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Perspectives

Act Now: A Call to Action for Scholarly Preparation in Mathematics among Nurse Scientists

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"Data science"—an interdisciplinary science encompassing statistics, mathematics, engineering, computer science, informatics, and/or decision science to elicit *evidence-based informed shared decision-making rationales* among parties (O'Connor, 2018; Park, 2018a, 2018b)—has grown by leaps and bounds since 2016 when Google DeepMind's AlphaGo revealed its exceptional performance beyond human capability. Further, "data science" is now evolving bi-exponentially all around the world. The leading Industry-University Collaboration initiatives for Artificial Intelligence (AI)-centered research include the institutions of (1) Google and University of Toronto (the Vector Institute), (2) Google DeepMind and University of Alberta, (3) IBM and Massachusetts Institute of Technology, and (4) Microsoft and University of Montreal and are expected to promote AI's high-speed development (Bushey, 2017), improving the process of scientific discovery and the quality of decision-making given unpredictable conditions and advancing a data-driven economy (Ahalt et al., 2014; Park & Glenn, 2017). Such a consortium heralds that academic, economic, and sociological innovation/transformation would ensue sequentially and concurrently. Dare we dream how far science can go?

The impact of these changes has not yet affected our everyday lives because these technological advances have not yet become an essential part of our lives. However, Virtual Reality (VR) developers are already almost finished constructing a real economy in several VR platforms (Park, 2018c). The AI-driven Autonomous Driving Car (ADC) is also expected to be released in 2020 (Business-Insider, 2016). By extension, Google's Toronto smart city project will initiate its pilot program this summer, begin construction in 2020, and have its first residents by 2022 (Li, 2018). A drastic socio-structural change in our lives is already underway (Park, 2018c).

Each academic discipline is accordingly transitioning to a STEM (Science, Technology, Engineering, and Mathematics)-integrated education policy and reforming the curriculum to meet the demands of the times. Such an attempt mainly focuses on providing students a wide array of methodological expertise and hands-on experience in data science through taking additional courses delivered by STEM-related departments, upon students' request. The course content includes combining large data sets with advanced analytics, e.g., (1) data/text/opinion/reality mining, (2) descriptive statistical analytics such as data visualization, social network analysis and cluster analysis, and (3) predictive analytics such as mathematical modeling, forecasting, simulation, machine learning, and so on (O'Connor, 2018).

However, we must face an inconvenient truth about students' preparation in statistics and mathematics, the foundational subjects of data science. Above all, before teaching students computer programming with Python or R, we first need to figure out *WHAT* the students want to mine from the flood of data. We also need to proactively identify whether the students understand *HOW* to explore their intellectual curiosity. That is, a well-established pre-knowledge about the primary specialization encompassing statistics and/or mathematics is required. For example, a decision science expert whose primary major is not nursing science has inherent limits performing data analyses appropriately reflecting the nature and value of nursing care. His/her evidence may be ineffective or even dangerous to nursing practice. No matter how perfect its scientific integrity is, knowledge without a foundation in the primary science may result in invalid policy-making in nursing practice (Park, 2018b), consequently threatening patient safety.

Data science requires a totally different way of thinking and working from traditional, fixed framework-oriented, statistics-based nursing science (O'Connor, 2018; Park, 2018b), indicating that creativity and originality are highly valued in the new era of science. However, most undergraduate and even graduate nursing programs do not currently have an educational system synthesizing mathematics and computer programming such as Python or R, even though statistics is relatively well-integrated in curriculums. First, a lack of competent educators in both nursing

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science and data science is an urgent issue. However, insufficiency of scholarly preparation in mathematics among current nurse scientists is more urgent (Park, 2017), setting back the advancement of nursing science and going against the trend.

An enormous challenge lies ahead due to the demanding nature of mathematics, with its long, high-intensity training and the wide gap between/among the viewpoints of academic disciplines—i.e., the humanities/social sciences and STEM. However, we should no longer avoid such a challenge. We nurses have an obligation to keep on doing our best to satisfy the ever-changing and complex needs of our patients in order to protect them from potential harm as well as enhance patients' well-being.

***Keywords**: data Science, STEM, artificial Intelligence, mathematics, scholarly preparation*

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