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The Impact of Developing Technology on the Art of Nursing[1]

Gelişen Teknolojinin Hemşirelik Sanatı Üzerine Etkisi

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ABSTRACT

The art of nursing is based on empirical and metaphysical knowledge and the use of creativity in uncertain situations. Empirical knowledge obtained from evidence-based research contributes to the development of nursing science, while metaphysical knowledge influences and guides care processes through individual experiences and insights. The rapid advancement of technology has made it necessary to integrate these innovations into nursing practices. Nursing technology improves patient care, reduces workload, increases patient safety, and strengthens nurse-patient collaboration. However, the integration of technology into care processes brings new debates, such as ethical issues and uncertainties in some clinical applications. This review discusses the impact of developing technology on the art of nursing and innovative technologies used in current care practices. As a result, it is of great importance for nurses to closely follow technology and improve the quality of care by integrating their knowledge and skills with technological development. By strengthening clinical and academic collaborations, nursing students and clinician nurses should be provided access to current technological developments using a multidisciplinary approach, thus increasing their knowledge and skill levels.

Keywords: Art; nursing; technology.

ÖZ

Hemşirelik sanatı, ampirik ve metafizik bilgi ile belirsizlik durumlarında yaratıcılığın kullanımına dayanmaktadır. Kanıta dayalı araştırmalardan elde edilen ampirik bilgi, hemşirelik biliminin gelişimine katkı sağlarken; metafizik bilgi, bireysel deneyimler ve içgörüler yoluyla bakım süreçlerini etkilemekte ve yönlendirmektedir. Günümüzde teknolojinin hızla ilerlemesi, bu yeniliklerin hemşirelik uygulamalarına entegre edilmesini bir gereklilik haline getirmektedir. Hemşirelik teknolojisi, hasta bakımını iyileştirmek, iş yükünü azaltmak, hasta güvenliğini artırmak ve hemşire-hasta iş birliğini güçlendirmek amacıyla kullanılmaktadır. Ancak, teknolojinin bakım süreçlerine entegrasyonu, etik sorunlar ve bazı klinik uygulamalarda belirsizlikler gibi yeni tartışmaları da beraberinde getirmektedir. Bu derlemede, gelişen teknolojinin hemşirelik sanatına etkisi ve güncel bakım uygulamalarında kullanılan yenilikçi teknolojiler ele alınmaktadır. Sonuç olarak, hemşirelerin teknolojiyi yakından takip etmesi, bilgi ve becerilerini teknolojik gelişmelerle entegre ederek bakım kalitesini artırması büyük önem taşımaktadır. Klinik ve akademik iş birlikleri güçlendirilerek, hemşirelik öğrencileri ve klinisyen hemşirelerin multidisipliner yaklaşımla güncel teknolojik gelişmelere erişimi sağlanmalı, böylece bilgi ve beceri düzeyleri artırılmalıdır.

Anahtar Kelimeler: Hemşirelik; sanat; teknoloji.

Introduction

Nursing is recognised as the best example of the coexistence of technology and the art of care (Locsin, 2017). The nursing population comprised three generations with an average age of 51 years. The oldest generation of today's nurses consists of the baby boom generation, born between 1946 and 1964, a period defined by the dawn of automated systems (1946) and the beginning of artificial intelligence (McCarthy, Minsky, Rochester, & Shannon, 2006; Watson, Womack, & Papadakos, 2020). Nursing care services, which have a significant role in healthcare services, are realised under the influence of intensive information flow and technology, such as all healthcare services (Aytur & Kantek, 2020; Lusmilasari et al., 2020).Nurses are involved in many areas, such as protecting and promoting health, treating diseases, providing rehabilitation services, and providing training. The success of nursing care services is associated not only with nursing care practices but also with the ability to apply modern technology that helps the nursing profession to advance through continuous learning and improvement (Aytur & Kantek, 2020; Eastwood et al., 2008). Nurses are at the forefront of integrating technology with human elements in the health system (Aytur & Kantek, 2020).

A literature review revealed numerous articles on nursing science and technology; however, the limited number of studies focusing on the integration of nursing art and technology highlighted the need for this review (Aytur & Kantek, 2020; Bayuo, 2024; Bayuo, Abu-Odah, Su, & Aziato, 2023; Çoban, Eryiğit, Dülcek, Beydağ, & Ortabağ, 2022; Locsin, 2017)

A Historical Perspective of Nursing Art

The nature of nursing as both an art and science is a generally accepted definition of the profession. Nursing care practices are shaped by evidence-based care and research methods(Aytur & Kantek, 2020; Bayuo, 2024; Bayuo et al., 2023). Nursing science serves as the foundation of the profession by providing evidence-based knowledge and structured methodologies, while its artistic aspect remains open to interpretation because of its subjective nature. Although nursing art cannot be easily defined or measured, it is intrinsically linked to scientific principles. As nursing science and art reinforce each other dynamically and exist in interdependent relationships, it is impossible to discuss them without acknowledging others (Watson et al., 2020). Nurses have attempted to define the art of nursing since Florence Nightingale (1854-1946). In the past, it was suggested that nursing was a fine art. It was then defined as craft (Edwards, 1998). As nursing science and art reinforce each other dynamically and exist in interdependent relationships, it is impossible to discuss them without acknowledging others (Austgard, 2006; Edwards, 1998). Despite all these efforts, the concept of the art of nursing remains unclear. The need for a more precise conceptualisation of the art of nursing to guide nursing practice and research is evident(Finfgeld-Connett, 2008). The art of nursing is based on the use of empirical and metaphysical knowledge and values in meeting the care needs of individuals, sensitive adaptation of care in meeting the individual needs of patients, and the use of creativity in situations of uncertainty. Empirical knowledge consists of various studies and evidence-based practices and is called nursing science. It also serves as a cognitive guide for nursing care. As Lindeman states, 'without the guidance of science, the art of nursing would be blind and helpless, even dangerous' (Lindeman, 1999). Metaphysical knowledge guides care practices through unique experiences, innate senses, and acquired insights (Finfgeld-Connett, 2008). This type of knowledge depends on 'our ability to process unconscious information, extracting data from various sources, reprocessing and acting on the results'(Greenslade, 1991). Metaphysical knowledge is the intelligent awareness of things that are not always visible, audible, or tangible and is often thought to be intuitive (Murray, 1994).

Barbara Carper is one of the theories that most often refers to the art of nursing. According to this theory, art is creative mould nurses use to recognise and perceive to guide their care. According to Carper, aesthetic (innate) knowledge is gathered through various methods of humanistic enquiry (empathy, personal, and ethical) that nurses use to continuously shape the care process (Carper, 1978; Watson et al., 2020). Based on these definitions, Bender and Holmes defined the nature of nursing as a logical process and way of thinking in an effort to combine art and nursing science. According to Carper, aesthetic (innate) knowledge is gathered through various methods of humanistic enquiry (empathy, personal, and ethical) that nurses use to continuously shape the care process (Bender & Holmes, 2019; Watson et al., 2020). The nursing process is humanistic, based on emotional intelligence, and is the embodiment of human care. The inability to fully define nursing or remove its humanistic aspects implies that AI cannot fully replace it (Watson et al., 2020).

Historically, nurses and nursing have dynamically redefined their roles in the healthcare system, from an apprenticeship model at the bedside to its own science and advanced practice (Watson et al., 2020). As the relationship between science and the art of nursing continues, the meta-paradigms of nursing have begun to be discussed. Meta paradigms refer to statements or groups of statements that describe the relevant phenomena of a profession. These central themes and unifying concepts underpin the profession (Bayuo, 2024; Fawcett, 1984). Four basic meta-paradigms of interest in nursing are mentioned: person, health, environment, and nursing (Bayuo, 2024; Fawcett, 1984). Walker (1971) limited nursing to four subsets: (1) people providing care, (2) people with health problems and people receiving care, (3) the environment in which care is provided, and (4) the end state of welfare. Bender (2018) argued that nursing science cannot remain dynamic if meta-paradigms depend solely on these concepts (Walker, 1971). Fawcet (1996) stated that the conceptualisation of the four paradigm areas of nursing should not be seen as 'an early closure in explaining the phenomena of interest to the nursing discipline' and predicted that there might be newer areas(Fawcett, 1984). Following this information, Johnson and Carrington (2023) argued that technology could be considered the 'fifth domain of the nursing meta-paradigm' with the fact that 'machines are intertwined in daily human life' (Johnson & Carrington, 2023). In the context of this information, technology is indeed a fundamental part of all the interventions we perform as nurses.

Historical Perspective of Nursing Technology

The central role and continuous use of technology in nursing should always be considered. Existing and recent studies suggest that technology should be considered a fundamental concern that will enable nurses to influence further development. Barnard (2002) states that intertwining nurses with technology may lead to new epistemological, ontological, and ethical issues that need to be considered (Barnard, 2002). However, recent studies have argued that the onto-epistemology of technology is unique and requires further study (Bayuo, 2024; Johnson & Carrington, 2023). Locsin's (2016) 'Theory of Technological Competence as Care in Nursing' illuminates the coexistence of care

and technology as the essence of technology in health care, where machine technologies are grounded as a general concept of mechanical organic and electronic objects or things (Locsin, 2017). It was also argued that the technologies used in health practices offer a way of understanding people through 'health and human care' technologies and offer nurses another way of getting to know people. At this point, it was stated that the person's understanding is supported through the 'realities of the data obtained from technology and that the competent use of technology shapes people's purposeful understanding (Locsin, 2017). Bayuo et al. (2023) concluded that 'the essence of technology is a unique way of knowing, discovering, and revealing the truth or reality of the world' (Bayuo et al., 2023). These claims offer unique insights into positioning technology as a key phenomenon of interest in nursing (Bayuo, 2024).

Advances in technology reflect a desire to influence the world around us. Technology has emerged as a critical component of being in the world, with technological objects permeating every aspect of our lives(Bayuo et al., 2023). These advances in nursing and health services continue to be an existing, progressing, and rapidly developing phenomenon that affects how we approach patient care. At this point, the roles and responsibilities of nurses are greater than ever, making it essential for them to examine techno-onto-epistemology in relation to the nursing profession. (Bayuo, 2024). This is a critical point, given that the intersection of nursing and technology is an ongoing area of debate that requires further philosophical reflection (Bayuo, 2024).

While many analyses and comments have been made about the use of technology in nursing care and practice, it is seen that technology is also frequently used in other areas of nursing. Nursing is no stranger to these and other unprecedented changes, with the increasing use of technological objects in clinical practice, population/public health, education, and research. Applications with technological infrastructure, such as wearable devices, e-health, m-health applications, robotic devices, and digital platforms, such as virtual and augmented reality, are routinely used in all areas to facilitate nursing care delivery (Bayuo, 2024; Doorenbos et al., 2020; Lin & Lou, 2021). The latest technology products, such as virtual and augmented reality applications, are included in nursing education(Bayuo, 2024; Bayuo et al., 2023; Vargo, Zhu, Benwell, & Yan, 2021).

As seen in these examples, technology is at the centre of the art of nursing care, and its impact cannot be adequately explained. Indeed, the relationship between technology and nursing is potentially close and inextricable and is part of every practice nurses undertake, and their work is intertwined with it (Johnson & Carrington, 2023; Von Gerich et al., 2022).

Technology in Care Practices

The most fundamental role of nurses in computer technology is to reflect on the relationship between nursing and technology in the care environment. With the equipment and devices used, technology is always at the centre of nursing practice. In addition, technology is recognised as a sine qua non for the art of nursing care(Archibald & Barnard, 2018; Locsin, 2017; Monteiro, 2016). The areas of use of technology in nursing can be classified as tools and devices that complement people (prosthetic devices for missing body parts or non-functional ones), facilitate care, and imitate people (robots)(Locsin, 2017). Generally, it is recognised as a phenomenon encompassing the knowledge and skills associated with machines, tools, or applications that facilitate patient care (Doorenbos et al., 2020; Locsin, 2017; Ohneberg et al., 2023). In this context, information technologies, wearable devices, monitoring devices, use of extracorporeal machines, electronic recording systems, robotic technologies, virtual and augmented reality applications, machine learning, simulations, artificial intelligence, and big data analytics support the development of professional roles of nurses and nursing students in providing care and promoting health in health care settings (Bayuo, 2024; Bayuo et al., 2023).

Extracorporeal machines, machine learning, and artificial intelligence can be programmed to maintain body functions and prevent death (Bayuo et al., 2023). The simulation laboratories used in nursing education mimic real-life conditions using innovative video-based approaches, augmented reality, and virtual reality (Bayuo et al., 2023; Wong et al., 2023). The meta-universe is used to train nurses or treat and rehabilitate patients in a virtual environment through technology (Bayuo et al., 2023). In addition to the meta-universe, Internet-based resources and mobile health applications are essential, especially for the elderly and paralysed patients (Çoban et al., 2022; Wong, Bayuo, et al., 2022; Wong et al., 2023). Robots play an active role in facilitating healthcare delivery. Instead of aiming for full automation and nurse replacement, collaborative or 'cobot' robots are designed to assist nurses in care delivery(Babalola et al., 2024). Although the first use of robots in the healthcare sector was in surgical applications in the 1980s, they cover a wide range of applications, such as disinfection, prescription drug delivery, physical therapy assistance, emotional support, and social companionship (Babalola et al., 2024). For example, Robot Cody is used for bathing, dressing, and rehabilitating bedridden patients; Robot Robear assists with lifting and transferring patients; and Pepper Robot facilitates hospital orientation with its ability to speak 20 languages. Robot Nao and SAM are among the first that come to mind for the treatment and care of vulnerable groups, including children and the elderly, as well as for rehabilitation, motivational support, and patient visits. Additionally, IV Robots RIVA play a crucial role in ensuring patient safety by preparing IV drugs and perfusions at the correct dosage(Çoban et al., 2022).

Examples of uniquely designed cobots include the 'Lio' personal assistant for routine functions such as blood sample collection and mail delivery, the 'Carver-Cap' cobot trolley for logistics, the 'ARNA (adaptive robotic nursing assistant)' platform for nurses to bring objects and take patients' temperature, and "ISOLDE," a multi-modal interactive mobile cobot for thermal measurement and delivery of medicines and objects (Babalola et al., 2024; Lundberg, Sevil, Behan, & Popa, 2022; Miseikis et al., 2020; Thamrongaphichartkul, Worrasittichai, Prayongrak, & Vongbunyong, 2020).

Furthermore, the Terapio robot was developed for medical and nursing visits to process information and patient data. The robot accompanies nurses during transitions and tours and allows patient data input and progress monitoring (Ohneberg et al., 2023; Song et al., 2017). Robot Ed and iRobot were designed to assist with activities of daily living by providing audiovisual instructions on how to perform certain activities (Buhtz et al., 2018; Zhang et al., 2021). The i-Merck Robotic System is available for catering and is responsible for the delivery of specialised dietary food after the dietician has checked in. In addition, Care-o-Bot 4, which is used for long-term care of inpatients, offers small snacks and drinks (Graf, 2019). Robot TUG, which is used in drug distribution services, delivers drugs defined by the pharmacist to the clinic. The WDBOT robotic system supports all medication systems; medicines are ordered by the healthcare staff, and the robot collects

the medications and takes part in the distribution with the nurse. The nurse then checks and approves the medicines on a tablet (Ohneberg et al., 2023). (Table 1).

The CASERO robot delivers items other than food and beverages. The robot, which is a smart care trolley, can be guided via a smartphone and is responsible for delivering wound-care materials or laundry to the destination. It carries clean laundry to the station and launches it dirty. This robot aims to reduce nurses' workload by reducing their walking distance (Graf et al., 2013). The function of robots used in monitoring, security, and navigation is to monitor and document vital signs. For example, the IVO & Tommy robot fulfils the task of reading vital signs in the patient's room via an integrated camera, while the robot named Silbot is designed for daily recording of general and mental status and medication reminders (Antony et al., 2020; Bartosiak et al., 2022). The ARNA Robot supports patient safety by assisting with walking, while Kompaii and RAMCIP robots assist individuals with information and communication functions (Gerłowska et al., 2018). We have seen new technologically based products in different fields. For example, Marvin, which was developed in line with the needs of the growing and aging population, is a new assistive robotic platform tasked with providing basic home assistance. The tasks are defined as user monitoring, night assistance, remote support, and connectivity. Robotic products, such as Nao, Aibo, and Paro, have been designed for dementia, loneliness, and aging. The SMOOTH Robot is configured as a modular assistant for healthcare services and performs laundry, garbage transport, water distribution, and guidance tasks (Table 1: Robots and Missions) (Eirale et al., 2022).

Table 1: Robots and Features

Robots	Features of Robots
Robot Cody	Bathing bedridden patients and dressing their clothes Rehabilitation of stroke patients
Robot Robear	Lifting and transferring patients
Pepper Robot	Ability to speak in 20 languages to ensure hospital orientation of patients
Robot Nao	Treatment, care and rehabilitation of children and the elderly and providing motivational support
Sam	Visiting patients in their rooms and questioning their condition
Iv Robot Rıva	IV Preparing drugs and perfusions Patient safety
Lio	Blood sample collection
Carver Cap	Moving objects Measuring the temperature of patients
Arna	Thermal measurement
Isolde	Delivery of medicines and objects
Terapio	Medical and nursing visits
Robot Ed and İrobot	Assistance with activities of daily living Providing audiovisual instructions
İ-Merck Robotic System	Food and beverage service
Care-O-Bot 4	Serving small snacks and drinks
Robot TUG	Drug delivery
Casero	Smart care trolley
Ivo & Tommy Robots	Measuring vital signs from the patient room with a camera
Sılbot	Recording daily mental and general state Medication reminders
Arna Robot	Help to walk Patient safety
Kompaii And RAMCIP Robots	Information and communication purposes
Marvin	Providing basic household assistance
Smooth Robot	Laundry washing Garbage transport Water distribution

References: Çoban et al., 2022; Wong et al., 2022; Wong et al., 2023; Babalola et al., 2024.

The effects of technology on the transformation of nursing art

Today, many new diseases and disease trends that affect the health of individuals are emerging. This further complicates the clinical management of patients and increases the need for support to improve the outcomes (Zhao & Wong, 2009). Nursing care interventions and practices are emerging as a new art of care models to improve patient and family outcomes with growing and aging population groups. Now, more than ever, both healthy and sick individuals can use advanced technology to manage their own care, even without a healthcare provider (Wong et al., 2023; Wong, Wong, et al., 2022). In the historical processes of nursing, many authors have argued that nurses can work in harmony with technology and that the art of care, which is the basis of nursing, can be possible in a highly technological environment (Von Gerich et al., 2022; Wong, Bayuo, et al., 2022; Wong et al., 2023). Ray defined this as 'technological care' in 1987 for the first time in history. According to these authors, nursing care interventions provide a reference context that allows technology to interact with patients (Walters, 1995). That is, technology derives its true meaning from nursing practices. In this way, technology is used to extend nursing care to patients (Walters, 1995). The importance and reality of this knowledge have started to find its meaning in today's world, and the relationship between the art of nursing care and technology continues at the highest level.

Technological development has led to significant changes in nursing care. Owing to advanced monitoring systems and wearable devices, patient safety increases, and the risk of complications and errors decreases with real-time monitoring of vital signs (Amin, Mobbs, Mostafa, Sy, & Choy, 2021). Furthermore, digital systems, such as electronic health records (EHR), improve nurses' time management by facilitating documentation, allowing them to focus more on direct patient care (Çetin & Eroğlu, 2020). Technological innovations have also strengthened communication and collaboration. Telehealth applications and mobile platforms enable faster and more accurate information transfer between healthcare teams (Barbosa & Silva, 2017). In addition, simulation-based training and virtual reality (VR) applications contribute to the development of professional skills by supporting nurses to be prepared for complex clinical situations (Plotzky et al., 2021).

However, technology also has a negative effect. Overdependence on technology may negatively affect the holistic quality of care by reducing the interaction between nurses and patients, leading to procrastination behaviour in nurses (El-Sayed, Goda, & Elbialy, 2024).

Further, errors that may occur in automated systems carry the risk of leading to incorrect clinical decisions, which may threaten patient safety (Çetin & Eroğlu, 2020). Complex technological systems increase the workload of nurses, increasing the risk of burnout syndrome and causing cognitive overload (Kremer, Lipprandt, Röhrig, & Breil, 2022). However, the protection of patient data obtained through digital platforms also creates various problems in terms of ethics and privacy and necessitates the security of personal information (Erden, 2022).

Conclusion

Today, rapidly developing technology reshapes the art of nursing and significantly transforms care processes. It has become critical for nurses to improve the quality of patient care by blending scientific knowledge and individual experiences with technology. The opportunities offered by technology have the potential to increase patient safety and the effectiveness of care while reducing the workload of nurses.

Recommendations:

• For nurses to adapt to technology-supported care processes, professional development programs should be established, and training on current technologies should be organised.

• Collaboration between universities and health institutions should be strengthened to provide students and clinician nurses access to the latest technological developments.

• Awareness of the ethical dimensions of technology use should be increased, and guidelines should be prepared for the ethical dilemmas that nurses may encounter in this process.

• Practices that strengthen nurse-patient communication should be encouraged so that technological integration does not overshadow the understanding of human-centred care.

• Technology-oriented research in which nurses actively participate should be supported, and nurses should be encouraged to contribute to innovative solutions developed to improve care processes.

• Nurses' access to current technologies in clinical and academic areas should be increased, and educational programmes should be structured in a way that balances the art of nursing and technology integration.

• Nurses' innovative skills should be enhanced, and they should receive education and support in developing and patenting new products.

In conclusion, it is of great importance for nurses to closely follow technology and improve the quality of care by integrating their knowledge and skills with technological development. The future of the nursing profession will be shaped by the contributions of nurses who adapt to technological innovations, observe ethical values, and maintain a patient-centred approach.

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