent of them secured employment after receiving services (Chen et al. 2015). Given the significant heterogeneity in ASD, there can be an array of challenges for individuals entering adulthood such as co-morbid health conditions, impairment in social functioning and reduced capacity for independent living that may lead to poor educational outcomes and employment prospects (Spain & Blainey 2015).

One important strategy in addressing this employment crisis is to involve a multi-disciplinary team of professions, agencies and businesses. This article describes a case study of a university-community partnership in a technology education program that recognises the strengths of the individual with autism. The partners in this community collaboration include an interdisciplinary team of university professors and students, a community employment centre, a school district, a construction company and the university's entrepreneurial centre. This case study is a part of the larger technology educational program described below.

A TECHNOLOGY PROGRAM FOR TRANSITION-AGED STUDENTS WITH ASD

The NeuroVersity™ program was developed in an effort to increase vocational readiness for students with autism by teaching them 3D technology skills (Diener et al. 2015). Criteria for inclusion in this program require students with an autism diagnosis to be verbal, have an interest in technology and be visual–spatial learners, and typically from regular education classrooms and capable of working in a group setting. Trimble SketchUp, a free downloadable 3D modelling program, is the foundation software used in this program. SketchUp is used in a wide variety of professions including architecture, construction, engineering, computer science and video-gaming. Many students with autism are visual learners and interact with SketchUp modelling tools and design techniques with confidence and creative ability (Grandin 1995; Kennedy & Banks 2011; Wright et al. 2011). During workshops, students create intricate 3D models based on individual interests, ranging from ideal living spaces to fantasy worlds. A SketchUp expert, a professional who uses SketchUp in their career, provides SketchUp demonstrations at the beginning of each day and is a role model of a professional working in a 3D design field. Two facilitators, typically professionals with ASD experience, work with

the students, monitoring behaviours and assisting students as they learn SketchUp. Classes range in size from 10 to 12 students who are in their transition years (16–22 years old). Foundational workshops focused on basic SketchUp skills are offered in a two-week, half-day workshop format, primarily during the summer months, followed by after-school programming workshops during the school year.

The program is evidence supported and has served over 80 students with ASD (with a wide range of diversity and disability) in four states of the USA and internationally in South Africa over the last five years (D'Astous et al. 2013; Diener et al. 2015; Diener, Wright & Smith 2014; Wright et al. 2011; Wright 2014a). The program provides students the opportunity to work and socialise with peers and to build on natural skills and abilities that can potentially benefit them in the workplace. The program also emphasises the importance of visual–spatial strengths in fostering creativity (Diener, Wright & Smith 2014).

A very important dimension of the program is the emphasis on *community* partners. The program uses a collaborative community, multi-faceted skill development model (personal, social and vocational) to program structure and curriculum (Wright et al. 2014). Community partners, as well as families and students, are important contributors to program design.

The university-community partnership case study took place over two weeks during the summer. Students attending the workshop were paid to create 3D models based on exact specifications from 2D plans provided by the construction company. Funds for this pilot study were provided through a grant from the state's Technology, Commercialization, and Innovation Program (TCIP).

Method/Implementation Process

The implementation of the study was successful because of the involvement of a wide range of professionals and agencies with similar missions. The university provided the staffing and expertise for implementation of the study and the community employment centre provided the space and computers. The school district identified and recruited students and families and provided technology support. The university's entrepreneurial centre brought us all together, planned meetings and took minutes, and created action items to ensure continuing group progress over the six-month planning period.

The business graduate students from the entrepreneurial centre surveyed local architecture and construction companies about their use of SketchUp for their 3D drawings and whether they outsourced this design work. One large construction company was particularly interested in our program and provided a SketchUp construction job for the students in our case study to complete and a SketchUp expert who facilitated successful completion of the job.

This case study was designed for participants in the transitional ages of 16–18 years. The local school district transition

specialist contacted high school special educators who nominated students with autism with visual–spatial skills and an interest in technology. Enrolment required a family member (parent, sibling, grandparent or significant other) to be available for the designated two weeks in the summer, to provide transportation and attend the student presentation component of the workshop, and be able to attend a student/parent orientation. At the end of the two-week recruitment period, seven families registered for the orientation meeting. At the orientation meeting parents and students were introduced to the program and students participated in a SketchUp demonstration. Three students from previous workshops were recruited as peer teachers and helped with the orientation and participated in the workshops. Thus, a total of 10 students and their families attended the orientation and all participated in the two-week summer workshop.

Participants

Parent reports indicated that 8 out of the 10 students had an autism diagnosis, including Asperger's, a high-functioning form of autism. One parent did not provide a diagnosis and another reported that their child had other related disabilities (learning disability and social challenges). As reported by parents, 97 per cent of students had social problems, 79 per cent exhibited perseveration, 60 per cent engaged in atypical communication and development, and 68 per cent had mood disturbances. These figures were based on indicators from the Checklist for Autism Spectrum Disorder (Mayes et al. 2009). All of the students met the minimum cut-off as per the Checklist for Autism Spectrum Disorder for an autism diagnosis. This measure shows high diagnostic agreement and strong convergence with other autism instruments (Mayes et al. 2009). Participating students were male and ranged in age from 15 to 18.

Parents reported in their background information that the students had few friends and little success in enrichment or extracurricular activities. One mother in this case study wrote that her son did not participate in activities because he was always 'kicked out'. Parents reported many failure experiences when they had enrolled their student in previous group activities.

The program was held for three hours each weekday for the two-week period. In the first week, the SketchUp expert, a theme park designer, demonstrated SketchUp basics. Students created 3D models based on their interests using their newly acquired modelling skills. Student projects included such designs as a neighbourhood, a home, a dragon world, a casino, a planetary world (Figure 1) and an entire community (with stores, parks, homes). During the second week, students worked each day on the assigned SketchUp job that required following directions to the specifications of the construction company SketchUp expert (Figure 2). Specifically, the students built tilt panels for a building foundation.

The daily workshops followed a structured schedule that included a demonstration, work time, break (with a socialisation

goal), presentations of their 3D designs and goal-setting. Students were paid a total of $50 for their work on the construction job, earning $10 per day. The program had a 100 per cent attendance rate for the two weeks. Many students started to come earlier than the 9 am start time to work on their projects. One mother, who had a reluctant son on the first day, said that by the end of the first week her son was rushing her out of the house to get to the workshop.

Goal-setting was a daily activity, in which students identified their accomplishments for the day and created goals for the following day, to help them remain focused on making progress with their designs. Family members participated in the goal-setting with the students, reinforcing goals achieved and goals set. Goal sheets were posted at each student's computer workstation to remind them of the goals. Many students referred to their goal sheets to plan what to do next and to see their progress.

There were daily pre- and post-evaluations by the staff that focused on what went well, what did not, and what modifications and behaviour supports were needed for individual students. For example, adjustments were necessary in seating arrangements and break activities. One facilitator, a behaviour therapist, created action plans and individualised accommodations that included headphones, additional breaks, and individually focused behaviour supports to keep some students on task.

EVALUATION

Students and family members (parents, grandparents and siblings) were active participants in the development of the program through their feedback and evaluation. For this case study, parents and students were essential participants in program evaluation. These evaluations are reported on below.

Parent Evaluation

At the end of each week, the parents were given open-ended surveys to evaluate the program. Parents noted individualised learning, creativity, and increase in self-confidence, social engagement and flexibility as student outcomes from program participation.

Individualised learning and creativity were identified by parents as contributing factors to student success. One father commented in relation to his son's experience, 'if he had a question about something he could raise his hand and someone would come over and give him individual help and that paradigm works really well for him'. Parents also reported that what they liked about the program was the 'creative' use of technology. In their background information many had expressed concern about the amount of time their child spent on technology (primarily gaming activities) – gaming was seen as unproductive time. One parent explained the strength of the program to be 'the environment, the creative emphasis in the program, really allowed him [the son] to grow and thrive and I would say that would be the most valuable aspect of the program for him'.

As in past workshops (Wright et al. 2011), parents reported that the program helped with their child's confidence and increased social interactions with peers in the group and with family members who attended presentations, and that the students learned new computer skills. The opportunity to present and explain their designs to their classmates and family members encouraged positive social interaction throughout the duration of the workshop. The workshop provided an opportunity for students to see each other's work, ask questions and provide feedback to each other. Many parents highlighted the social aspect of the program as important, however one parent noted, 'he didn't make any friends, there wasn't a big social component for him, which I think actually made it more friendly for him, less anxiety provoking because there was not pressure on him to make friends or to socialize'.

One concern from parents before the workshop was the inflexibility of their students in dealing with unanticipated changes or problems. Parents also expressed concern about an increase in co-occurring conditions such as anxiety. Computer problems that had the potential to increase anxiety and inflexibility were encountered throughout the two weeks. The students, however, demonstrated flexibility by managing to problem solve these frustrating situations with each other and the facilitators. During the two weeks students had to deal with numerous technology issues including program crashes (when their designs got too large), slowing of the computer speed with different design elements (shadows, fog), computers freezing, and having to reset lost work.

To prevent the loss of a design in the event of a program crash or disruption, the facilitators enabled 'autosave'. Autosave saved the current version of the design at the expense of program speed. When students became frustrated with a lagging computer, facilitators gave them the option to turn off Autosave. The students were also prompted to save their work often. One student who encountered lagging computer speed opted to disable Autosave. He was then responsible for saving his work regularly as he was working on a large multi-day project. At the end of the day's work period, he stood up to go to break and knocked his hard drive tower off the desk. He controlled his frustration and emotions and went to work on problem solving the situation. While other students went to break, he stayed with the SketchUp expert and to the best of his ability recreated his project for presentation time. Students expressed their understanding of his disappointment in losing his project and were complimentary about how he was able to reconstruct his 3D design project in a short amount of time.

Although parents worried about their students having emotional meltdowns due to technology frustrations, there were no meltdowns. Students supported each other and demonstrated great empathy. Another instance of flexibility occurred when students were unable to access the 3D Warehouse, a function

within SketchUp that allows downloading of pre-made models into designs. The students decided, instead, to focus on building other parts of their projects.

Although parents expressed initial anxiety about their student's likelihood of success in the program given prior failure experiences, all participating families perceived multiple levels of success for their students at program completion. As one father said, 'on the first day, I just waited around for the phone call [to come and get his son] and it never came'. It is important to note that both the parents and the students had experienced many failures together, so both perspectives were essential to program development and evaluation. Parents are the best source of information on their student's skills, abilities and challenges.

Student Evaluation

Students were interviewed on camera about their experiences at the end of the two weeks; all students except one agreed to the video interviews. This student was interviewed and staff recorded his verbal responses. The purpose of the video evaluations was for the students to reflect on their work and their experiences during the workshop. Students' self-reported successes were in the areas of creative, social and 3D modelling skill development and vocational exploration.

An important aspect of the program that facilitated skill development was the interactive creative teaching and learning style. As one participant enthusiastically noted, 'We were able to be creative and be free spirited, we can create our own objects through SketchUp and basically we have lee way and it's quite easy to learn the program.' Another student wrote about his experience, 'I truly enjoyed sharing my work at presentation time. It helps me connect with others, allows feedback to be given and can give me ideas.' Presentation time was also used to reinforce SketchUp tool use and peer-to-peer teaching as the students demonstrated how they created things in their designs. One student said about presentation time, 'it's fun and entertaining to show your projects. As well you might get some feedback on how to improve it, whether it is positive or negative, doesn't matter because you can improve on it. Take those tips and stand and show everybody your piece of work.'

Students also received genuine positive feedback from their peers and the SketchUp experts about their designs. Students felt a sense of respect and accomplishment, which led to their having a successful experience. A student commented, 'I think I was most successful in learning the tools and how to use them and with my self-confidence.' One student in his video interview talking about what he liked best about the program said, 'I liked meeting new people and learning how to use this program, to build my dreams'. The social component of the program was enhanced by students sharing their interests and talents in the presentations of their 3D designs.

Another aspect of program success was the student–instructor–peer relationship dynamic. Redirecting the traditional

teaching path from teacher to peer-to-peer and student-to-instructor provided multiple opportunities for conversation, problem-solving and relationship-building. Most peer teaching is designed with a neuro-typical student teaching social skills to a student with autism (Chan et al. 2009). In this case study, students with autism taught one another, which was an empowering experience for participants in building self-confidence. The students quickly became comfortable with helping one another, and staff encouraged students to ask their peers when they had questions about SketchUp design tools. Three returning peer teachers who had attended previous workshops and had good proficiency in SketchUp were also present to offer assistance. The veteran students were strategically placed between the new students. When a student needed assistance, instructors would turn first to the veteran student to offer help. Peer teachers were guided to comment positively on other students' work and to answer new student questions as needed while working on their own 3D designs. One of the peer teachers commented in his video evaluation, 'I've always been kind of a leader so it just kind of, it was just like natural to me. Yeah, I was confident in myself when I helped.'

Students often turned to one another to figure out problems, but they also asked for additional help from the SketchUp expert or facilitators. Another peer teacher noted, 'I get those connections with people, we are doing SketchUp and we comment about each other's work and find out something in common like you know me and one kid we found out we both like movie villains and we talked a lot about that'. The students developed a genuine camaraderie with the staff and among themselves in this short period of time. One parent noted, 'there was no tension with the boys, there was not, like in school, in high school where he was, it seemed like he was always on the outside'. She added, 'He was right in the middle of the group, he was participating, he was enjoying, he was laughing, there was no tension, it was just camaraderie and pleasantness'. Furthermore, this camaraderie helped to promote peer collaboration. For example, two students worked on a collaborative dragon world design, and students made helpful suggestions on each other's designs and adopted creative ideas learned from the projects presented.

Students also gained exposure to the idea that they might be able to use their skills and interests in a career, something many of the students had not yet considered. One student stated in his evaluation, 'I like that it's sort of real world so we get some experience on what we would do if we were to join a company like that.' Another student remarked, 'I liked leaning about architecture; that was really cool.' One student commented during the video interview, 'I liked learning how this program could be used for modern day construction.' And another student realised the real-life application of being able to build and replicate designs like the tilt panel foundation exactly to scale in SketchUp. He enthusiastically noted, 'it was cool that this design could exist in the real world'.

The monetary reward at the end of week two was a highly motivating factor for these students. The reinforcing aspect of earning money enabled one student, in particular, to work through frustration issues that were limiting his ability to complete work. The initial work period of 30 minutes would earn the student $10. As the facilitator could see his agitation increasing, she put a note by him that said, 'You have already earned $5. Would you like to try for another $5?' Reinforcing that he had already successfully earned part of a pay cheque for his work redirected his focus away from frustration and back to being a successful employee. When he became frustrated with assembling a part of the building, he worked through his limited ability to accept suggestions from other people. Students were explicitly told that they were being paid for their time spent working on task. Pay was not dependent on task completion. However, students were very motivated to keep up with the work of their peers. They were very focused on their job, as well as finishing their own creative project. One student wrote in his evaluation, 'I like to share because I like to show what I can do. I like sharing my hard work.' This sense of accomplishment was motivating for students. One student ended his evaluation interview with 'I want to thank you for helping me learn about SketchUp, helping me prepare for a job, and I made a lot of friends here.' Another student remarked, 'It was good actually quite fun, just because I was able to make friends. I was able to knock my passion of creating new things, when it comes to graphics, and basically be able to use my imagination the way I feel fit.'

This positive, supportive learning environment fostered student success in technology skills and in the social engagement domain. Through shared interests, students developed authentic friendships with their peers in the program. They shared contact information (unprompted) and went to each other's homes, and one student had a party and invited all of the enrolled students (and most of the students came).

This case study shows successful application of 3D skills and completion of an assigned job by students with autism who were paid a stipend. The 3D modelling skills students learned in the workshop can translate into a number of different careers that the students were exposed to by the SketchUp experts (theme park designer and construction manager). Students not only gained technology skills, but also learned and demonstrated the essential vocational preparation skills of critical problem-solving and self-monitoring.

DISCUSSION

This university-community partnership focused on developing technical and vocational skills in young people with autism, and the program provided a place to practise flexibility, problem-solving skills and social skills in an accepting environment. Within this positive, supportive environment, students gained confidence as they experienced success. Most students who come to the workshops have a history of failure. On any given intake form,

failed attempts at involvement in activities and social isolation are indicated. In the current study, several elements of the program overcame these failure experiences, including staffing expertise and the strength of the community partnership, which are discussed below.

Staffing

A component of the success of this case study was staffing expertise. The study involved two SketchUp experts: the theme park designer taught SketchUp basics in week one and the construction manager guided the students through the work project in week two. Two graduate students experienced in working with students on the autism spectrum served as facilitators in both weeks. One of the graduate students was a special educator with positive behaviour support training. She took the lead in assisting the SketchUp experts and managing any behaviour issues that arose. She used the competing pathway model for developing behaviour support plans (O'Neill et al. 2015). Our research team had previously documented the characteristics of SketchUp experts and facilitators that lead to student success (Diener et al. 2015). These characteristics included patience, enthusiasm, humour and sensitivity to individual student needs, all of which are elements of a positive supportive environment. The staff also helped to maintain this environment by focusing on the students' positive behaviours and problem-solving behaviour issues as they arose.

The SketchUp experts were professionals in a field that used SketchUp and they led the SketchUp instruction. Lessons were brief and individual assistance was provided as the design expert walked around the classroom. The facilitators had strong positive behaviour support skills (Diener et al. 2015). The SketchUp expert in week one was a theme park designer who was part of the design team that created the Harry Potter theme park at Universal Studios, Florida. That wow factor, coupled with impressive computer skills, made him a cool guy in the eyes of the students. In the facilitator SketchUp training before the workshop, he modelled how he teaches lessons. He demonstrated a few of the fundamental design tools to the workshop facilitators, and then said, 'In the workshop, you don't need to worry about the kids looking at the screen during my lesson – they're listening.' He emphasised, from his experience from previous workshops, that students don't need to demonstrate traditional behaviours of 'paying attention' such as eye contact with the instructor, or looking at the screen. 'They're taking it all in – trust me', he said. The format of the workshop encouraged students to ask the expert questions. As he answered, he validated their question and treated it as a professional problem-solving collaboration.

The case study experts and facilitators limited their involvement to answering questions, encouraging collaboration and proactively supporting positive social behaviour. The approach emphasised being a 'guide on the side' and the instruction team created a supportive learning environment designed specifically

around the learning styles and interests of the students. The instructors accepted the differences in the students and embraced their quirkiness.

University-Community Collaboration

Most importantly, this university-community collaboration was very successful in its joint mission of teaching students with ASD 3D modelling as a potential employment skill. It was a particularly successful collaboration that reached its goal of 'every student needs to experience success'. Yet, there are always challenges in university-community collaborations in balancing missions and resources. For example, coordination across four large agencies (university, school district, community centre, construction company) required many meetings and negotiations. Also, a member of the community centre was recruited and trained to become a facilitator and work alongside the implementation team. However, by the end of the program, she had taken another position in another state. This transition left a gap in our goal of sustainability.

As noted previously, there were many technology challenges, and off-site technical assistance was required from the school district. This created some problems when the weekly passwords were changed without notification and the wrong version of SketchUp was loaded onto the computers (instructors did not have access to download programs). The school district had planned a technology system check during the summer, but the internet connection to access the 3D Warehouse was not available to our students. Another challenge occurred when the fire alarm went off 30 minutes before the first class session; fortunately, the instructors were able to convince the administrators to shorten the emergency drill so that it was not going on when the students arrived. Given the students' typical hypersensitivity to their environment, this could have been a disastrous start. These technology and administrative issues were unanticipated.

Student behaviours were sometimes challenging and our interdisciplinary team in pre- and post-conferences problem-solved such situations. On many occasions our community partners joined in the daily evaluations and provided suggestions and resources. For example, some students struggled with staying on task and needed more breaks, which required coordination with the busy community centre staff and clients. Individual positive behaviour support plans were developed to address situations that might arise. For example, one student had an auditory processing disorder and would become very anxious if too many instructions were given, so a staff member began working with him one-on-one. Although one of the goals of the program was increased social engagement, one student did not want any social interaction with other students or staff. Surprisingly, he attended the party held by one of the students and commented to the staff, 'These kids [in the workshop] just talk too much'. One student, in particular, had a difficult time containing his comments during presentations

and irritated a few students with his constant talking during work time. Another student frequently went to other sites on the internet (breaking a program rule) and had to be monitored closely by the staff. Thus, behaviour challenges were a daily occurrence that required skilled team members familiar with positive behaviour strategies (Schall 2010).

CONCLUSION

This case study presented a university-community based technology program that matched the skills and abilities of students with ASD. In addition, social interactions were naturally facilitated through the program design. Although some professions might be critical of the program not being inclusive (serving only students with autism), most of our students are in inclusive settings and this was an opportunity to show their talents and abilities to similar peers. Behavioural issues were minimised because students were highly motivated to create designs based on their interests and were paid for their work for the construction company. Professionals could replicate this experience for some students with autism by similarly focusing on technology skill development. Additionally, a community engaged program brings more stakeholders to the agenda of providing students with ASD job opportunities that match their strengths and abilities.

One profession overlooked in this partnership was vocational rehabilitation (VR). Our community partners made us aware of the mandate that 15 per cent of each state's public VR funds must be used for transition services (Sung et al. 2015). We are currently working with our state agency, which has identified clients with ASD for transition funding in our program. With its focus on technology skill development for clients with ASD, our program is a nice complement to the many services being provided by VR. Many professionals, including vocational rehabilitation counsellors, struggle with the complexity of behaviour issues associated with clients with ASD and employment (Nicholas et al. 2015).

An emerging theme in the literature is the pivotal role of employment services, the school system, transition planning and the building of community partnerships in facilitating efficacy in vocational rehabilitative services (Gal et al. 2015; Jacob et al. 2015; McDonough & Revell 2010; Schall 2010; Sung et al. 2015). For example, some research has emphasised the importance of social support, mentoring, vocational opportunities and successful outcomes during the transition to adulthood (Tobin, Drager & Richardson 2014). Chappel and Somers (2010) propose that school systems and their vocational rehabilitation partners need to make a commitment to work together to provide a comprehensive transition plan for students with ASD. Community partnerships are also essential to successful programming.

More important is the premium placed on developmentally appropriate strategies for transition-age students with ASD (Tantum 2014). Although there are difficulties and challenges for

the individual with ASD, in recognising and helping to develop their strengths there is potential for a fulfilling life (Lai et al. 2013; Wright et al. 2014b; Wright 2016).

Future directions, as an extension of the workshops, include the development of internships and supported employment. Parents expressed many concerns about their student's future. One mother said, 'it would be wonderful if there was a work study program, he could get his feet wet, even without pay would be great. We would jump at the opportunity.' The international navigational company Trimble (which owns SketchUp) is supporting this aspect of the program and providing the necessary in-kind services for development. Students on the autism spectrum need multiple levels of positive support for successful employment, and a model is being developed in collaboration with Trimble that incorporates mentors, managers and job coaches.

University-community collaborations and university-based partnerships are promising strategies to resolve the unacceptable rates of unemployment and underemployment of students with ASD (Chappel & Somers 2010; Sung et al. 2015; Wehman et al. 2014c; Wilczynski, Trammell & Clarke 2013). In summary, well-designed community partnership programs and services that are implemented in a strategic fashion and targeted at optimal age levels can improve adaptive skills in individuals with ASD (Wehman et al. 2014a). Furthermore, it has been shown that supported employment services for individuals with ASD involving many community partners, including universities, are a worthwhile investment and can lead to economic benefits by decreasing lost productivity and resources costs (Jacob et al. 2015). As Wehman et al. (2014b, p. 35) have indicated, '… youth with ASD have significant untapped potential that has been underappreciated'. Many students with ASD have hidden talents that can come to light with a program like NeuroVersity that highlights strengths and abilities of the autism condition. And as one student in this job-focused case study summarised the program, 'it's just a group of people who get together to be open, free minded and able to socialize and while directing to one goal to use SketchUp to create your wildest dreams'.

The scaffolding to build the bridge across the barriers and challenges of the transition years for youth with autism requires many stakeholders, including university personnel, businesses, community services, parents and students, to come together to make a difference.

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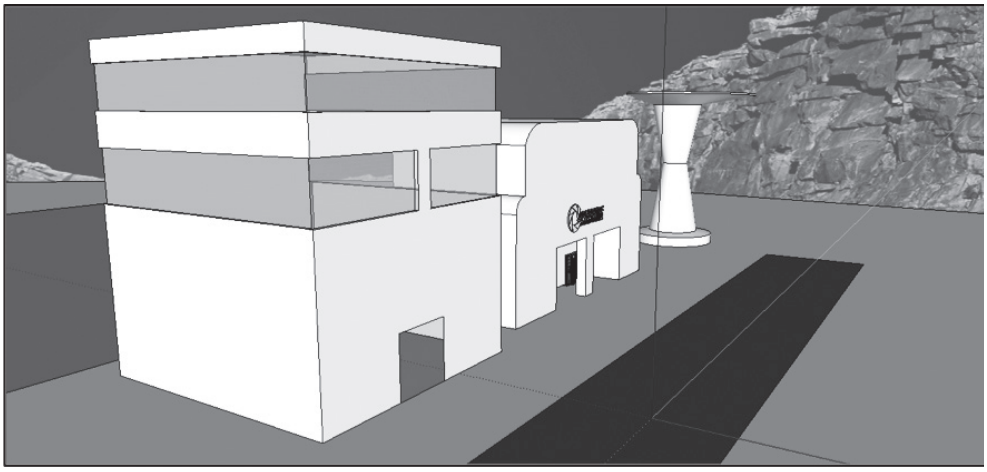

Figure 1: Three-dimensional design created by a student, 2014

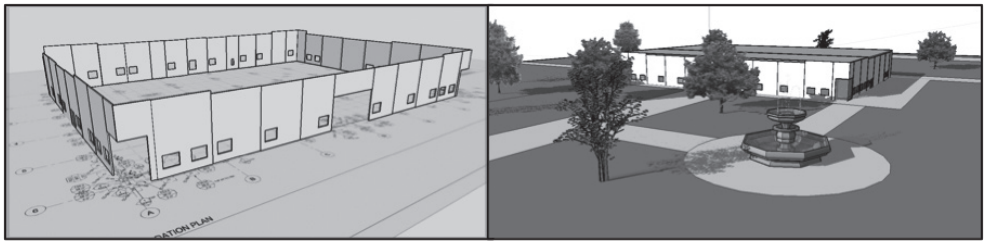

Figure 2: SketchUp Design Construction Project, with two-dimensional plans at left, and 3D SketchUp Design with embellishments at right