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# Robotics and Social care

## The Effects of Introduction of Robotics to Social Care

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This study was a systematized review of literature on robotics in social care context. The focus was on the perceptions of and challenges experienced by the users of the services and the professionals working in elderly- and childcare settings as well as among people with disabilities.

Data bases available via Ebsco host were searched for research publications between years 2014-2018, by using key words “robotics”, “social care”, “elderly care”, “children” and “persons with disability”. The quality of the chosen articles was assessed with the critical appraisal checklist developed by Aromataris & al (2015).

The search resulted in five articles. The findings indicated that perceptions about robots in the study material were generally positive with emphasis on the potential of the use of the various robots. Thematic analysis of elderly, children and persons with disabilities was conducted and the conclusion was that robots have social benefits, rehabilitative and assistive benefits. The livelihoods of the users may drastically improve if they have access to robots and are supported to maximize on their uses. The main challenge raised was the costs of purchasing the robots, and costs incurred in training both end users and their caregivers.

In conclusion, more studies are needed to reduce the costs and address the ethical implications of the use of robotics in social care.

| | |
|---|---|
| Keywords | Robotics, Humanoids, elderly, socially assistive robots, social care, children, persons with disability |

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# 1 Introduction

Technological development is rapidly evolving and exerting profound changes on the daily lives of people. It has affected economies and industries, but per-haps none more than the production industry. This development has also affected the products and service delivery in the field of technology. Robotics and various other technologies are revolutionizing the future of production (World Economic Forum, 2017). They are expected in the coming decade to be seen more in the daily routines in areas such as home cleaning, childcare, secretarial duties just to mention a few. This shift towards more dependence on technology, has also made it possible to manufacture operating systems that handle repetitive and dangerous tasks (Bekey 2012).

One third of the vacancies in existence today with be taken over by the rise of smart technology by the year 2025 it is estimated (Frey and Osborne, 2012; Thibodeau, 2014).The world is rapidly headed for mass redundancy due to the rise of the various technologies such as robotics, artificial intelligence and algo-rithms ( Bort, 2014; Lynch, 2015) The effects of robotics is slowly being felt in all the sectors , this has made issues concerning manufacturing of these machines be of great interest.

There is great potential in the inception and use of robotic technologies, in the various operating possibilities available. Whatever the mode of operation, assis-tive devices, or remotely operated appliances, the environment potentially stands to benefit from this resource (Delmerico et al.,2019).

Different parts of the world have assimilated the concept of robotics in their own developmental stride. In South Africa for instance, the lack of expertise has hampered introduction and use of robotic for education purposes. This has led to a lack of zeal in subjects such as mathematics and engineering. The govern-ment is endeavoring to make available educational robots so as to get these young students enthusiastic in engineering and other careers in the fields of

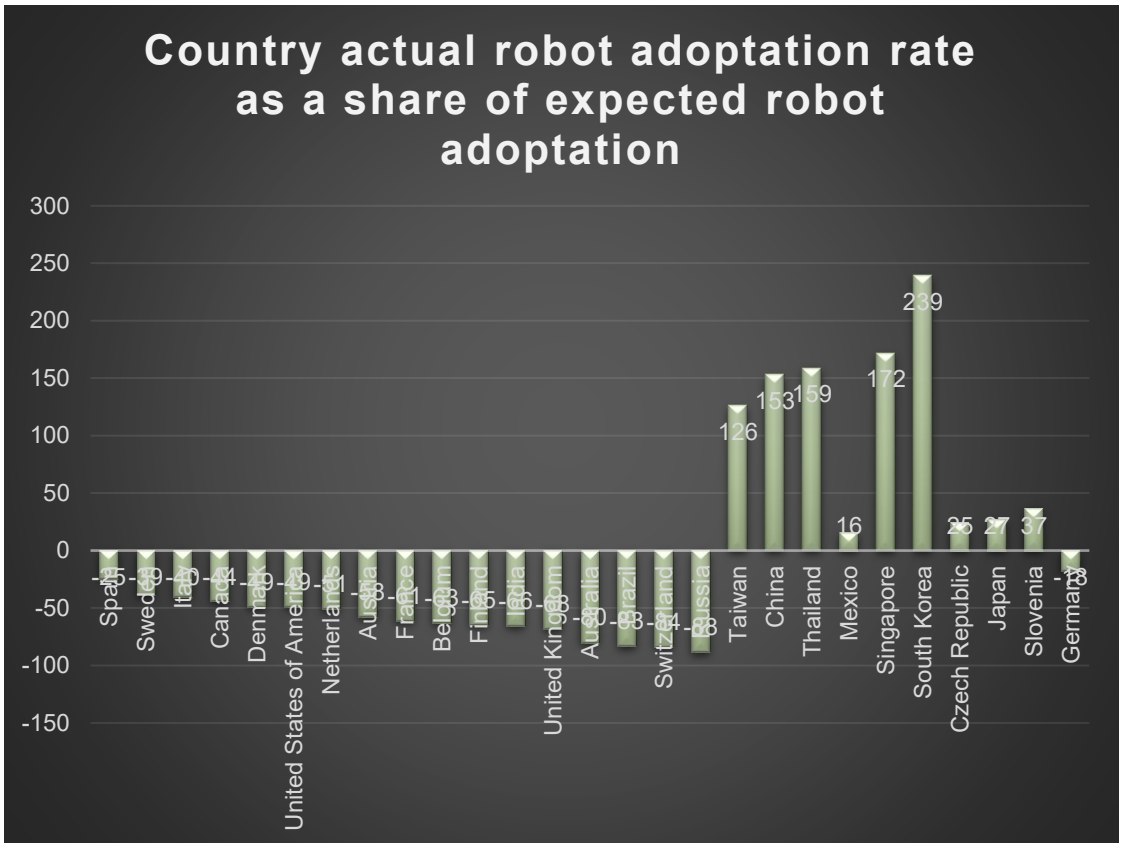
technology (Mondala et al., 2016.). South Africa like many other African countries faces challenges of availability and accessibility of internet an important element for connection and technology advancement.

Economic giants such as Japan has reported a decline in birth rate and thus grappling with a possibility of a lack of staff especially in the care sector. To prepare for this eventuality, robot companies have begun to manufacture very advanced technology robots to fill these gaps. They further argue that robots will only compliment and not replace workers. Most elderly care facilities in Japan are deploying robots for assistance in daily activities such as exercising and also remembering details about the residents that would otherwise be forgotten especially by the clients themselves (Lufkin, 2020). The perceptions concerning robotics is very important especially in the service sector because effects of robotics will eventually affect the lives of all persons in some way, this may be financially, physically, ethically, socially and psychologically.

## 1.1 Statistical adaptation of robotics

Various other countries especially in Asian continent have embraced the uses of robotic for especially industrial purposes (Winick, 2018). This has also led to an increase production of robots for other purposes such as for social and care assistive uses. In 2017, Innovation Technology Information Foundation (ITIF) conducted a study to find out to what extend concept and use of robot has been adopted in twenty-seven countries (Winick, 2018). The main purpose was to attempt to measure the actual adaptation of robotics in the industries as a share of expected adaptation rate on the basis of the wealth currently of this country. The results using the statistics available were presented in a graph as follows;

### 1.1.1 Graph 1; Country actual adaptation rate




Statistics in the graph are courtesy of ITIF data (https://itif.org/publications/2018/11/19/which-nations-really-lead-industrial-robot-adoption)

Despite the obvious representation of the graph that these countries have high numbers of industrial robots, this is just one way of measuring robotic revolution. Perceptions have been seen to influence adaptation of change. The countries on the negative side indicate little use of robots industrially.

According to the International Federation of Robotics, Asia has been reported to be leading in the adaption of robotics for industrial use. This is measured by the number of robots per 10,000 industrial workers (Winick, 2018). India was bottom of the list with only three robots per 10,000 workers while Korea

topped the chart by a staggering 750 robots per 10000 people. The report further showed that America and Europe did not have as many robots as would be expected (Winick,2018).

The president of the Information Technology and Innovation Foundation(ITIF) was encouraging regions such as Europe , UK and America to adopt policies that encourage assimilation of Robotics as this productivity and living standards . Introduction of Robotics to various sectors will in future act as an indicator of development of an economy, and this will be important for policy makers and stake holders (Atkinsons, 2018.).

Social care has experienced significant development particularly in terms of social robots. The fields that are seen to have greatly benefited are those of elderly care, education in children, care of young people especially those with disabilities or developmental and other conditions specific such as autism or other birth defects (Share and Pender 2018). There is an increased interest in the impact socially, ethically, and even economically of the introduction and use of robotics, especially in the social field.

As a person interested in the promotion of social wellbeing in people, and improving the standards of living, the concept of robotics in social care is important. It affects all people in some way regardless of one`s origin or place of habitation. The world is slowly becoming on big village and this effect of globalization touches the aspect of inclusion and future of social care  worldwide. There have been many positive aspects robotics reported such as the potential to ease tasks, more production in the industries and even companionship. There have also been concerns and potential challenges sited in the uses of robotics.

The thesis is a study of the perceptions of robotics in social care specifically among the elderly, children and in persons with disability. Data on robotics is available everywhere, the study shall concentrate on the University of Metropolia of Applied Sciences. This study will review kinds of robots and their

uses in the social context. Articles will be selected, and findings recorded in the paper.

# 2 Background

Artificial intelligence and robotics are already actively integrated in various capacities such as healthcare, in training people with learning disabilities, guidance in rehabilitation exercises, supporting everyday tasks for persons who need reminders in activities such as eating or taking medication and even assisting with surgeries. The advancement of technology has also pro-vided social interaction that assists reduction of isolation and loneliness. In the medical field, patients have also benefited greatly in cases of chronic illnesses (RCN Bulletin 2020.).

According to the authors Murphy and Woods (2009) stories told lead to assumptions that a robot had complex insight and displays cognitive skills comparable to what children would display and this aspect made it possible for humans to give commands (Murphy & Woods 2009). The interaction between the social care as a system and robots has generated great ideas and raised concerns as well. Some of these concerns being, the physical to emotional impact of the interaction, Other impacts of introduction of these robots to social care and the possible economic implications of it all to the field.

Many types of robots are in existence and are named according to their features and sometimes named according to their functions also, for example medical robots or social human like robots. Social robots have many functions, and such are that they are used for companionship, for physiological therapy and affective therapy, may be used also as a social facilitator (Abdi et al. 2018).

## 2.1 History and development of Robotics

Robotics is not a new term and can be dated back to ancient Greeks. Greek mythology has it recorded that robots were mechanical servants that belonged to the Greek god of technology, fire, and the furnace who was known as Hephaestus (Robotik Sistem). After the 1900s a lot of developmental stages occurred creating various forms and system variations of robots.

The term robotics originated from the term robot, which is a composition of various other subjects. Some of these are electrical or mechanical engineering, computer science which deals with design, construction, operation, and also the use of robot related computer systems. The word robotics seems to be defined in various ways. The first mention of the word “robot” was by an author of fiction plays known as Karel Capek in a play in the year 1921. He created the word from a Czech word “robota” meaning servitude (Robotik Sistem).

The International Federation of Robots is an international industrial group which has its focus on robotics for commercial purposes. This federation defines industrial robot as “automatically controlled, able to be reprogrammed, has possibility to be used for various purposes in different angles. These appliances can be either fixed or mobile in its use as an automation application in an industry. (IFR).

Automated programmed devices were very initially designed and patented in 1954. In 1961 technology further developed and the Unmate 1900 series a robotic arm used for factory animation was produced for the first time. This production was then televised to audiences around the world who got to see the robot for the first time in the year 1966. Engelberger who is often referred to as the father of robots had the robot perform interesting tasks such as knocking a golf ball into a cup, conduct a music band and pour out beer (Unimate).

Due to the rapid market growth and demand, Engelberger sought to widen the market possibilities outside of the United States. A Finnish company Nokia was approved by the Scandinavia ja Eastern Europe to manufacture the robots. In time, exposure to some Japanese executives resulted in massive development in the robotics field (Unimate).

The 18th century industrial revolution was a very critical phase in the growth development of robots because it was the time when mechanics and electricity applications were developed and also robots in that would be useful for surgical purposes (Yates, Vaessen and Roupret 2011).

Artificial intelligence, which is a major part of robotics, and can be said to be the science of making machines to behave intelligently, it is also said to be the quest to make a computer perform as excellently as humans, these explanations have raised controversies, in matters concerning the ethical implications (Murphy, 2019).

Modern day robots have advanced over the years and are able to accomplish so much more either specific or menial tasks. The human like robots are al-ways being improved and the programming is getting more and more specialized and sophisticated. One such example that will be later mentioned in detail is the famous and human like robot very recently built by a Saudi company Hanson Robotics. This robot goes by the name Sophia and it has even been awarded Saudi Arabian citizenship in the year 2017. This very humanoid robot expressed a desire to even have a family someday, something that only living beings can achieve thus far (Robotics today).

## 2.2 Classification of Robots

There is no universal way of classifying robots, most of the categorization is done according to the end uses or features of the robot in question. The Japanese Industrial Robot Association (JIRA) classification scheme below gives insight into features of robotic classifications in an industrial context (Kinds of robots).

Table 1: Classes of robots (according to JIRA)

| | Operation mode | Functionality |
|---|---|---|
| Class 1 | Manual handling device | Allows movement freedom in various degrees |
| Class 2 | Fixed-sequence robot | Not easily modified, fixed preprogrammed mechanism is used to perform a specific task |
| Class 3 | Variable- sequence robot | A modification of class two and it is easy to modify |
| Class 4 | Playback robot | Replicates motions recorded of human operator |
| Class 5 | Numerical control robot | A replacement of class 4 that has a movement control program |
| Class 6 | Intelligent robot | Able to carry out tasks and to understand environment, in spite of changes in the surroundings. |

Robots can also be classified according to the intended application field and their performance scope (Ben-Ari & Mondada 2018).

In this study emphasis shall be on social robots as used for psychological and social support of people, those that are used to improve the value and condition of the life of people in daily living. The commonly used robots in social care are humanoids which are assistive interactive robots that are often in presentation of human like or animal like shaped. Their purposes range from physiotherapy or support in social well-being and companion purposes, among others. Social robots are often human like, or animal like, and these features are important due to

their interactive role on an emotional level and also is often verbal and visual too (Ejdys, J. et al., 2018).

Other than social care, humanoids are used for other tasks that require a level of intelligence and precision. Humanoid robots are used also in dangerous tasks such as disaster response, in inspection and maintenance at power plants to relieve human workers of laborious tasks (RIA). In the following section, more shall be discussed about humanoids and various kinds that exist in accordance with their tasks and features.

## 2.3 Humanoids

Humanoids are very complex mechanically designed autonomous mobile robot built with possibility to move the body parts. They perform various services such as homecare services, cleaning just to mention a few (Ben-Ari & Mon-dada, 2018). The earliest forms of humanoids were created in 1495 by Leonardo Da Vinci. Present-day humanoids have been developed to carry out diverse tasks that are taken up by human beings and assume different roles in the service sector (Singh, 2019).

Humanoids are manufactured with the capability to connect and interact with humans and other robots, interpret information, and perform activities in for a desired outcome. Humanoid robots are manufactured with sensors and are programmed for a specific prearranged activity and action. Thus, they are classified in three categories and these are healthcare, educational and social humanoid robot (Choudhury., Li, & Greene, 2018.).

Humanoids are used to assist in pain reduction, for distress and anxiety during medical procedures by offering distraction when used to provide psychological support (Srivastava, 2020). These robots used in medical procedures are thus known as surgical assistants and are also remote-controlled. They assist surgeons in performing operations with minimum personal invasion (Crawford 2016). This has made various procedures that are delicate and those that require precision such as brain surgery and neurology related operations possible. 1985 was

a significant year in this field of operation as it was the first time the use of robot in human surgery was publicized (Kwoh et al., 1988).

### 2.3.1 Healthcare Humanoids

Healthcare humanoids as the name suggests are robots fitted with artificial intelligence and are used at healthcare centers, or by patients at home for treatment or improvement of their conditions. Robots can be pre-programmed or manually operated (Choudhury et al., 2018). Humanoids also offer assistance in surgeries, in disinfection of rooms they act as per instructions this alleviating infection and dispensing of medication while not touching the pills. They can also be used remotely to carry out tasks that would require human manipulation in contaminated environments. They provide assistance to patients without risking the lives of the medical practitioners (Srivastava, 2020).

Robots are also being integrated hospitals, and nursing care institutions to monitor basic issues such as blood pressure and sugar levels especially with the elderly who constantly need to be reminded (Michaud., et al. 2007).

Tele operated appliance enables off-cite supervision in instances such as surgical procedures. This reduces the time between operations and allows for more crucial operations to be conducted (Becevic et al., 2015).

In tele-operated instances, robots are controlled remotely thus operation of the appliances is often conducted from a different location. The time of transmitting instructions is programmed such that relevant instructions are sent timely stimulating reactions from the patients immediately (Takanori & Wada 2010).

Robotic appliances used in healthcare present in various forms, these are telemedicine, smart homes, tele health and so many others. The use of tele operative devices especially in nations with advanced science has been adopted due to the

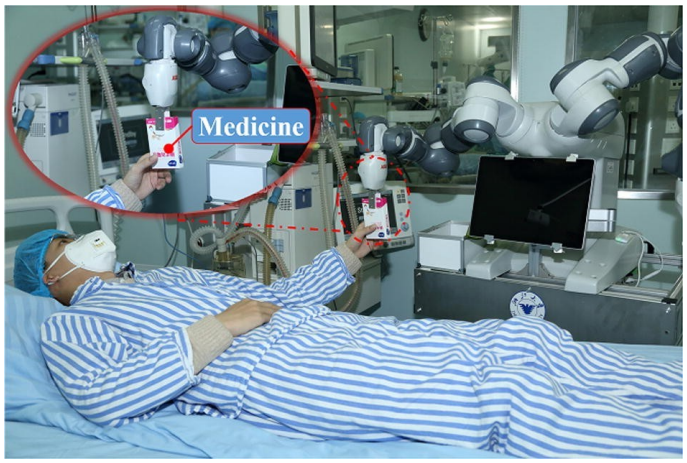
increased life expectancy in the aging and also improvement in diagnostic technology (Majumder et al. 2017).

The advancement of technology has also made possible applications to be manufactured that remind the elderly to take their medicines and concurrently remind the care givers to keep track of this process. These applications also assist in the wellbeing and nutrition maters in that a reminder to eat is also made possible (Zao, 2010).

One example that will be mentioned is the teleoperated robot, very commonly used in the healthcare sector for various tasks.

In the Figure 1 below, medicine being delivered to a patient by a tele-operated robot. This is particularly useful in situations that require distancing from patients to avoid any form of contamination.

Figure 1. Application of a teleoperated robot




Picture courtesy of Chinese Journal of Mechanical Engineering (Yang., et al. 2020).

Using this technology, the person-to-person contact can be reduced thus protecting healthcare workers especially in situations where there is an outbreak of a pandemic for instance.

### 2.3.2 Educational Humanoids

In this phase of increased technology awareness, robots have been increasingly used to in learning technology subjects such as science, engineering, technology and mathematics. This has been beneficial because students have the flexibility to learn at their own pace by selecting suitable programs in accordance to their level of understanding (Burbaite et al. 2013).

The various programs installed in the robots encourage interactive learning and strong collaboration between the learners, instructors and the robots.

Technology is increasingly becoming a part of regular learning from a very young age. Early education in technology is often fostered using robotics (Schiffer &Ferrein, 2018). There are different types of educational robots and these have different appearances. They possess structural variation, operating systems and functionality (Benitti, 2012). These educational robots are thought to consist very many sensors.

Educational robots have been reported as useful in two ways mainly, first is that they can be used directly as a study tool in the technology and engineering and the other way is programing the device so as it may be used as an agent alongside study sessions by providing instructions to the students (Tanaka et al. 2015).

Other educational uses are that they are that they are used as a channel to tell stories to children. Studies conducted recommended that this activity improves the children's general academic performance, and that this interaction has been reported to make children very happy. It has also been reported that children

have displayed positive social aspects from playing educational games with robots such as kindSAR (Kindergarten social assistive robot) for example. Fridin goes on to state that motivating pre-school children to solve algebra problems can be attained by assistance of robots (Fridin, 2014.).

There are various kinds of educational robots such as the Pro-bots, Bee-bots used in solving mathematical problems. These are said to have simple and interactive interface, making learning simple and engaging (Highfield, 2010).

Figure 2 below is a picture of an educational robot Dash which is used for educational activities. It has various useful features such as, ability to connect it to another device via Bluetooth thus control is made swift and real-time. Dash robot

Figure 2. Dash Robot

(Picture source: https://www.makewonder.com/wp-content/uploads/sites/4/2019/08/dash-hero-shot-1.png)

The advantage of robots such as Dash is that it encourages playful learning. Dash is said to be a beneficial type of robot because it has been seen to have positive impact especially in the elementary learning level. This would be ideal in schools

because of the manageable size and also the ready availability of their accessories (Nelson, 2020).

It has transmitters that make it interactive with other robots, possibility of playback this allows for repeated action for emphasis and to allow for the children to fully master what is being taught. It has wheels and sensors to enable it to be located and also to move about without hitting other objects. The moving about stimulates learners senses and causes interaction (wonder workshop).

### 2.3.3 Social humanoid robots

These are robots that interact mainly with humans, contrary to the various other types of robots, the human-robot interactions are more geared toward a personal contact level. Various types already in existence and more are constantly being developed with special abilities (Jevaan, 2018).

The social purposes of humanoids continue to draw interest, the designing of this kind of robot requires a deep understanding of human intelligence and social behavior both cognitively and physically. The complexity of this study calls for This a multidisciplinary approach that applies artificial intelligence (Breazeal, Takanishi & Kobayashi 2008).

Social humanoids are manufactured for various functions such as for entertainment, physical assistance, rehabilitative purposes, and companionship just to mention a few. Some of the popular known and used humanoids are such as, ASIMO, Sophia and Kasper. Below are some of the commonly used humanoids, the pictures and brief description.

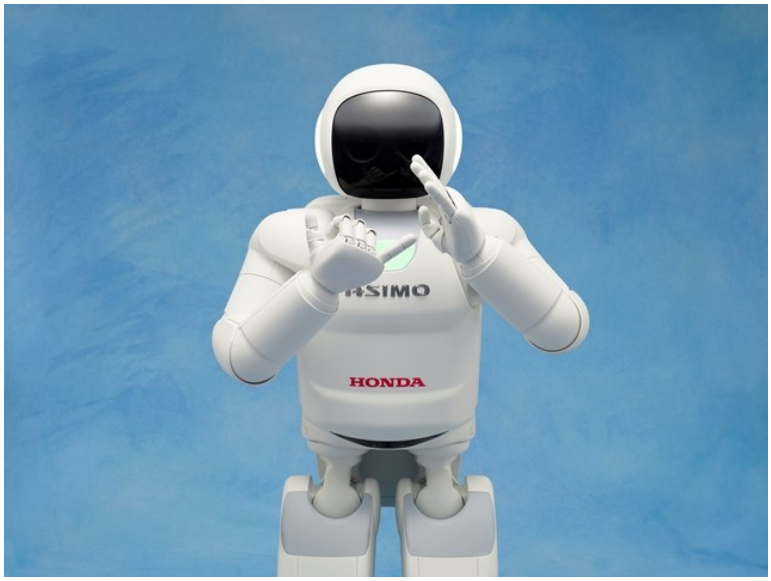
a) ASIMO

ASIMO is an acronym for Advanced Step Innovation Mobility. It is a bipedal which means it has two feet humanoid robot. This robot according to Honda was developed with the aim of facilitating co-existence between humans and robots and

also providing a practical assistance in the daily lives of humans. It was first introduction in 2000 and in 2011 a superior version was released to the market thus marking the introduction of the world´s first autonomous behavior control technology (Honda).

It has improved over the years in its flexibility and is able to perform more tasks and activities than it did a few years ago. ASIMO is said to carry out tasks considered dangerous for humans to do such as going into places considered hazardous, disarming bombs, or fighting fires (Obringer, & Strickland). Figure 3 below is a picture of the latest version of ASIMO designed by the Honda company.

Figure 3. ASIMO




Source: Courtesy of Honda global: https://global.honda/content/dam/site/global/innovation/cq_img/robotics/ASIMO/task02.jpg

This is ASIMO by Honda and above it is seen to display the ability to communicate in sign language (Honda robotics). It was considered the world´s most advanced humanoid in 2014 because of the gait and ability to interact. It has such precession on might suppose that it is a human in robot suit. It has so many

unique features such as ability to recognise voices even when several people are speaking at the same time (International business times, 2014).

b) KASPAR

This is an acronym meaning Kinesics and Synchronization in Personal Assistant Robotics (KASPAR). On of it´s distinct feature is that this humanoid is said to minimally expressive robot (Mengoni et al., 2017). It is small and has childlike features, developed to research human and robot interaction and also assist children with behavioral challenges. KASPAR robots are used as social mediators in that they assist children to better interact and communicate with adults and also with other children. This has been made possible by the various fitted sensors that enable immediate responses. KASPAR has been viewed especially useful in children with autism spectrum for developing of social skills. Other use of the robot is for hobbies such as drumming among kids (University of Hertfordshire). Below is a picture of KASPAR, developed for a duration that lasted longer than a decade by the University of Hertfordshire's world-famous adaptive systems research group.

Figure 4. KASPER Robot

Photo source: University of Hertfordshire https://www.herts.ac.uk/__data/assets/image/0005/160862/uherts_368017448591-min.jpg

Studies conducted at the university of Hertfordshire have shown that KASPAR can act as a safe and predictable tool for education in children with autism because it enables them to engage in direct eye contact in a relaxed play context (Hertfordshire University).

c) SOPHIA

Sophia is said to be the most advanced humanoid, the robot has a many unique features that depicts the future of AI and advanced robotics. Sophia is very captivating and as had been earlier mentioned is the world´s first robot to attain citizenship, it has also awarded robot innovation Ambassador for the United Nations Development Program.

This robot is very advanced, it is said to use artificial intelligence programming for research purposes and also to generate own ideas (Hanson robotics.). Figure 5 is a picture of Sophia 2020 as seen on the manufacturers site Hanson robotics.

Figure 5. SOPHIA

Photo courtesy of Hanson robotics, source: https://www.hansonrobotics.com/wp-content/uploads/2020/09/Sophia-full-body-clothed-jpg-531x1024.jpg

Sophia has human like appearances, and facial expressions too and has a possibility to be programmed for wide range of activities (Hanson robotics).

## 2.4 Interactive therapeutic animal-shaped robots

These too are socially assistive robots that assist humans by means of social interactions. They comprise of pets, companions, service robots among others (Bedaf et al., 2015).

Not only are these robots referred to as assistive devices but are also perceived as social devices as mentioned earlier providing comfort, communication, and entertainment (Chen et al., 2019). Artificial robotic pets are useful for therapeutic and other social purposes. In instances such as Japan, where live animals may be a challenge to own or maintain due to the culture, it is therefore beneficial to have a robot pet. In many instances, animals cannot be allowed into hospitals or institutions as they are seen as dirty and unhygienic (Ribi, et al., 2008). There are various pet assistive robots in existence, some popular examples are AIBO and the famous PARO.

### AIBO

In Japanese, AIBO means ‘companion’, abbreviated from artificial intelligence robot (TechTarget). AIBO was designed for family entertainment, it can form emotional bonds with persons and provide affection. Nurturing the pet has been reported to provide a deep sense of love and joy (Sony). Figure 6 below is a picture of the dog like robot AIBO.

Figure 6. AIBO (Performance robot)

Picture property of Sony; source https://robots.ieee.org/robots/aibo2018/Photos/SD/aibo2018-photo2-full.jpg

Above is a picture of AIBO the robot which has been said to have built in actuators that facilitate smooth and as natural as possible movement. (Sony). There are various advantages of using AIBO for therapeutic purposes and some of these are the cleanliness, non- allergy properties, and adjustable noise level. This is especially beneficial in clean areas such as hospitals and thus actual dogs may be probably replaced by AIBO (Ribi et al., 2008).

PARO

This assistive robot was developed in Japan by a professor known as Taka-nori Shibata (National Institute of Advanced Industrial Science and Technology). PARO is acronym for physically assistive robots (PARO), It is said to be roughly the size of a new-born baby and behaves like an actual pet encouraging reactions and engagement. It is said to have 12 in built sensors that assist in invoking responses.

Some of the abilities PARO possess has are that it is able to move its tail and paws, turn towards the person talking and also it has the ability to mimic the sound of a seal. PARO was specifically designed seal like to reduce or do away with negative connotations associated with being just another animal. (National Institute of Advanced Industrial Science and Technology, Japan). Figure 7 is a picture representation of a PARO.

Figure 7. PARO

The therapeutic robot Paro. Photo courtesy of Hive life: https://hivelife.com/wp-content/uploads/2020/03/PARO-Japanese-Therapeutic-Robot.jpg

There are various studies that have been conducted regarding Paro. Effects associated with PARO include effects such as reduction of sadness and encourage calmness. It was also seen to stimulate communication between the clients and healthcare providers (Jung et al., 2017), invoked positive relations and affected the wellbeing (Keyes 2002).

# 3 Aim of study.

The aim of this study was to examine the implications and perceptions of introducing robotics in social care particularly among the elderly, children, and persons with disability.

There is continued shift in the ways of providing services in social care, a study addressing the perceptions of the users of robot services, the caregivers and other professionals in the social care arena concerning the introduction of robotics is necessary and useful for improvement of support for the service users and efficiency for professionals engaged in the everyday handling of robotics. The following research questions will be used to address the aim of the study.

## 3.1 Research Questions

What are the users' perceptions of introduction of robotics in social care for the elderly, the children, and persons with disabilities?

What kind of challenges have been disclosed in the studies as a result of the introduction of robotics as experienced by their users in social care for the elderly, the children, and persons with disabilities?

In the study context, users were both the immediate end users and the professional care and support givers who offer assistance and support services by the use of these devices. The level of use of robots in the everyday life has increased in the recent years hence it is important to identify the social acceptance and perceptions of robots and their functionalities.

# 4 Method

To study the perceptions of robotics, the method applied was systemized review. This methodology centers on existing studies, specifically selects, and evaluates the material, data is then analyzed, and the results reported. A systematic review often will result in reasonably clear conclusions about known and unknown facts (Denyer & Tranfield, 2009). This methodology often limits inclusion criteria to deal with heterogeneity by only including studies reporting a specific outcome (Wright et al., 2007). This then allows for freedom to interpret the data preselected with the available data in the study only.

The reason why this method was selected for this study was because the subject of robotics is wide and a lot of material is available, to arrive at specific information systematically, the method needed to be one that allows for elimination. By using the inclusion criteria with set limitation, it was possible to end up with a selection of material for study that will provide reasonably clear result.

Due to the continuous development in robotics, the information available changes rapidly too. This methodology makes it possible to trace back the results if there is need to analyse or further develop a product because of the clarity of the step by step applied in the process. It also allows for follow up in cases need repetition of the studies conducted.

A systematic review as a method of study seeks also to analytically search for, assess and synthesize research evidence. It adheres to the guidelines on the conduct of a review provided. It is transparent in the reporting of its methods thus enables others to replicate the process in the event of the need to clarify a matter (Grant & Booth, 2009).

PICO was used as a tool to clarify on the research questions and verify the search words as shown in Table 2 below. The PICO approach can be used to construct several types of research questions. It focuses on the research scope and thus avoids unnecessary literature search (Santos et al., 2007).

In this study, population of study are they elderly, children and persons with disability using robotics as method of intervention, the context of study is social care and all that pertains to this and outcome. The expected information is the perceptions of end users and those that assist in delivering services to these end users. Table two is an outline of the study scope.

Table 2: PICO outlining research study scope.

| | |
|---|---|
| Population | Elderly, persons with disability, children |
| Intervention | Robotics |
| Context | Social care |
| Outcomes of interest | Perceptions, Challenges |

## 4.1 Literature Research

The literature search of material to be used in the study was conducted in Metropolia university's data base. The university comprises of various search engines, due to it´s multidisciplinary nature, Ebsco Host was selected as the overall search database. Ebsco Host database encompasses of various search engines such as CINHAHL complete, Business source elite, Information Science and technology, abstracts and GreenFile and thus promoting fairly broad coverage.

The key search words used for data search were "Robotics" and "social care", and for advanced search AND "elderly care", "Children and "persons with disability". Further inclusion and exclusion parameters were that the articles needed be peer-reviewed, written in English, had an abstract and full text of the article available. The timeline was between January 2014 to no later than December 2018,

making it a total of 5 years including both the years 2014 and 2018. Another inclusion factor was subject relevance as displayed in the article´s abstract and titles.

## 4.2 Core concepts for the study

The study selected three main categories of the vulnerable groups of people, and these are the elderly, children, and persons with disability.

The world health organization includes the following categories as vulnerable these are the elderly, expectant women, children, the sick and the mal-nourished people (World health organization). The reason why people are vulnerable partly is because of their unavoidable dependence on the assistance of others (Peroni & Timmer, 2013).

Vulnerability is also as a result of developmental challenges, personal incapacities inadequate support systems and disadvantage in social status. Older people in the society suffer illnesses and other social calamities and this may lead to social isolation (Mechanic & Tanner, 2007.).

Many world initiatives have social inclusion as a core, to include all plus persons with disability. United Nations Charter core values involve inclusion of persons with disability as a human rights instrument and this means that all should be done to allow involvement in daily life activities for all (United Nations).

Inclusion of all people is important and that can be made possible by supporting all people to be a part of the society actively. All groups of vulnerable cannot be covered in this study, however these three categories represent various in themselves represent other minorities in some other ways and also allow for rehabilitation and support a better quality of life.

## 4.3 Social care concept

Social care is specifically any kind of assistance or various types of support or supervision provided by social workers and professionals of similar training (Lexico dictionary). This support can be offered to all people in need and especially the vulnerable in the society to enable them to live comfortably. People are eligible to support and care and this is organized differently by every society. This too is one of the concepts behind the selection of the categories of the person to be studied, they need and deserve social care and support. The groups of study were defined in accordance with their understanding as stated by the world health organization.

Social care encompasses various categories of support systems and some of these are personal home assistants, childcare, mental health, rehabilitation, aging and this demands a significant amount of human interaction. Social care has been thought as empowering and due to that it is often associated with social work (Dalrymple and Burke 2006).

## 4.4 Definition of the study terms

The term elderly is said to be a shift in livelihood according to Thane (1978), The author further states that old age is seen to occur in women and men at different times. In women it may be between the ages of 45 and 55 years and for men between the ages of 55 and 75 years (Thane, 1978). WHO writes that most countries are in agreement that there is no actual age-related definition of the elderly, it therefore safe to say that retirement age can determine the definition of the elderly in most countries. An elderly person can therefore be anyone above 60 years old (WHO, 2002). Due to the increase in dependence with age, medical care and social care is very relevant among the elderly.

A child is a person 19 years or younger according to world health organization, with exception of if the national law defines a person to be an adult at an earlier age in the society one is placed (WHO, 2013).

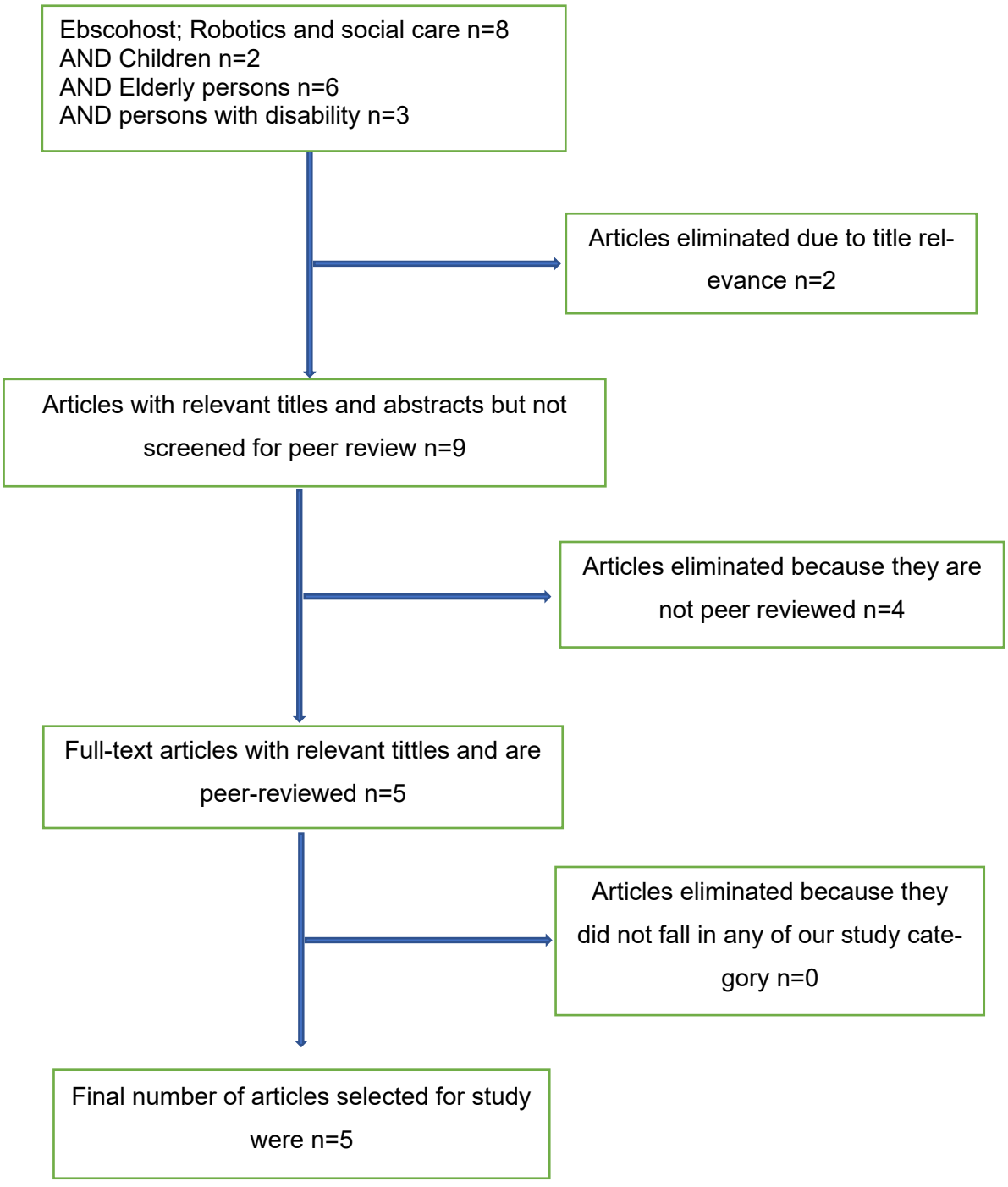
The understanding of disability in the recent years has shifted from a physical or medical viewpoint to one that is inclusive of a person's social, psychological, and even political context according to the WHO. Disability in this present day is understood to stem from the interaction between a person's health condition or impairment and environmental factors that are influencing the condition at hand (Disability, WHO 2020).

## 4.5 Data Search flow process

The flow diagram number 1 is a chart outlining the process by which the articles selection was conducted from the commencement to the final stage to arrive at articles that met the inclusion criteria. Out of a possible 19 articles initially picked, the final selected study materials were 5 in total.

This method is particularly good because it is possible to trace back the process in the case that certain information is needed.

Flow diagram no. 1: The process of selecting the final material.



The selection process resulted in three articles and table below is a table of the names of the articles that were selected finally for the study. This table includes the names of the authors, the year of publication and theme it fulfilled in the study.

Table 3: Articles selected

| Data-base | Title of article | Author(s) | Publication year | Theme |
|---|---|---|---|---|
| CIN-HAL com-plete | Service innovation through social ro-bot engagement to improve dementia care quality | Chu, Mei-Tai; Khosla, Rajiv; Khaksar, Seyed Mohammad Sadegh; Ngu-yen, Khanh | 2017 | Elderly care, People with disabil-ity |
| CIN-HAL com-plete | Care staff percep-tions of a social ro-bot called Paro and a look-alike Plush Toy: a descriptive quali-tative approach. | Moyle, Wendy; Bram-ble, Margue-rite; Jones, Cindy; Murfield, Jenny | 2018 | Elderly |
| CIN-HAL com-plete | Robot-assisted up-per extremity reha-bilitation for cervi-cal spinal cord inju-ries: a systematic scoping review | Singh, Hardeep; Unger, Janelle; Zariffa, José; Pakosh, Maureen; Jaglal, Susan; Craven, B. Cath-arine; Mussel-man, Kristin E. | 2018 | Disability rehabilitation |

| | | | | |
|---|---|---|---|---|
| CIN-HAL | Robot-assisted gait training might be beneficial for more severely affected children with cerebral palsy | van Hedel, Hubertus J. A.; Meyer-Heim, Andreas; Rüsch-Bohtz, Christina | 2016 | Children, rehabilitation |
| CIN-HAL | How to Implement Robots in Interventions for Children with Autism? A Co-creation Study Involving People with Autism, Parents and Professionals. | Huijnen C, Lexis M, Jansens R, Witte L | 2017 | Children, rehabilitation |

# 5 Findings

The five articles selected for this study approached the application of robotic in a social care context from various angles. These articles had different modes of method of data collection and analysis, main words featuring in all of them were robotics. There were strong perceptions both positive and negative concerning the uses of robotics and how it affected the producers, professional care givers and the end users. Below is a brief outline of what was observed thematically, and the study further covers these perceptions in the next chapter on discussion. Continuous studies and considerations are still recommended to allow full integration of robotic interventions.

## 5.1 Elderly

The quality of livelihood of persons with dementia has been greatly improved by use of robotics assistive technologies (Chu et al., 2017). This was reported as evident in various capacities and people groups such as in caring for the elderly in the society also among people needing re-habilitation. It was also reported that Though robots are useful and beneficial, they only provide physical services, and not factoring in the relevance of human touch in social context (Libin & Cohen-Mansfield et al., 2004).

The study materials concentrated on elderly persons suffering dementia and also those that seemed lonely and in need of companionship. In the case of dementia, the articles determined that the work of the caregivers was made lighter, the participating persons also had positive interactions with these so-cial robots, and this improved their social capabilities (Chu et al., 2017). The robots that were used in the study were social robots Sophia and Jack.

PARO the animal shaped seal like is the most commonly studied robotic pet. It is covered in tactile sensors making it respond to elements such as light, sound and touch. (Moyle et al., 2018). The perceptions of both the users and care givers were taken into consideration in this study and it was observed that Paro had a positive impact on the elderly (Moyle et al., 2018).

According to the article of study, PARO assisted in uplifting the moods of people who needed the companionship thus said to increase quality of life of the aging population by the companionship provided (Moyle et al., 2018).

During this study, a similar looking toy plush was subsequently introduced at the same time as PARO and though both weighed the same and were similar in size, the residents in the care home preferred (Moyle et al., 2018). Perhaps it was the physical presentation that determined their popularity, plush might have been too childish in the perspective of these elderly persons.

## 5.2 Children

In studying about children and robotics, KASPAR a social robot was the center of this study. This article centered around children and especially those with autism. The study results indicated that Children adopt well to robots that are accessible. Physical features were said to be of importance for example, the color of clothes needed to be tailored to meet specific needs of each child, the basic appearances too seemed to come forth as important. (Huijnen, et al.,2017).

Integration of other methods alongside technology intervention was mentioned as being crucial for optimization of output in children therapy for education purposes. Children with autism differ in their needs and support requirements will be different. Customization of services was therefore strongly recommended. It was also observed that children with autistic traits interaction with robots can be particularly empowering, caution though should be applied in the use because excessive speech from the robot can lead to information overload (Huijnen et al., 2017).

## 5.3 Persons with Disability

Persons with disability will benefit from rehabilitative interventions. There interventions vary with the needs and severity of the disability. Persons rendered incapacitated either partially or completely due to severe injuries or those born with disabilities need support. In interventions for spinal injury, approaches such as

training in movement using robotic devices, aim to promote flexibility and practical improvements. Robotic research is said to place more emphasis on lower extremity training, than upper extreme training using robotics thus allowing bodily function. (Anderson, 2004).

Therapy initiated at the early stages alongside personalized plans are useful in giving support to individuals to cope with disorders and their symptoms (Volkmar et al., 2005). Persons with disability can be found in all groups of people, they exist among children, the elderly, or adults. Two of the selected articles of study covered to different forms of disability conditions, one was on cerebral palsy and the other was challenges in movement of limbs resulting from spinal injury.

The analysis of one study was that persons with cerebral palsy need assistance to attain equal chances as others. Children affected by cerebral palsy suffer with social functions. The condition is said to be the most common motor disability in childhood, this is caused by damaged muscle (CDC, 2020).

It is believed that improvement in social participation in children can be achieved with the help of a robot assisted gait trainer. Robot assisted gait trainer can be used both in adults and children, van Hedel and others in their article explored the effects of using robot-assisted gait trainer alongside conventional physiotherapy (van Hedel et al.,2015). The robot used was a Lokomat, which provides support for the legs, back and the posture, while assisting in taking steps. Each child received training with the Lokomat robot as well as following their regular treatment program. Training on the Lokomat was done 3 – 5 times a week. (van Hedel et al., 2015).

The results indicated that although there was no significant change between the groups of had Gross Motor Functional Classical System (GMFCS) levels which are used to measure gait improvement, there was a significant change of performance for children within closer level groups. Upon completion of the training period, some children who did not have severe functional levels could walk almost

normally. General implications of the study suggest that the use of Lokomat during rehabilitation could increase the independence of children (van Hedel et al., 2015).

Despite improvements within groups the analysis of the study concluded that more controlled studies are needed to confirm differences between groups. Another point of benefit would be introduction of other types of robots to observe what more can prove beneficial in the management and rehabilitation of persons with cerebral palsy. In addition to this involving other types of robots could increase the benefits observed in the treatment of cerebral palsy (van Hedel et al., 2015).

The second article selected for the physical disability study addressed a different kind of physical disability which was disability caused by spinal injury. This was centered on use of robots among people with upper-limb impairment as a result of this spinal cord injury. In this particular study covered the types of robots used were categorized as exoskeletons, these robots align with the targeted joint to allow control and support of the limbs. The robots used were chosen by clinicians to provide maximal restorative therapy and were specifically tailored to the capability of the participants. The report showed uncertainty of when the robots should be introduced, also it was reported that robotic intervention was in order whatever stage of injury one was at, that is chronic or subacute stage (Singh et al., 2018).

Below is a summary of the study outlining major findings.

Table 4: Details of the study

| Authors | Sample participants | Aim of study | Methodology used in article | Major findings | Recommendations | Strengths and limitations |
|---|---|---|---|---|---|---|
| **Chu, et al. (2017)** | data comprises a total number of 11,635 behavioral reactions, such as facial expressions and body responses (between robots and 139 participants) | (1) Determine how social robots (Jack and Sophie) engage actively with PwD? (2) How do social robots improve the capacity of caregivers in residential care facilities? | Comparative analysis of unstructured data collected using observational method | There was evidence that the selected robots have shown a significant improvement from 2010 to 2014 in care quality. Study illustrated that participants had positive interactions with | Commitment to further develop capabilities of social robots in social contexts with PwD to deliver personalized services is particularly desired. | Encouragement of social activities during the studies (S)<br>Not possible to apply various data collection techniques due to the nature of the clients (L)<br>Group in data sample was comparatively small |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | these social robots, leading to an improvement in the participants' social capabilities | Future research is encouraged to consider social robots in a broader sample size. | and of similar attitudes towards robots (bias) |
| **Moyle et al. (2018)** | Care staff from nine LTC facilities in Southeast Queensland, Australia. | explore care staff perceptions of Paro and a look-alike non-robotic animal, including benefits and limitations in dementia care. | Qualitative within a larger cluster-randomized controlled trial | The robot PARO was seen as useful for improving moods. Staff is willing to adapt PARO for companionship | Older generation increasing and would benefit from this intervention however, further studies should be conducted to find out what type of people would benefit from animal | Costs of PARO and cost of training staff to use it. (L)<br>Robot functionality might sometimes present undesired effects.<br>Biasness in the selection participants they were seen to love animals (L) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | look alike robotics therapy. | Previous research conducted yielded similar result (S) |
| **Singh et al. (2018)** | 73 participants with various levels of spinal injury | Provide an overview of the practicability and outcomes of robotic-assisted upper extremity training for individuals with cervical spinal cord injury (SCI). Identify gaps in current research and articulate future | Systematic review | Little to no clinically significant improvements in muscle strength. Statistically significant improvements in robotic measurements of smoothness of movements. Functional independence observed. | In future, designing or selecting appropriate robotic devices for rehabilitation; clinical utility and costs of robotic devices are two important factors to consider. integrating new evidence | Variation is study designs (L) Low sample group number(L) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | research directions. | | | and collaboration with viewpoints from multiple stakeholders in the design of robotic also. More intense study designs, larger sample sizes and homogenous groups should be employed. | |
| **van Hendel (2017)** | 67 children (3.9–19.9 years) with GMFCS levels II–IV | Robot-assisted gait training (RAGT) can complement conventional | observation (retrospective analysis on clinical data | The greatest benefit may be for children with more severe | None given | Methodological limitations Group analyzed was homogenous(L) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (Gross motor functional classical system) | therapies in children with cerebral palsy | | functional capacity | | No control group included (L) Limitations in standards of measurement(L) |
| **Huijnen et al. (2017)** | Professionals, parents of children with ASD and adults with ASD (Autism spectrum Disease) | gain insight into how robots can be practically implemented into current education and therapy interventions for children with autism spectrum disorder (ASD) | Qualitative (Focus group and co-creation sessions | Different requirements by different users are hoped for. Not all will benefit from having Kasper a robot as the center tool of attraction | Intervention templet was created to describe robot mediated objectives and robot rules | S) Good for therapy and education. L) while the study was for benefit of children, the study was not able to incorporate the actual children due to laws and ethics. |

## 5.4 Quality Appraisal

All systematic reviews must undergo a process of critical assessment of the evidence. This is done so as to evaluate the quality and credibility of the study and also determine the extent to which this study has addressed the possibility of partiality in its design, analysis and compiling of the data. According to the Joanna Briggs Institute (JBI) critical appraisal checklist for systematic review, papers selected for inclusion in the systematic review need to be subjected to meticulous appraisal by at least two critical appraisers.

The table 5 below provides a checklist of 11 questions used in assessment of the study.

Table 5: Critical appraisal checklist.

| Checklist questions | Yes | No | Unclear | Not applicable |
|---|---|---|---|---|
| 1. Is the review question a clearly and explicitly stated question? | ❖ | | | |
| 2. Were the inclusion criteria appropriate for the review question? | ❖ | | | |
| 3. Was the search strategy appropriate? | ❖ | | | |
| 4. Were the sources and resources used to search for studies adequate? | | ❖ | | |
| 5. Were the criteria for appraising studies appropriate? | ❖ | | | |

| | | | | |
|---|---|---|---|---|
| 6. Was critical appraisal conducted by two or more reviewers independently? | | ❖ | | |
| 7. Were there methods to minimize errors in data extraction? | ❖ | | | |
| 8. Were the methods used to combine studies appropriate? | ❖ | | | |
| 9. Was the likelihood of publication bias assessed? | | | ❖ | |
| 10. Were recommendations for policy and/or practice supported by the reported data? | | | | ❖ |
| 11. Were the specific directives for new research appropriate? | | | | ❖ |
| Total evaluation performance | 5/11 | 2/11 | 1/11 | 3/11 |

The JBI appraisal checklist by (Aromataris, E. et al. (2015)

The inclusion criteria were specific, clearly outlining the inclusion and exclusion criteria that this was critical for the study data. The research aims and questions were appropriate, and the study was able to gather data sufficient for the study. The search strategy was appropriate a plan for selection of material from the data base of the university. The sources were not sufficient for a topic this relevant. Information was readily avoided yet to remain specific, limits had to be placed for places of data search.

The appraisal method was appropriate because through it, further review and feedback enables improvement on the pitfalls so as to attain more credible evidence based on the results. This is especially important because in this study the assessment did not include a second assessor as is ascribed by the JBI guide.

In the study, the material selected seem to highlight positive aspects of robotic concept without critically diving into the hurdles and challenges that may arise. Also, the representation was mainly the developed nations and statistical data from the global south for example seemed not so as readily available this therefore represented some bias in publication.

The method used to compile the data for study was systematic and thus minimizing the possibility of error in data collection. The study reported a lot of advancement and development in the field of robotics and also room further studies was allowed just as has been recommended in almost all the selected articles. Conclusively, the material selected for the study was suitable for the research questions raised for study.

## 5.5 Analysis

SWOT stands for strength, weaknesses, opportunity and threats, it has been around for centuries as a tool especially in planning and development. It is valuable because it is easy to understand and can be applied in various levels and is easy to communicate the findings. It has disadvantages too and some of these are that it uses generalized and often biased data making it easy to ignore underlying principles (Sarby,2016).

The analysis to determine the SWOT in this study was conducted thematically. This means that each group selected for studies was analyzed using the articles selected for each study. The reason for the SWOT analysis to be conducted thematically was to enable specific development possibilities. Various strengths reported in the study appeared similar across the board in all the theme groups of study.

The analysis depicted the rapid spread of the uses of robotics as a strength, greater investment needs to be placed in trying to develop and improve the already existing devices. Research is needed to optimize the use of these assistive robots in social care.

Weaknesses give opportunities to develop, one such is the social poverty that may arise from full use of robots. This means that there is an opportunity to further develop these devices so that with the assistance and support provided, there is room for human socialization.

The results of the analysis were recorded in the table 6 below.

TABLE 6 : SWOT analysis of the themes of study

| Themes | Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|---|
| **Elderly** | Social inclusion and participation.<br><br>Allows for accurate monitoring and assessment of clients | Human contact deprivation.<br><br>Small size sample for the study | Development of specific technologies<br><br>Further studies that will improve the products | Challenging for users with other complications<br><br>Ethical issues |

| | | | | |
|---|---|---|---|---|
| **Children** | Improvement in communication | Difficult to report the opinions of children directly.<br><br>More data is required for conclusive reports. | Innovations for combined programs that support children´s development. | Variation in standards of assessment |
| **Persons with disabilities** | Alongside other therapy, positive results were recorded | there were no control tests thus difficult to measure outcome | To develop more advanced and personalized devices | Literacy or knowledge accessibility for all is limited |

The strengths are seen as social inclusion is made possible in various instances. This is due to the improvement in social behavior and also the continuous interactions. There is a need for finding a balance between the resources available and human contact deprivation. The reports also indicate that the sample groups could be larger to increase the information credibility. The possibilities to further study and develop these products in an opportunity to further customize these robots and also increase in knowledge of manufacturing and assembling this product.

# 6 Discussion

The study aimed at answering the various perceptions brought about by the introduction of robotics to social care and the challenges of the same with specific reference to the children elderly and persons with disabilities. Perceptions of robotics were overall positive in these studies, in the case of Sophie and Jack the social robots used in improvement of the social capacities of elderly persons particularly those suffering from dementia, studies indicated that positive interactions were encouraged between the old people and also towards the caregivers. This was because of unique human-like communication features built into these social robots that provide social functions alongside the services delivered to the elderly (Chu et al., 2016.).

In the case of children and robotics, with emphasis on children with autism spectrum disorder studies indicated that there were various perceptions. Concerns were raised regarding the physical out-look. Matters concerning the outward appearances had effect on the reception of the robot among the children. It was also stated that for maximum function training for use of robots was suggested for professional readiness (Huijnen et al., 2017). Other positive attributes associated with robots were ability to maintain prolonged attention span in children , an attribute that contributed to the positive perceptions built about robotics and in this case in use for children.(Costa et al. ,2013); They were also said to assist in bringing out in social interaction and mediating skills (Robins et al., 2009); and in attainment of skills in physical interaction (Costa et al., 2015) these were some of the factors according to one article that augmented the use of social robots among children.

In an article by Moyle et al. on perceptions of the caregivers of elderly in care home involving animal like robot PARO, that caregivers reported that they observed that their clients preferred animal like robots for companionship in comparison to an alternative offered of a stuffed animal Plush. When presented a robot was that was toy like or another form of animal that did not seem to show life, the response was not as positive, they felt that it was childish. These services

of animal like pet robots were also seen to have no social benefits in that they did not promote or encourage interaction, however these social robots provided company to the less likely to mingle and otherwise withdrawn individuals (Moyle et al., 2018).

The caregivers further stated that, the clients were able to feel loved and received companionship to wade off loneliness. The cost of these robots was in the use of robots for rehabilitative purposes as is in disability, cost of device and clinical utility are important consideration factors (Zariffa et al., 2012). Another aspect mentioned was also the challenge in acquisition and use of robots and an associated this with a financial implication (Moyle et al., 2017.). This was the most prominent challenge mentioned in relation to adaptation and active use of assistive or social robots.

People with disabilities require different services and support than everyone else. Personalization of robots will allow for maximum potential of various needs to be met even using similar assistive devices. (Rabbitt et al., 2015).

In assistive robots such as in the case of rehabilitation, it was reported that due to the specialism of operating them, it would be of great benefit have some formal training and also it was reported that a combined approach yields best results, that is assistive robots and conventional therapy. (Singh et al., 2018). In the case of use of assistive robot to improve the gait in children, the research also indicates that there is use of multidisciplinary rehabilitation program in that alongside robot assistive therapy, conventional physiotherapy is useful for care and support (Van Hedel et al., 2016). Also, In the report about use of robot assistance in upper extremity rehabilitation, the study reported that it was feasible in terms of safety and tolerance (Singh et al., 2017) reiterating the positive attitude of the use and application of robots.

An important point noted was that there is no single solution for all, and thus tailoring of robot-assisted interventions was strongly recommended. Another strong opinion was that the success of robot intervention is dependent factors

such as the end users' needs, physical presentation of the robots, and length and intensity of the interventions (Hujinen et al., 2017). Positive instances such as in the case of assistive gait trainer, it was noted that the length of intervention plays a role in the reception of robots (van Hedel et al., 2017). Placing the end user at the center of the designing of technology will prove cost effective and also produce more user friendly assistive and social devices. (Norman, 1986).

World health organization stated that if the barriers that hinder people with disabilities from performing optimally in their daily lives are addressed, social participation can be improved. Assistive technologies are essential tools that encourage independence and improve participation (WHO 2011). That said, social robots and assistive robots are essential for integration and participation especially in in-stances that call for extra support in the everyday dealings in various facets of life.

## 6.1 Challenges and Limitations of the Study

The challenges mentioned in the study were that sample groups were not diverse enough to provide non-biased evidence-based results, most of the articles indicated that the evidence may have been more credible if there was a control group (Van Hedel et al., 2017; Chu et al., 2017). Larger groups of study that are more homogenous in nature would have been employed would have also give a more dependent result other sources said (Singh et al., 2018; van Hedel et al., 2017).

Another limitation mentioned was that sample sizes were small and because they lacked control groups, conclusions could not be drawn about effective-ness meaning there was generalizability of the review results (Singh et al., 2018).

Time constraint was mention also, in the case of the study with PARO as social robot for the elderly, the writers mentioned that the time allocated per focus group study was always limited and not long enough to have further investigations carried out or verification of the results. This meant that that study strongly relied on the caregiver's opinions as opposed to the actual opinions of the clients or end

users, a fact that might have affected the biasness in the study (Moyle et al., 2018).

The study also encountered technical challenges, conducting the data search was very challenging due to the vast availability of material in this subject matter. The key words selected brought forth a lot of possible articles and narrowing to have fair number yet a fair representation of the articles to study was challenging. Another challenge was the terminologies used, some articles were challenging to analyze due to the technical terms used for measuring and determining user end result.

The amount of time taken to conduct this study was lengthy and this may have affected the outcome of the study. Some of the materials available changed in availability and content.

Having limited the study to English the language of study also ruled out the possibility of very useful material that may have been in other languages considering that technology as we know is more developed in other nations such as Japan and even some European nations. The relevance of the material may be subjective and this means that the result reported is only and strictly limited to the materials that were selected studied and analyzed as per the inclusive systemized methodology.

## 6.2 Ethical Aspects

Finnish National Board on research integrity here in Finland has set guidelines on the requirements and standard of research conducted in this country. It must be reported therefore that the study was conducted from a neutral point by the author. There was no previous knowledge of the articles the selection was based on the key words selected for the study only hence there was no conflict of interest.

Whereas more material may have further augmented the study outcome, the material used was sufficient and contained the information sort after by the research

questions. The inclusion methodology used in the selection of study material allowed for the subject of study topic to be fully explored, the themes were represented in the articles and it was possible to make reasonable observations which assisted in the study findings and conclusion.

The study had no direct dealings with any person nor was handling personal data necessary thus no special permit was needed to carry out the study as would be the case if the data collection was directly from clients (Finnish national board of research integrity).

The study was conducted independently purely for learning purposes and did not received funding from any organization.

## 6.3 Conclusions

This study draws heavily upon the fact that the perceptions expressed seemed positive with a willingness be a part of the revolution and development in this area of robotics. To enhance the development of robotic knowledge, educating and training for a deeper understanding would be highly recommended. Also, simplifying the operating systems of some of these appliances can be vital in embracing the uses of these assistive and social devices.

The effectiveness and proper uses of robots depends on the training of the staff and care givers that offer support and care in social care. It was also seen that if properly designed, the robots are able to improve on the efficiency of the tasks at hand. Robots are motivational, the studies show these assistive devices encouraging a healthy lifestyle by regular reminders for meals and medicine, other functions such as drinking water and taking medicines.

Discussions on the ethical implications of use of robotics in social care seem to be open to further discussion in instances such as robots challenge the independence and social responsibility of human aspects for example. In each assistive

robotic intervention, there is promotion of dependence on the device, while achieving independence in the daily life tasks is achieved. Additionally, the social poverty that robot deployment brings about. In the quest to meet an immediate need, a new problem might be introduced, and measures should be put in place to address these matters.

Finally, matters concerning the costs of the robots, costs incurred in training and preparing caregivers and end users for the usage of robotics remains a challenge, in the uses and adaptation of this new way of living. The benefits must outweigh the costs, perhaps the initial costs incurred may lead to worthwhile results. This means that a sense of inequality will be created because not all will have access to this new way of life alike. Challenges will not seize to exist, but with them rises the possibility for major improvements, especially in the future. Social care portrays a readiness to embrace robotics as a concept. It has not been viewed in any way as a threat despite the blind spots in may present.

Significant changes are bound to occur in the social care field with this new era of technology. It is important to prepare adequately and this call for further studies in this field of robotics in social care. It will be in the best interest for all if these devices will improve the quality of livelihood as proposed without robbing humanity of their sense of well-being.

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