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ARTIFICIAL INTELLIGENCE (AI) ENHANCED NEXUS LEARNING APPROACH AS AN EXAMPLE OF STUDENT-CENTERED LEARNING

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Abstract

This paper reports on student-centered learning, dubbed Nexus Learning. It covers pedagogy related to academia-industry collaborations in the development of product opportunities while utilizing Artificial Intelligence (AI) capabilities. It focuses on putting students in an industry project situation where their combined contribution is required to achieve the final goal. Thus, it aims to develop clear sense of the requirements of a graduate for the future workplace. This teaching approach requires students to construct knowledge by engaging collaboratively with industry partners, and has proved more effective than traditional didactic approaches in developing innovative thinking, knowledge creation capacity, and professional skills. It meets the emerging needs of industry to develop managers, designers, and engineers into more accomplished practitioners in the global economy. With Nexus Learning, students learn by designing and constructing actual solutions to real-life problems. In this paper optimization of the food system distribution in Pottstown, Commonwealth of Pennsylvania in the United States, is considered. It has been noted in literature that effective project learning has five key characteristics: Project outcomes are tied to curriculum and learning goals; Driving questions and problems lead students to the central concepts or principles of the topic or subject area; Learners' investigations and research involve enquiry and knowledge building; Learners are responsible for designing and managing much of their learning; and Projects are based on authentic real-world problems proposed by industry partners that students care about. Industry sponsored projects are ideal instructional approaches for meeting the objectives of Nexus Learning, because they employ the 4Cs Principle – critical thinking, communication, collaboration and creativity with learning structured in real world contexts. Researching across subject boundaries, managing different parts of the projects, critiquing each other's work, and creating a professional, quality product opportunities, helps develop real-world problem-solving skills. In addition, motivating learners to utilize the power of Artificial Intelligence, manage their own time and efforts, and present and defend their work, equips them with valuable skills for their workplace.

Keywords: *Higher education, artificial nexus learning, student-centered learning, industry sponsored student projects.*

1. Changes in educational theory and learning

Historically, Thomas Jefferson University (TJU) was an academic medical center with a campus in the center of Philadelphia that has a long history rooted in the graduate health sciences. Philadelphia University was on the city's outer edge has a long history rooted undergraduate education, particularly design, engineering, and business. In 2017 these two universities merged and are now known as Thomas Jefferson University. The East Falls campus, formerly Philadelphia University, has a long history of applied research and had experienced success with a signature pedagogy known as Nexus Learning. Nexus Learning actively engages all learners in a collaborative approach to solving real-world problems and uses a humanistic approach to designing effective solutions (Frisby and Sztandera, 2020).

Educational theories of learning have changed as well. Professors encourage group learning activities following constructivist models. Students work in teams to solve real world problems. Thomas Jefferson University has captured these components and integrated them into Nexus Learning "with a little help of your friend" Artificial Intelligence.

2. Nexus learning

Active and engaged learning, along with collaborative inquiry, with the use of real-world problems and experiences, supported by the strong integration of the liberal arts and sciences with professional disciplines, has defined Nexus Learning. As reported before by Mathews and Soistmann (2016) as well as Frisby and Sztandera (2020), campus learning spaces, including libraries and team meeting places, had to be re-designed to represent innovative rethinking of the classroom space that allowed the learning facilitator to be less encumbered by the physical constraints of space, furniture and technology. Those spaces ultimately enhanced student learning and creative teaching. For example, Nexus Learning classrooms allowed for seamless transitions to different modes of active and engaged learning. The knowledge hubs also optimized collaborative involvement for all students through movable furniture and appropriate technologies that fosters co-creation and sharing of ideas. Our students self-reported significant gains in class participation, ability to focus, Professor feedback opportunities, learning through multiple means, physical movement, stimulation, and comfort level in Nexus Learning classrooms compared to traditional classrooms on campus.

3. Artificial intelligence focus

Following the success of the Nexus Learning classroom we believed it was time to reinforce the use of Artificial Intelligence software across the undergraduate and graduate curricula. We have utilized IBM® Business Analytics Enterprise software that provides a single entry no-code content hub to discover, personalize and recommend business analytics content. It is an analytics platform that combines predictive analytics, reporting, data analytics and data integration capabilities natively out-of-the-box to help students navigate real data industry challenges.

In addition, AI Trilogy package has been utilized to provide students with actionable recommendations based on the data. It provides an analysis of independent variables (inputs) to help determine which ones are most important in the models. In our case, in research supported by Smart and Health Cities grant, the power of Artificial Intelligence approaches as related to increasing the capacity of the Pottstown Area Food System, has been utilized to increase connections between producers and markets by completing a food supply chain analysis. This analysis will identify changes needed to the Pottstown Food system to increase affordable, healthy food access for those living in the 6 census tracts. It will also help to corroborate the food chain supply analysis model by utilizing a research protocol developed in the Jeff Smart Seed grant. In terms of Artificial Intelligence, development of models to discover and prioritize data patterns to provide information and actionable knowledge stakeholders as well as public health policy decision makers will be explored. Artificial Intelligence is used: 1. To explore data to find new patterns and relationships (data mining); 2. To evaluate and test previous decisions (randomized controlled experiments, multivariate testing); 3. To explain why a certain outcome happened (statistical analysis, descriptive analysis); and 4. To venture into the future (forecast) results (predictive modeling, predictive analytics). All four research avenues capture very well the significance and impact of Artificial Intelligence to discover hidden and actionable outcomes. These packages listed below are part of the AI Trilogy business and scientific artificial intelligence software.

3.1. NeuroShell Predictor

The NeuroShell Predictor contains state-of-the-art algorithms that train extremely fast, enabling you to effectively solve prediction, forecasting, and estimation problems in a minimum amount of time without going through the tedious process of tweaking neural network parameters. Designed to be extremely easy to use, this product contains our most powerful neural networks, it reads and writes text files for compatibility with many other programs. The prediction algorithms are the crowning achievement of several years of research. Gone are the days of dozens of parameters that must be artistically set to create a good model without over-fitting. Gone are the days of hiring a neural network expert or a statistician to build your predictive models.

The two training models available to the students are:

1. The first training method, which is called the "neural method" is based on an algorithm called Turboprop2, a variant of the famous Cascade Correlation algorithm invented at Carnegie Mellon University by Fahlman and Lebiere (1990), TurboProp2 dynamically grows hidden neurons and trains very fast. TurboProp2 models are built (trained) in a matter of seconds compared to hours for older Neural Networks.
2. The second method, the "genetic training method", is a genetic algorithm variation of the General regression neural network (GRNN) invented by Specht (1991). It trains everything in an out-of-sample mode; it is essentially doing a "one-hold-out" technique, also called "jackknife" or

"cross validation". If you train using this method, you are essentially looking at the training set out-of-sample. This method is therefore extremely effective when you do not have many patterns on which to train. The genetic training method takes longer to train as more patterns are added to the training set.

Both training methods provide an analysis of independent variables (inputs) to help users determine which ones are most important in their model.

3.2. NeuroShell Classifier

The NeuroShell Classifier was crafted from the beginning to help optimization of classification and decision-making problems. NeuroShell Classifier can detect categories in new data based upon the categories it learned from case histories. Outputs are categories such as {cancer, benign}, {buy, sell, hold}, {acidic, neutral, alkaline}, {highly qualified, qualified, unqualified}, {winner, loser}, {product 1, product 2, …, product N}, {decision 1, decision2, …, decision N}. Like the NeuroShell Predictor, it has the latest proprietary neural and genetic classifiers with no parameters to set. It reads and writes text files.

The classification algorithms are the crowning achievement of several years of research of software development. Gone are the days of dozens of parameters that must be artistically set to create a good model without over-fitting. Gone are the days of hiring a neural net expert or a statistician to build the predictive models.

There are two training models to select from:

1. The first training method, which we call the "neural method" is based on an algorithm called Turboprop2, a variant of the famous Cascade Correlation algorithm invented at Carnegie Mellon University by Scott Fahlman (1989). TurboProp2 dynamically grows hidden neurons and trains very fast. TurboProp2 models are built (trained) in a matter of seconds compared to hours for older neural networks types.
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3.3. GeneHunter

The genetic method provides an analysis of independent variables (inputs) to help determine which ones are most important in the selected approach.

GeneHunter is a powerful software solution for optimization problems which utilizes a state-of-the-art genetic algorithm methodology. GeneHunter includes an Excel Add-In which allows the user to run an optimization problem from Microsoft Excel, as well as a Dynamic Link Library of genetic algorithm functions that may be called from programming languages such as Microsoft® Visual Basic or C.

Genetic algorithms (GAs) seek to solve optimization problems using the methods of evolution, specifically survival of the fittest. In a typical optimization problem, there are a number of variables which control the process, and a formula or algorithm which combines the variables to fully model the process. The problem is then to find the values of the variables which optimize the model in some way. If the model is a formula, then we will usually be seeking the maximum or minimum value of the formula. There are many mathematical methods which can optimize problems of this nature (and very quickly) for fairly "well-behaved" problems. These traditional methods tend to break down when the problem is not so "well-behaved."

The algorithms provide analysis of independent variables (inputs) independent variables (inputs) to help determine which ones are most important in the models. The power of Artificial Intelligence approaches as related to increasing the capacity of the Pottstown Area Food System will be utilized to increase connections between producers and markets by completing a food supply chain analysis. This analysis will identify changes needed to the Pottstown Food system to increase affordable, healthy food access for those living in the 6 census tracts. It will also help to corroborate the food chain supply analysis model by utilizing a research protocol developed in the Jeff Smart Seed grant. In terms of Artificial Intelligence, development of models to discover and prioritize data patterns to provide information and actionable knowledge stakeholders as well as public health policy decision makers will be explored. Artificial Intelligence will be used: 1. To explore data to find new patterns and relationships (data mining); 2. To evaluate and test previous decisions (randomized controlled experiments, multivariate testing); 3. To explain why a certain outcome happened (statistical analysis, descriptive analysis); and 4. To venture into the future (forecast) results (predictive modeling, predictive analytics). All four research avenues capture very well the significance and impact of Artificial Intelligence to discover hidden and actionable outcomes.

While the Smart and Healthy Cities Institute at Thomas Jefferson University (TJU) provides the funding for the undertaking, the Pottstown Area Health & Wellness Foundation (PAHWF) is the primary testbed for the project. Based on previous project research outcomes (DiSantis et.al 2011), TJU contributes two co-investigators to collaborate with stakeholders to conduct community engagement and complete assessments focused on: 1) Neighborhood food environment and the influence of neighborhood food access on chronic disease risk and overall health, and 2) Food supply chain; and develop recommendations for food system adjustments. The partners will integrate qualitative and quantitative data gathered through PAHWF's 2018 Tri-County Area Community Health Needs Assessment and 2022 Pottstown Community Health Needs Assessment, PAFC's food system stakeholder interviews and 2022 community engagement plan, and other relevant works to inform assessments, community engagement strategies, and strategic plan draft writing. Partners will identify knowledge gaps and develop approaches to improve local food systems production, processing, distribution, and consumption.

Thomas Jefferson University students are moving beyond the current commercial and financial understanding of innovation as they go through an educational experience that requires break through ideas, approaching industry challenges with an experimental mind frame, as well as compelling insights and a focus on the human element with data written all over it (Sztandera, 2023). We have been teaching Integrative Interdisciplinary Project at the undergraduate level and New Product Development at the graduate level to instill industry interactions and professionalism in students, in that regard.

4. Conclusions

As Universities and Colleges update their classrooms to enable active learning methodologies, adjust their student-centered teaching approaches, Artificial Intelligence aided curricula could provide meaningful support to the teaching and research communities in academia to affordably educate students and prepare them for the jobs of the future. Colleges must also build the technological infrastructure to house and converge the massive volume of academic data. Furthermore, they need to invest in the human capital, educating big data scientists and engineers, and computational intelligence experts to further guide us into the exciting frontiers of business, science, and population health.

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