Introducing Animal-Assisted Intervention for Special Education in Integrated Farming System

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Abstract

Autism spectrum disorder is a neurodevelopment disorder that affects an individual's social skills, communication skills and repetitive behaviours. Due to these factors, an autism learning environment has to be purposely-built to cater for the sensory needs of these learners. In special education practice, animal-assisted intervention has become popular over recent years to this end. This study aims to analyse the practice of animal-assisted intervention in an autism learning environment with the aid of a sustainable system called an integrated farming system. The study is conducted using mixed methods, involving content analysis of the technical information and detailed drawings of an integrated farming system, as well as an online survey about the implementation of the intervention in autism classrooms via such a system. Our findings show that the technical drawings for implementing an integrated farming system in the built environment represent an architectural intervention. The online survey also shows positive feedback from experts in autism services. The study concludes that animal-assisted autism learning is a promising future model for special education. It also suggests that an integrated farming system is a potential nature-based livestock farming solution to include animals in a farm-based autism educational setting. This could serve as a reference and basis for future architects or researchers to extend the research or implement animal-assisted interventions in real practices.

Keywords: animal-assisted intervention, autism learning environment, autism spectrum disorder, integrated farming system, special education

Autism spectrum disorder (ASD) is a lifelong neurodevelopment disorder (Cassidy, 2019). Ting et al. (2014) listed three characteristics that describe ASD: impairment in social skills, communication skills, and repetitive behaviour. Autistic individuals often require a sensory-friendly environment for effective learning due to their sensory processing disorder (Ghazali et al., 2018). Different technologies have been integrated into the learning environment for the needs of special students (Balmeo et al., 2014). Architects could play an important role in designing the learning environment based on the sensory requirements of autistic individuals (Mostafa, 2014).

Problem Statement

In Malaysia, there is a shortage of autism related facilities to cater for the increasing number of ASD diagnoses every year. According to research, the government policies pertaining to educational building for autism is insufficient in Malaysia (Nazri & Ismail, 2016). While there is a resurgence in the research field on nature or farm-based education, very few autism schools in Malaysia incorporate such programs in a farm-based setting (O'Connor et al., 2018). The only purpose-built autism educational facility in Malaysia is Permata Kurnia, built in 2015 in Sentul, Kuala Lumpur. This is the most relevant facility in Malaysia that incorporates greenery in the layout design, albeit it does not have a full-scale animal integrated facility (Ghazali et al., 2018).

In many countries including Malaysia, the inclusion of animals in educational settings for animal-assisted intervention (AAI) is still relatively new and controversial (Rud & Beck, 2003; Uttley, 2013). Animal-loving parties might support the idea, while the opposing parties might raise concerns of bringing animals into an indoor environment due to concerns such as safety, sanitation, public relations, parents' agreement, housekeeping and management (Comartin, 2018). Besides, there is a lack of technical information on the inclusion of animals through architectural intervention to ensure that the welfare of animals is protected.

Research Objectives

This study aims to implement animal-assisted intervention in a sensory friendly, autism learning environment through a sustainable and passive system called an integrated farming system. The research objectives are formulated as follows:

- To identify the benefits and challenges of implementing animal-assisted intervention in an autism learning environment.
- To examine the technical information and detailing to incorporate livestock farming into an autism learning environment through integrated farming system.

By conducting this study, the sensory needs of autistic individuals can be catered for with benefits from the inclusion of therapeutic animals in a nature and farm-based environment. The study findings form a theoretical basis for experts in the autism community such as architects, researchers and other professionals to implement animal-assisted intervention and incorporate livestock farming into future autism facilities. This study also aims to apply architectural intervention to fill in the research gap of animal inclusion in autism learning environments. The technical information of an integrated farming system examined can serve as a basis for architects to include animals in the built environment for AAI without sacrificing the welfare of animals. By completing this study, we hope to address a gap in the research about incorporating animal-assisted intervention in special education, by showing how vertical livestock farming can be integrated into a school compound, especially in urban or sub-urban areas where land size and space are limited.

Literature Review

In special education, animal-assisted intervention (AAI) is used to assist individuals with autism spectrum disorder in their learning development (Brelsfordet al., 2017), bringing improvement in social interaction and affection to other people (Ferwerda-Van Zonneveld et al., 2012; O'Haire et al., 2013). Animals have been used to assist humans for a long time (Macauley, 2006; Trivedi & Perl, 1995). The first practitioner to use animals in therapy sessions was Levinson, a child psychologist, in the 1960s. The pioneering work of Levinson has contributed to the progress of animal-assisted intervention (AAI) in various fields, including special education in autism. The common choices of animals include dogs, cats, horses, guinea pigs, rabbits, turtles, birds, fish, and many more (Comartin, 2018). Besides, research has shown that exposure to nature and greenery contributes to an improvement in cognitive, emotional and physical abilities (Barakat et al., 2019; Birkeland, 2016; O'Connor et al., 2018; Reeve et al., 2015). There is also a resurgence in research in the benefits of outdoor learning (Entrich, 2014). These could serve as a theoretical foundation for a farm-based education with the inclusion of therapeutic animals.

For the purpose of introducing AAI in special education, an integrated farming system (IFS) is studied as a form of livestock farming to be practised in an autism learning environment. IFS is a sustainable system that relies on the direct use of fresh livestock manure in fish culture for fertiliser (Little & Edwards, 2003). This system ensures a "zero waste" policy through product recycling, which can be economical and ecological in the sustainable development (Fawcett, 1990). In special education, an IFS allows the combination of a fish subsystem with different types of livestock that can provide therapeutic effects to autistic students.

In Malaysia, integrated farming systems have been practised by farmers since the 1930s (Ahmad, 2001). In IFS, the livestock shed is built with slatted flooring directly over the fish pond so that the manure can drop directly into the pond and stimulate phytoplankton production (LiveCorp & Meat & Livestock Australia, 2008). Through photosynthesis, phytoplankton will produce dissolved oxygen to be consumed by the fish. However, an overabundance of phytoplankton should be avoided to maintain an optimum environmental condition for fish growth or survival. This controlled environment can be achieved by controlling the density of animals which in turn controls the amount of manure loaded into the pond (Sevilleja et al., 2001). In other words, while a higher number of animals is better for AAI in the autism learning environment, the number should not exceed the recommended number to avoid an adverse effect for fish growth in the pond.

Method

This study was conducted by using a mixed methods approach through both content analysis and online survey. Search engines such as Proquest, Google Scholar and Research Gate were used to obtain secondary data by previous researchers. The selection of material is mainly based on professional journal articles, books and conference proceedings.

Qualitative Method

Under qualitative research, the technical information of IFS was examined through content analysis. Since IFS is typically practised in rural areas, human-animal cohabitation design and autism-friendly design were applied to propose a common solution to implement IFS into a sensory-friendly, autism learning environment. Table 1 shows the summarised criteria that need to be fulfilled for this. The technical information on IFS determines the boundary

conditions for the inclusion of animals in an autism learning environment. Human-animal cohabitation design ensures a healthy connection between humans and animals, while autism friendly design provides the approaches to realise such integration in a farm-based autism school. Referring to the concepts and theoretical drawings from other researchers, detailed drawings were adapted and reproduced with the aid of AutoCAD.

Table 1: Criteria to implement IFS in an autism learning environment

Criteria	Description
Technical information on IFS (Little & Edwards, 2003)	• Depth of fishpond • Area of fish pond • Density of livestock to be raised per area of fish pond • Floor area required per livestock
Human-animal cohabitation design	• Nature or farm-based environment (Chutchawanjumrut, 2015) • Connection between human and animals for sensory stimulation (Jon Coe Design, 2014) • Environmental enrichment (Alshaheen, 2019)
Autism friendly design	• Curvilinear layout • Natural ventilation • Acoustics • Biophilic element • Natural building materials

Quantitative Method

The findings from the qualitative methods were translated into a questionnaire and distributed to the designated target groups through Google Forms. The online survey consists of 15 questions and was completed by 47 respondents. The personal information of these respondents is kept confidential, but 70% were special education teachers, 15% were the staff from the National Autism Society of Malaysia, 9% were other professionals in autism services and 6% were from other fields. On average, the majority of the respondents had below three years of experience in autism services. The summarised results are tabulated in Table 3 and discussed in relation to the research objectives. The online survey gives deeper insights and a more comprehensive picture of the study of animal-assisted autism learning environments via integrated farming system from the opinions of individuals with experience in autism services.

Findings

The summarised results provide a suggested solution to the implementation of AAI in a farm-based autism learning environment via IFS, as supported from the opinions of different experts in the field.

Implementation of Integrated Farming System (IFS) in an Autism Learning Environment

In order to adopt an integrated farming system into an autism learning environment, requirements of IFS are fulfilled, and human-animal cohabitation design strategies are applied to integrate IFS with autism-friendly architecture. Table 2 shows the technical information on IFS.

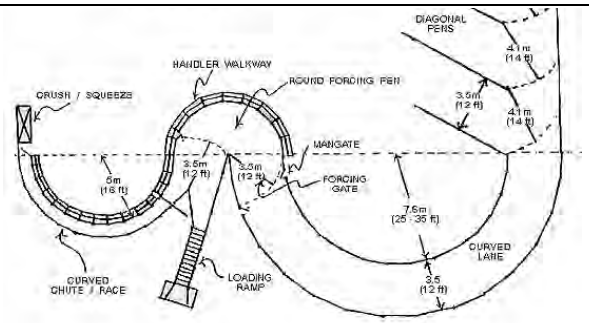
Table 2: Technical information of IFS

Types of animals	Low density (nos)	High density (nos)	Area of animals (m^2)
Ducks	3-5	15-20	0.45
Chickens	5-15	20-35	0.30
Goat/Sheep • All day • Night only	 2 4	 4 8	3.00

(District Livestock Development Office, 2012; Food and Agriculture Organization of the United Nations, 2010; Gupta & Noble, 2001; Tripathi & Sharma, 2001)

The three farm animals selected – ducks, chickens and goats – are the common farm animals suitable to be included in IFS as well as acting as therapeutic animals in an autism care farm. The density of animals raised on a shed above the fish pond determine the amount of manure loaded into the pond and should be decided carefully. Lower density of animals may ease the management, but this creates lower harvest of livestock products. In contrast, higher density of animals increases the harvest and creates more chances of interaction with the autistic students but requires more manpower in management. Nevertheless, the recycling properties of an integrated farming system very much ease the management and livestock handling process compared to the practice of individual livestock farming system. Hence, as long as the area of fish pond allows, it is good to raise high density of livestock. In certain scenario, animals are released from their sheds into the field during daytime and only kept at the sheds during night time. In such cases, the density of animals should be decided based on the recommended figure as shown in Table 2. Next, the data presented under the "area per animal" shows the space required by an animal when it is fully grown. If the design permits, it is always good to provide a larger space than the minimum requirement.

(a) IFS practised by farmers at rural areas (Sevilleja et al., 2001)



(b) Curved ranch layout by Temple Grandin (Grandin, 2001)

(c) Human-animal cohabitation design by Jon Coe (Jon Coe Design, 2014)

Figure 1: Theoretical drawings by other researchers

According to research, a curved layout is autism friendly due to more fluidity in circulation (Mostafa, 2014), and also animal friendly because animals are more attracted to curved structures in animal psychology (Grandin, 2001). This knowledge is applied by Grandin in her livestock farming design (Figure 1b).

Referring to the technical information in Table 2 and theoretical drawings in Figure 1, autism classrooms are improvised as typical modules slotted into a curved layout of farm grids where animals are kept in their respective sheds (Figure 2). There is not a single best recommended size for the classroom modules or teacher-student ratio due to the diverse needs of autistic students along the spectrum. As a general guide, the ratio can range from 1:15 to even 1:1 (Zarghami & Schnellert, 2004).

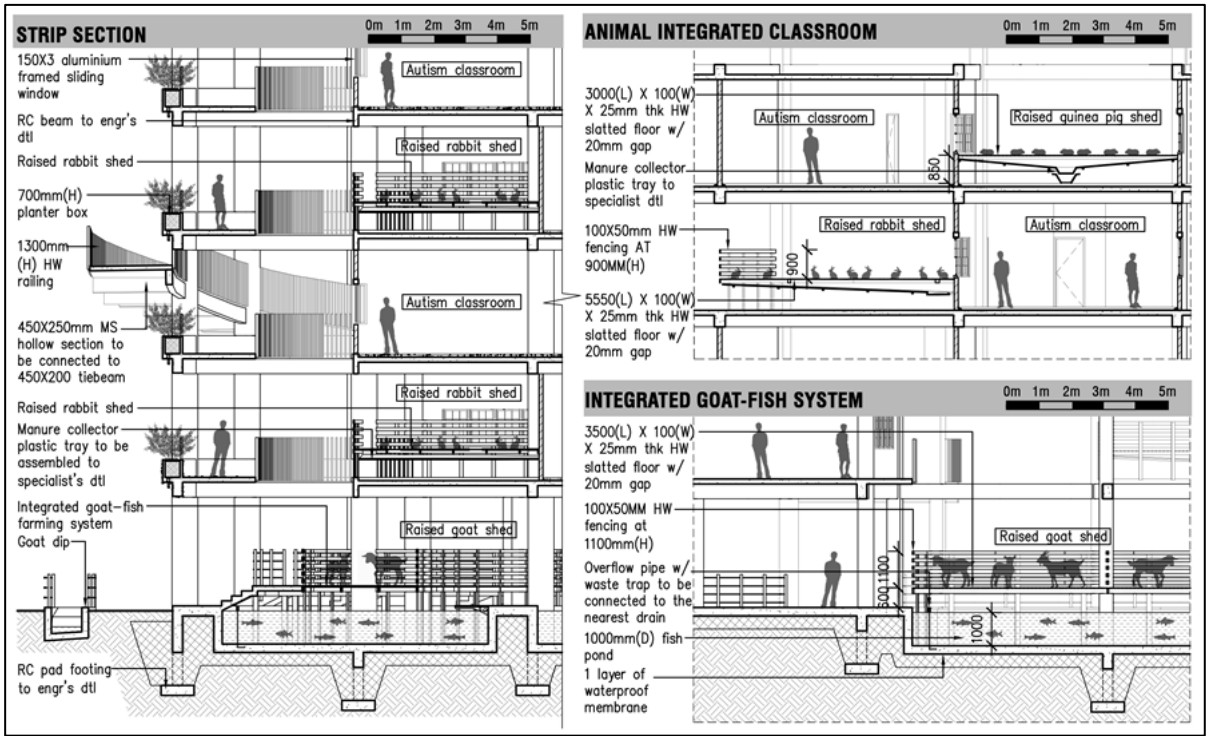


Figure 2: Improvised detailed drawings of IFS in a farm-based autism learning environment

In the improvised drawings shown in Figure 2, animals are raised in an open ventilated shed at a farm-based environment with perimeter planter box. The types of interaction, either active or passive, between autistic students and the animals depend on the types and sizes of the animals. Bigger-sized animals like goats are kept at the ground floor over a one-meter depth fish pond for easy management. In such design, the connection between humans and animals is passive as it only provides visual and sound stimulation to the autistic students in the classrooms located at upper levels.

Smaller animals such as rabbit and guinea pig can be integrated with the classroom at upper levels and form active connection between the two parties. Students will be able to interact with the animals by touching and holding them inside the classroom, where the animals are acting as "social lubricant" for the students. However, the limitation of an animal integrated classroom is the difficulty in applying integrated livestock-fish farming system as building separate fish ponds in between every classroom is not efficient and will be cost intensive. Hence, the animal shed is simply built with slatted timber above floor level with a manure

collecting system below for easy manure disposal. For cleaning, water can be splashed at the slatted timber and allow water to run through and rinse over the plastic tray to remove existing dirt and unpleasant scent.

Analysed Results from the Online Survey

As shown in Figure 3, the survey found that the top three farm animals selected by the respondents are rabbit, chicken and horse. 83% of the respondents selected "rabbit" as their choice of animals in AAI, which suggests that smaller animals are still generally preferred by most of the respondents to be raised in an autism school. However, if the school has a large compound, even large animals like horses can be included to be part of the animal-assisted program.

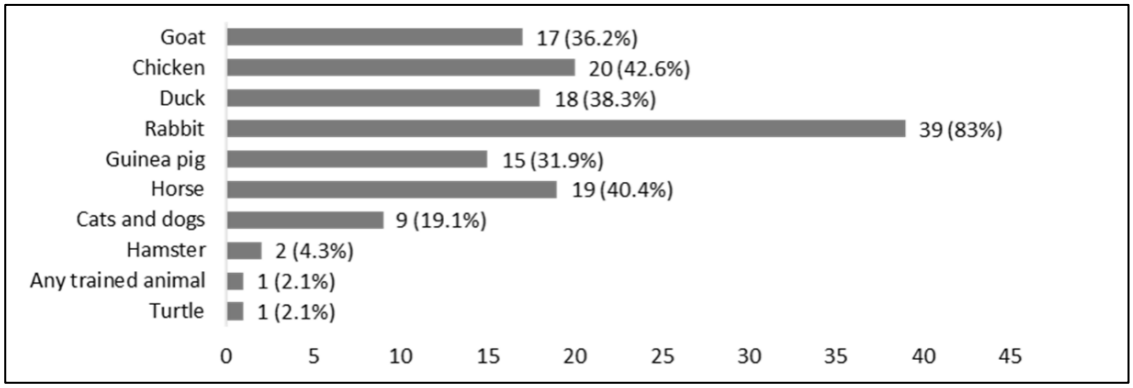


Figure 3: Suitability of animals for AAI in an autism learning environment

In the online survey, opinions on the benefits of integrating livestock farming or animal-assisted intervention in a farm-based autism school were gathered, as shown in Figure 4. The top three benefits chosen by the respondents include, "social improvement – 85.1%", "student engagement – 78.7%" and "reduce stress and anxiety – 78.7%". Further, 31.9% of the respondents chose "reduce problematic behaviour" to be among the benefits. The results suggest that the inclusion of therapeutic animals in an autism learning environment can benefit autistic students in many aspects, especially in social interaction and mental and behavioural management.

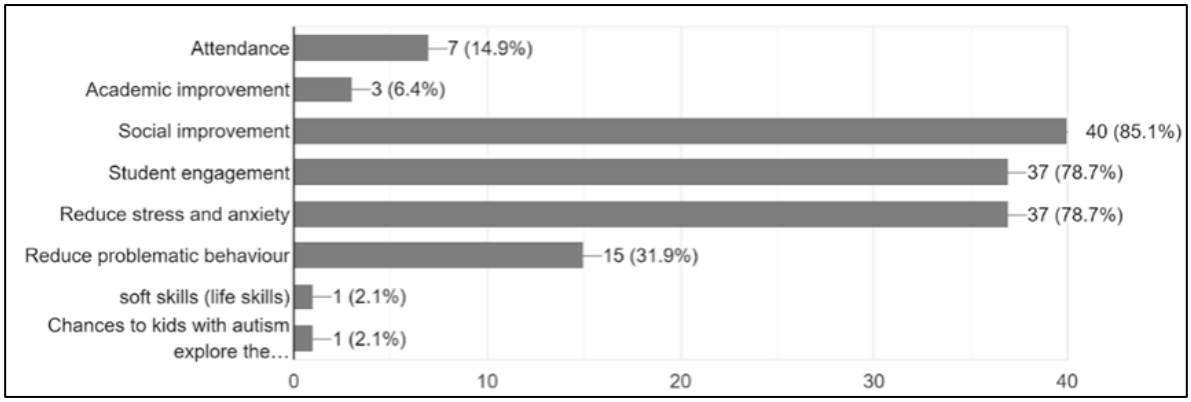


Figure 4: Benefits of livestock farming/AAI in a farm-based autism school

Figure 5 presents the common challenges to integrate livestock farming or animal-assisted intervention (AAI) into a farm-based autism school. The findings show that 72.3% of the

respondents rated "animal care outside of school hours" to be among the top challenges. Next, 66% of the respondents were concerned about the animal welfare as this is a common issue of animal inclusion in a learning environment. Also, there will be students' allergy issues if the hygiene of animals is not properly maintained. Further, 42.6% of the respondents raised concern on "animal manure handling" if animals are included in autism classrooms for animal-assisted intervention.

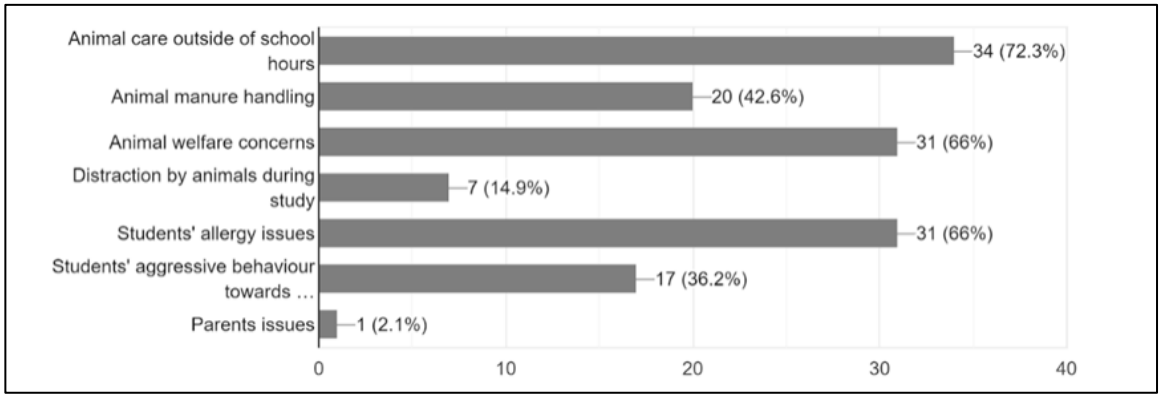


Figure 5: Challenges of livestock farming/AAI in a farm-based autism school

Discussion

For the benefits of animal-assisted intervention, in autism care farms autistic individuals can interact with animals such as horse, goat, chicken, pig, dog, cat, rabbit, guinea pig, cow, goose and other small animals (Ferwerda-Van Zonneveld et al., 2012). However, not all animals can be brought into a learning environment in a school setting. The types of animals to be selected for animal-assisted intervention in an autism school largely depend on the suitability of the animals in the learning environment. Large-sized animals are often excluded in the selection process due to insufficient space provision in the school, especially in urban areas. Also, animals such as pigs are often avoided because autistic individuals can be overwhelmed by the intense scent. Next, while dogs and cats can be included for AAI, they are not productive livestock that can provide income through livestock farming. Hence, the improvised detailed drawings in Figure 2 only include therapeutic animals like goats, rabbits and guinea pigs. Nevertheless, as a general guide, if other animals are to be included for AAI, the principles of IFS can be followed based on the requirements of the specific animals in the system.

Discussion on Content Analysis

Autistic students can interact with the therapeutic animals in two manners – one in an active connection, and another one in a passive connection. Among the animals in discussion, goats are the larger animals to be included in the autism learning environment. Considering the difficulties of bringing the goats to upper levels of the classrooms, they are only raised at the ground floor in an integrated goat-fish farming system for easy management. As the floor area in the ground floor is reserved for IFS, the classroom modules are only built starting at first floor level. Hence, students at upper levels can only interact with the goats at ground level passively from visual and sound stimulation. For direct interaction with therapy goats, students can come to the goat shed at the ground floor for the proven benefits of improving moods and overall quality of life (Harada et al., 2019).

Next, participation in livestock farming can be part of the animal-assisted program. Another type of livestock that can be included in an autism school is chickens. Due to their small size, chickens can be raised in an integrated chicken-fish farming system in the upper levels of the vertical farm grid as the transport and management of small-sized livestock is not too difficult. However, as a fish pond is required in IFS, there should be space provision for the depth of the fish pond. Similarly, the density of chickens to be raised above the fish pond is restricted by the size of fish pond to maintain a desirable amount of manure loaded into the pond. Therefore, even if the shed is big enough to accommodate a higher density of livestock, the density should be limited based on the specific requirements of the livestock presented in Table 2. Nevertheless, it is recommended to build the shed bigger than the minimum floor area to respect the "social contact" between the livestock. This ensures that the livestock are not cramped within a limited space as in intensive industrial farming (Blecha, 2007). If the space provision permits, a garden can be built beside the fish pond to release the chicken into the field to provide environmental enrichment for their well-being.

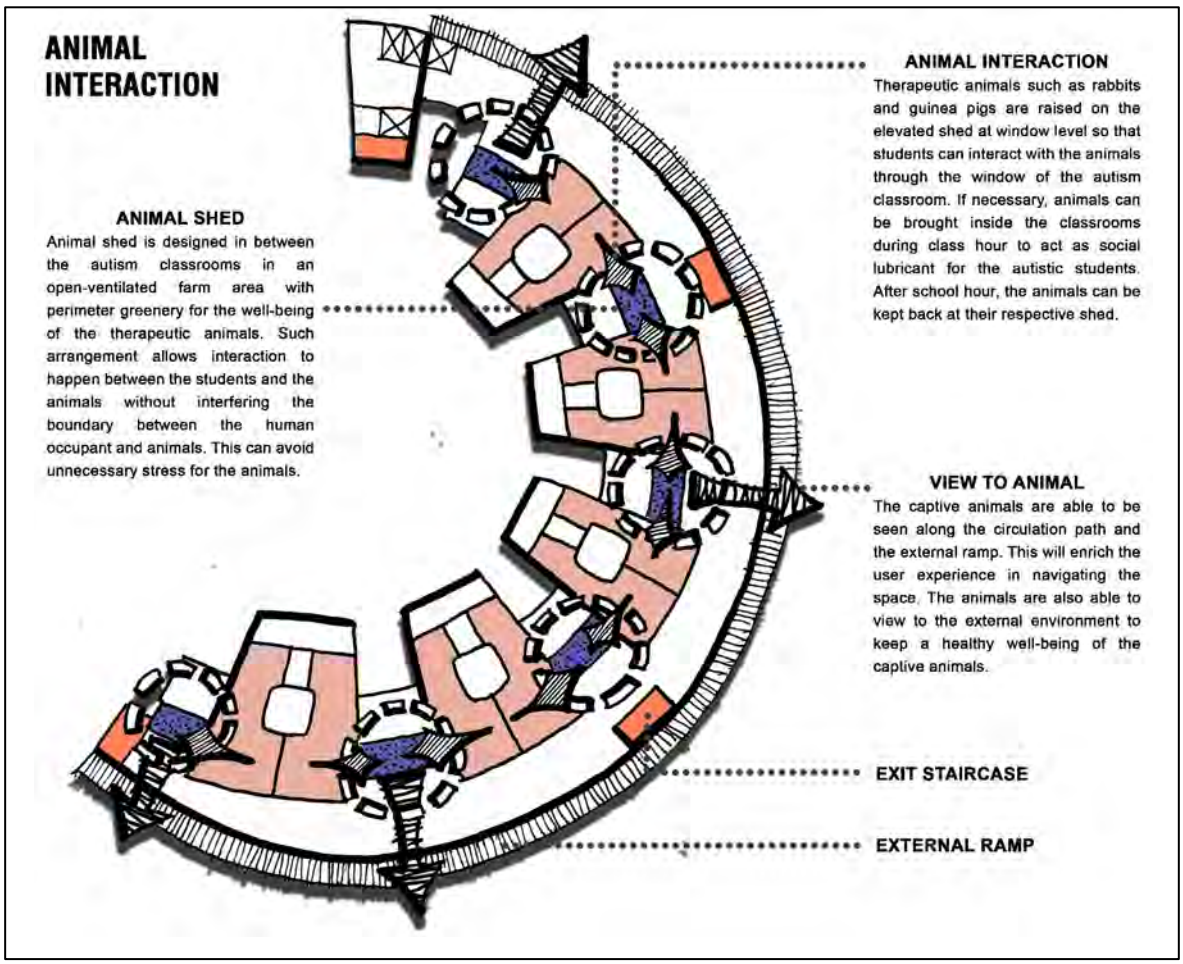


Figure 6: Animal interaction in an animal-assisted autism learning environment

Therapeutic animals recommended to be integrated with the autism classroom for AAI include rabbits and guinea pigs. This is because they are lazy and gentle animals which will not be overactive and require much care. Figure 6 shows the improvised plan layout of autism classroom modules inserted into the curved layout of farm grids. As discussed in the findings, a curved layout can bring mutual benefits to autistic students in their sensory needs, as well as animals in their natural behaviour. The animal sheds are built in between every classroom

module to allow interaction between students and animals to occur in an active manner. The farm grid design creates a farm-based environment surrounded by greenery from the perimeter planter box to maintain a healthy environment for the captive animals. Students can actively interact with the animals by touching and holding them inside the classroom. This could improve their social interaction with other students in the presence of therapeutic animals (O'Haire et al., 2014). The limitation of this approach is the difficulty in applying IFS with the classroom as the system requires a big size fish pond to collect the livestock manure in an automatic process. In this case, the manure collected from the manual collection system below the animal sheds can either be disposed of or manually loaded into the fish pond as fertiliser.

The improvised curved layout with autism classroom modules inserted into the farm grid is deemed to be sensory friendly to autistic individuals. As shown in Figure 7, the wayfinding is simple and straightforward to be comprehended by autistic individuals. As suggested by various research, autistic people can be stressed by sudden turns in transition and circulation (Marchi, 2013). In contrast, a curvilinear layout ensures a smooth circulation without dead corners, avoiding stress and anxiety experienced by autistic people in circulation. Additionally, ramps can be built as a form of vertical transportation as an alternative to staircases. Autistic individuals prefer to use ramps over staircases in terms of balance and body awareness (Marchi, 2013). The use of outdoor ramps allows users to enjoy the outdoor scenery in circulation.

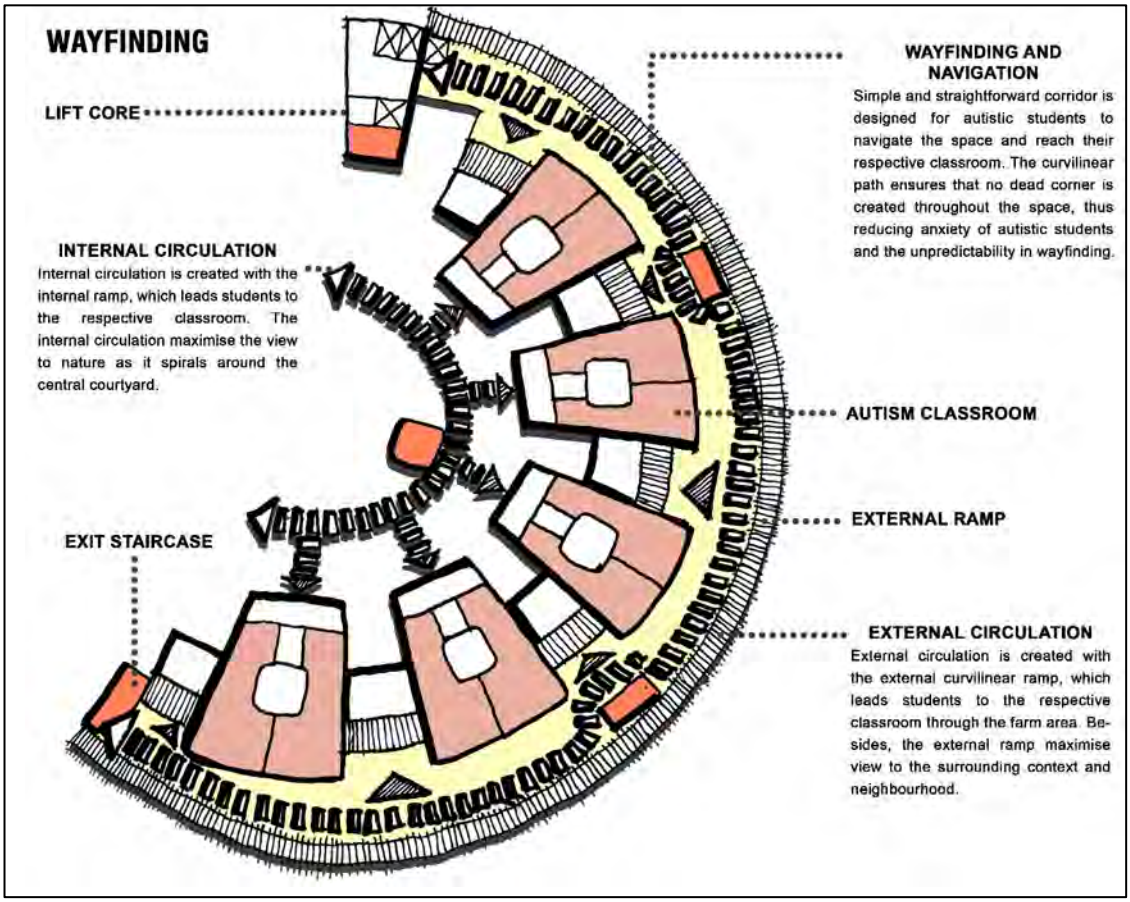


Figure 7: Wayfinding in an animal-assisted autism learning environment

Acoustics is another design criterion in autism sensory design (Mostafa, 2014). One of the design approaches for autism classrooms is to locate quiet rooms to be accessed directly from the classroom. This allows agitated autistic students to calm down in the quiet room during

behavioural meltdown. Also, quiet rooms can be used for one-to-one quiet learning if necessary. As an approach in acoustic design, quiet rooms and services rooms such as storage and restrooms can be located in between the classroom modules, similar to the animal sheds, to act as sound cushion (Figure 8).

The perimeter planter box at the farm grid is another greenery system that can aid in acoustical correction. Basically, the sound waves from the neighbourhood can be dissipated by the plant leaves through mechanical vibration (Iannace et al., 2012; Iannace et al., 2013). This can enhance the learning environment as autistic individuals can be sensitive to excessive sound stimulation. By achieving these sensory friendly requirements, autistic students are enabled to benefit from animal-assisted intervention in a farm-based autism learning environment.

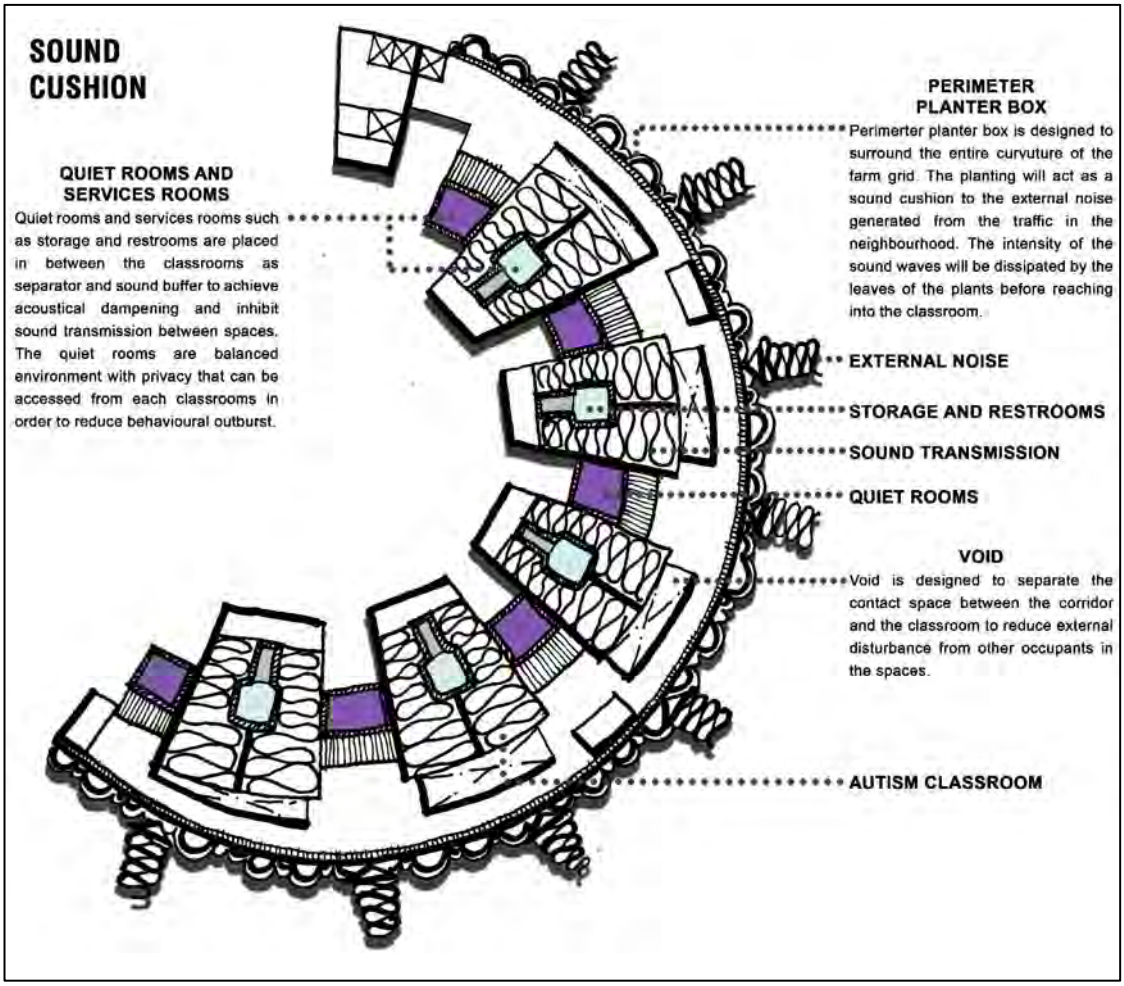


Figure 8: Sound cushion in an animal-assisted autism learning environment

Discussion on Online Survey

The results from the online survey are summarised and presented in Table 3. The discussion compares the findings with the preliminary studies and the results from the content analysis.

Table 3: Discussion on the findings from online survey

Analysed results	Discussions
Opinions on nature/farm-based education: • Nature exposure is essential – 95.7% • Farming and AAI is effective – 93.6% • Fish rearing is beneficial – 91.5%	The findings concur with the preliminary studies where the majority of the respondents agree that nature exposure is essential for the well-being of autistic individuals. Besides, since most agree that fish rearing and livestock farming is effective, it gives a supporting evidence to implement IFS.
Top three farm animals for AAI: • Rabbit – 83% • Chicken – 42.6% • Horse – 40.4%	The findings show that small animals are preferred for animal inclusion in the classrooms to assist learning. However, if space is not restricted, even large animal like horse can be raised for AAI, but it would be more challenging to practise IFS with large animals.
Top three benefits of livestock farming/AAI: Social improvement – 85.1% Student engagement – 78.7% Reduce stress and anxiety – 78.7%	The top benefits are mainly mental and socio-emotional benefits. Nevertheless, when one skill is improved, other skills will improve simultaneously as they are all interrelated.
Top three challenges of livestock farming/AAI: • Animal care outside of school hours – 72.3% • Students' allergy issue – 66% • Animal welfare concerns – 66%	The primary concern of animal care should be solved by having a management team to handle the housekeeping of animals. Next, hygiene of animals should be ensured to avoid students' allergy issue. Since IFS can automatically dispose the manure into the fish pond, it might be a good solution.
Opinions on integrated farming system (IFS): • Feasibility of IFS – 42.6% agree; 46.8% neutral; 4.3% disagree • Incorporating IFS in autism schools given proper support and facilities – 100% • Livestock farming/AAI as the future direction of special education – 89.4%	The findings show that IFS is still new to most respondents as the results on feasibility is a mixture of enthusiasm and scepticism. Nevertheless, the majority of respondents believe that AAI is the future direction of special education, indicating the growing popularity of AAI in autism services. More research can be done to further improve the practicality of IFS in an autism learning environment.

Recommendations

As suggested by the respondents in the online survey, the government should provide sufficient support and facilities in order to implement AAI in autism schools through IFS. Research on IFS can also be extended to enhance its feasibility and practicality. With new emerging technologies and sustainable system, different approaches and methods can be explored to include animals in a building. For future recommendation, animals' behaviour can also be further studied with animal specialists to create a healthy environment that allows interaction between the human occupants and captive animals. Also, there is a need for a more extensive study that integrates the recommended animals into actual autism classrooms with broader

participants in the sample to increase the accuracy of the benefits and challenges of IFS. The technical information and improvised drawings of IFS in this research can serve as a basis or reference to future architects or researchers to improve the practicality and eventually implement the system in real practices. Future research in this area should also seek to include input from the learners intended to benefit from the IFS support system. This information would complement the more technical input from autism experts, and is likely to provide additional insights and suggestions for implementing the IFS system in a user-friendly manner.

Conclusion

While livestock farming and AAI are still relatively new in Malaysia's special educational field, it is a potential model for future direction as the effectiveness of AAI has been proven in the research field. Nevertheless, this study provides the possible solution to implement AAI in an autism learning environment through IFS and architectural intervention, as summarised in the conceptual diagram in Figure 9.

An integrated farming system (IFS) is self-sustained due to the recycling of animal wastes into the fish pond as fertiliser. The water from the fish pond can become a convenient water source for the plants and animals. Besides, the farm grids with perimeter planter box creates a green and healthy environment for the captive animals and autistic students. The farm grid design is also complemented with a lot of environmental benefits, such as sun shading, acoustical correction, cross ventilation and filtering air pollutants (Figure 9). This ensures the well-being and mental health of the livestock serving as therapeutic agents for animal-assisted intervention. The concept of a vertical farm also allows animals to be integrated with the classroom modules in a farm-based autism school, especially in urban areas where land is limited. In conclusion, this study adds value to the research field on farm-based educational models in special education. It is a step forward to a more inclusive society, where the needs of special groups can be included in the design process of an educational architecture.

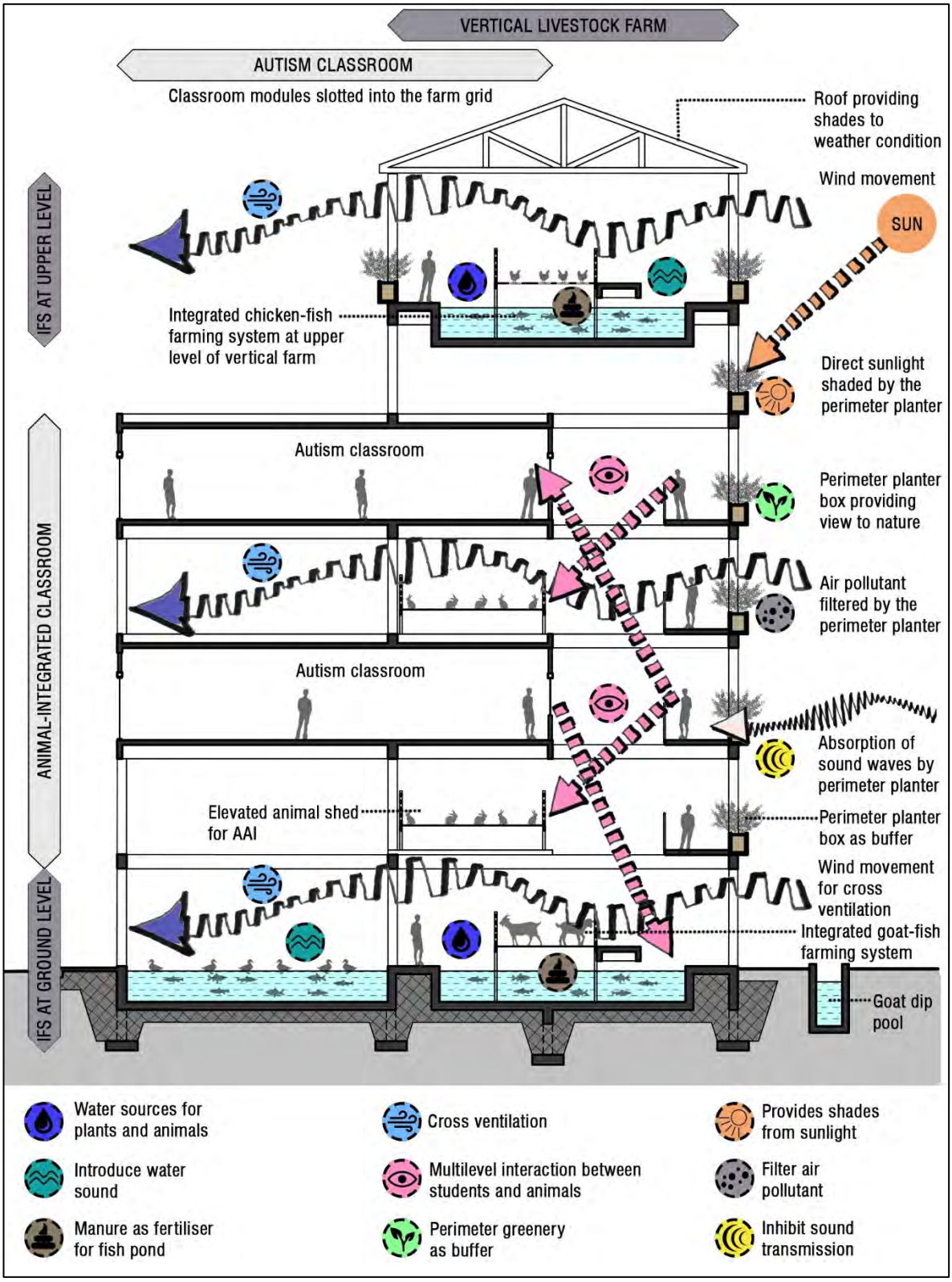


Figure 9: Conceptual diagram to summarise animal-assisted intervention in an autism learning environment via IFS

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References

Ahmad, R. S. H. (2001). Fodder-fish integration practice in Malaysia. In M. Halwart, J. Gonsalves, & M. Prein (Eds.), *Integrated agriculture-aquaculture: A primer, FAO Fisheries Technical Paper 407* (pp. 33–36). Food & Agriculture Org.

Alshaheen, R. (2019). *Post-Zoo design : Alternative futures in the anthropocene*. Arizona State University.

Balmeo, M. L., Nimo, E. M. A., Pagal, A. M., Puga, S. C., ArisDafQuiño, & Sanwen, J. L. (2014). Integrating technology in teaching students with special learning needs in the SPED schools in Baguio City. *IAFOR Journal of Education*, *2*(2), 149–178. https://doi.org/10.22492/ije.2.2.05

Barakat, H. A. E. R., Bakr, A., & El-Sayad, Z. (2019). Nature as a healer for autistic children. *Alexandria Engineering Journal*, *58*(1), 353–366. https://doi.org/10.1016/j.aej.2018.10.014

Birkeland, J. L. (2016). Net positive biophilic urbanism. *Smart and Sustainable Built Environment*, *5*(1), 9–14. https://doi.org/10.1108/SASBE-10-2015-0034

Blecha, J. L. (2007). *Urban Life with livestock: Performing alternative imaginaries through small-scale urban livestock agriculture in the United States*. University of Minnesota.

Brelsford, V. L., Meints, K., Gee, N. R., & Pfeffer, K. (2017). Animal-assisted interventions in the classroom—a systematic review. *International Journal of Environmental Research and Public Health*, *14*(7). https://doi.org/10.3390/ijerph14070669

Cassidy, M. K. (2019). Neurodiversity in the workplace: Architecture for autism. *Journal of Chemical Information and Modeling*, *53*(9), 1689–1699. https://doi.org/10.1017/CBO9781107415324.004

Chutchawanjumrut, T. (2015). *The zoological paradox*. Syracuse University.

Comartin, K. P. (2018). *Is man's best friend a best practice in public education? Animal-assisted interventions in classrooms and school-based therapeutic settings*. Alliant International University.

District Livestock Development Office. (2012). *Goat farming technical manual*. Retrieved from https://www.jica.go.jp/nepal/english/office/others/c8h0vm0000bjww96-att/tm_7.pdf

Entrich, S. R. (2014). German and Japanese education in the shadow – Do out-of-school lessons really contribute to class reproduction? *IAFOR Journal of Education*, *2*(2), 17–53. https://doi.org/10.22492/ije.2.2.01

Fawcett, R. H. (1990). Research and education for the development of integrated crop-livestock-fish farming systems in the tropics. *Agricultural Systems*, *32*(3), 293–294. https://doi.org/10.1016/0308-521x(90)90008-e

Ferwerda-Van Zonneveld, R. T., Oosting, S. J., & Kijlstra, A. (2012). Care farms as a short-break service for children with Autism Spectrum Disorders. *NJAS - Wageningen Journal of Life Sciences*, *59*(1–2), 35–40. https://doi.org/10.1016/j.njas.2012.01.001

Food and Agriculture Organization of the United Nations. (2010). *Simple methods for aquaculture: Manuals from the FAO training series* (2nd ed.). Food & Agriculture Org.

Ghazali, R., Md. Sakip, S. R., & Samsuddin, I. (2018). The effects of sensory design on autistic children. *Asian Journal of Behavioural Studies*, *3*(14), 68. https://doi.org/10.21834/ajbes.v3i14.165

Grandin, T. (2001). Basic curve design for cattle handling, cattle yards, and corral designs. Retrieved December 23, 2019, from https://www.grandin.com/design/blueprint/basicurv.html

Gupta, M. V., & Noble, F. (2001). Integrated chicken-fish farming. In M. Halwart, J. Gonsalves, & M. Prein (Eds.), *Integrated agriculture-aquaculture: A primer, FAO Fisheries Technical Paper 407* (pp. 49–53). Food & Agriculture Org.

Harada, T., Ishizaki, F., Nitta, Y., Miki, Y., Numamoto, H., Hayama, M., … Nitta, K. (2019). Relationship between the characteristics of therapy goat and children and older people. *International Medical Journal*, *26*(5), 405–408.

Iannace, G., Maffei, L., & Trematerra, P. (2012). On the use of "green materials" for the acoustic correction of classrooms. *Proceedings - European Conference on Noise Control*, (May 2014), 89–94.

Iannace, G., Trematerra, A., & Trematerra, P. (2013). Acoustic correction using green material in classrooms located in historical buildings. *Acoustics Australia*, *41*(3), 213–218.

Jon Coe Design. (2014). *Territory wildlife park master plan*. Retrieved December 22, 2019, from http://joncoedesign.com/zoo/twp_plan.htm

Little, D. C., & Edwards, P. (2003). *Integrated livestock-fish farming systems*. Food & Agriculture Org.

LiveCorp, & Meat & Livestock Australia. (2008). *Australian goat manual for Malaysian farmers*. Livecorp.

Macauley, B. L. (2006). Animal-assisted therapy for persons with aphasia: A pilot study. *Journal of Rehabilitation Research and Development*, *43*(3), 357–365. https://doi.org/10.1682/JRRD.2005.01.0027

Marchi, L. (2013). *Designing for adults with Autism Spectrum Disorders: Optimized live.work.play.learn environments*. Clemson University.

Mostafa, M. (2014). Architecture for autism: Autism aspectss™ in school design. *Archnet-IJAR*, *8*(1), 143–158. https://doi.org/10.26687/archnet-ijar.v8i1.314

Nazri, N. A., & Ismail, Z. (2016). Educational building facilities for children with autism in Malaysia. *Jurnal Teknologi*, *78*(5–2), 49–54. https://doi.org/10.11113/jt.v78.8489

O'Connor, J. T., Silkey, J. A., & Bonomo, L. E.-R. (2018). *Designing and building active outdoor learning stations : Teaching STEM concepts at a farm-nature preschool for children with exceptional needs*. Retrieved from https://digitalcommons.wpi.edu/iqp-all/1033

O'Haire, M. E., McKenzie, S. J., Beck, A. M., & Slaughter, V. (2013). Social behaviors increase in children with autism in the presence of animals compared to toys. *PLoS ONE*, *8*(2). https://doi.org/10.1371/journal.pone.0057010

O'Haire, M. E., Mckenzie, S. J., Mccune, S., & Slaughter, V. (2014). Effects of classroom animal-assisted activities on social functioning in children with autism spectrum disorder. *Journal of Alternative and Complementary Medicine*, *20*(3), 162–168. https://doi.org/10.1089/acm.2013.0165

Reeve, A., Desha, C., Hargreaves, D., & Hargroves, K. C. (2015). Biophilic urbanism : Contributions to holistic urban greening for urban renewal. *Smart and Sustainable Built Environment*, *4*(2), 215–233. https://doi.org/https://doi.org/10.1108/SASBE-11-2014-0057

Rud, A. G., & Beck, A. M. (2003). Companion animals in Indiana elementary schools. *Anthrozoös*, *16*(3), 241–251. https://doi.org/10.2752/089279303786992134

Sevilleja, R., Torres, J., Sollows, J., & Little, D. (2001). Using animal wastes in fish ponds. In M. Halwart, J. Gonsalves, & M. Prein (Eds.), *Integrated agriculture-aquaculture: A primer, FAO Fisheries Technical Paper 407* (pp. 121–124). Food & Agriculture Org.

Ting, X. N., Lee, L. W., Low, H. M., Kok, H. C., & Chee, K. C. (2014). Prevalence, diagnosis, treatment and research on autism spectrum disorders (ASD) in Singapore and Malaysia. *International Journal of Special Education*, *29*(3), 82–92. Retrieved from http://www.internationaljournalofspecialeducation.com

Tripathi, S. D., & Sharma, B. K. (2001). Integrated fish-duck farming. In M. Halwart, J. Gonsalves, & M. Prein (Eds.), *Integrated agriculture-aquaculture: A primer, FAO fisheries technical paper 407* (pp. 45–48). Food & Agriculture Org.

Trivedi, L., & Perl, J. (1995). Animal facilitated counseling in the elementary school: A literature review and practical considerations. *Elementary School Guidance & Counseling*, *29*(3), 223–234. Retrieved from http://www.jstor.org/stable/42871169

Uttley, C. M. (2013). Animal attraction: Including animals in early childhood classrooms. *YC Young Children*, *68*(4), 16–21. Retrieved from https://search.proquest.com/docview/1439083227?accountid=14645

Zarghami, F., & Schnellert, G. (2004). Class size reduction: No silver bullet for special education students' achievement. *International Journal of Special Education*, *19*(1), 89–96. Retrieved from http://www.internationaljournalofspecialeducation.com

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